Tamar SW-1 Exploration Program

Environmental Assessment

June 2013

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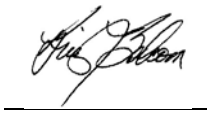

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ACRONYMS AND ABBREVIATIONS

3-D	three-dimensional
AHTS	anchor handling towing supply
Application	Application for Exploration Drilling
BOD	biological oxygen demand
BOP	blowout preventer
CCC	Criteria Continuous Concentration
CDC	Climate Diagnostics Center
CIESM	Commission Internationale pour l'Exploration Scientifique de la Méditerranée/Mediterranean Science Commission
CIRES	Cooperative Institute for Research in Environmental Studies
CO	carbon monoxide
CO_2	carbon dioxide
CSA	CSA Ocean Sciences Inc.
CYCOFOS	Cyprus Coastal Ocean Forecasting and Observing System
DNV	Det Norske Veritas
DO	dissolved oxygen
DST	Dead Sea Transform
EA	Environmental Assessment
EBS	environmental baseline survey
EMP	Environmental Management Plan
EMS	environmental monitoring study
ERL	Effects Range Low
GHG	greenhouse gas
IPF	impact-producing factor
MARPOL	International Convention for the Prevention of Pollution from Ships
MD	measured depth
MDBRT	Measured Depth Below Rotary Table
MEWR	Ministry of Enegry and Water Resources
MMS	Minerals Management Service
MoEP	Ministry of Environmental Protection
MSDS	Material Safety Data Sheet
NCEP	National Center for Environmental Predictions
NMFS	(U.S.) National Marine Fisheries Service
NO	nitric oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
Noble Energy	Noble Energy Mediterranean Ltd
NO_x	nitrogen oxides
NRC	National Research Council
NRWQC	National Recommended Water Quality Criteria
O_3	ozone
OSRP	Oil Spill Response Plan
OWS	oil water separator
PAH	polycyclic aromatic hydrocarbon
PAN	peroxyacetal
PM	particulate matter
ppb	part(s) per billion
PTS	permanent threshold shift
QC	quality control
rms	root mean square
RO	reverse osmosis
ROV	remotely operated vehicle
RPD	redox potential discontinuity
SO_x	sulfur
SOPEP	Shipboard Oil Pollution Emergency Plan
SPP	suspended particulate phase
TEU	thousand (20-ft) equivalent units
TOC	total organic carbon
TTS	temporary threshold shift
TVD	total vertical depth
USDOI	U.S. Department of the Interior
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WBM	water-based (drilling) mud

EXECUTIVE SUMMARY

ES-1 GENERAL OVERVIEW

ES-1.1 Application

Noble Energy Mediterranean Ltd (Noble Energy) is planning on drilling the Tamar SW-1 exploration well located in the Tamar License off the coast of Israel (**Figure ES-1**). The EA was prepared in accordance with guidelines issued by the Ministry of Energy and Water Resources and Ministry of Environmental Protection entitled "Framework for Guidelines for Environmental Document Accompanying License for Exploration."

The purpose of the EA is to identify environmental consequences early in the project planning and design process in order to facilitate preventing, minimizing, and mitigating potential adverse impacts. The EA sets out to 1) identify the various components of the Tamar SW-1 exploration program, 2) generally characterize the environmental resources of the project area, 3) assess the impacts of exploration drilling, and 4) identify relevant mitigation measures available to reduce or eliminate potentially significant impacts.

ES-1.2 Boundaries of the Application

The boundaries of the Application include site-specific and regional study areas. The site-specific study area encompasses up to 1 km around the proposed Tamar SW-1 exploration drillsite and will include the water column, seabed and sub-seabed, and the maritime infrastructure and facilities. The expanded area of the Application includes the entire marine and coastal area that might be environmentally affected as a result of exploration operations from potential transport of discharges or emissions. The expanded area will consider regional infrastructures and support vessel operations with their transit corridors between shore locations and the offshore drillsite.

ES-1.3 Regional Setting

The Tamar SW-1 drillsite within the Tamar License is located in the eastern Mediterranean approximately 98 km west-northwest of Haifa, Israel in the southeastern portion of the Levant Basin (**Figure ES-1**). The Tamar License is located along the northernmost portion of the Israeli maritime territory, and southeast of the existing Noble Energy Tamar and Leviathan Fields. The known regional infrastructure proximal to the Tamar SW-1 drillsite includes the Med Nautilus communication cable (approximately 2 km from the drillsite) and the Tamar Field infrastructure (e.g., subsea completions, flowlines, pipelines; approximately 10 km from the drillsite).

The Levant Basin is highly oligotrophic and is characterized by relatively high species diversity, very low biomass, and a higher degree of endemism than other oceans due to its relative isolation. Even within the Mediterranean Sea, the eastern Mediterranean is distinct because of its high salinity, low nutrients, transparency, and the temperature regime of its surface waters, which is higher than other areas of the Mediterranean. The EA provides descriptions of the baseline environment in sufficient detail to address potential impacts from the project, including both routine, project-related impacts and those potentially arising from an accident or upset. The accident or upset scenario evaluated included a small and large diesel fuel spill. Resource areas characterized include bathymetry, geology, sediment characteristics, and seismic activity; physical oceanography; nature and ecology; acoustic environment; archaeology; air quality; and marine transportation system and infrastructure.

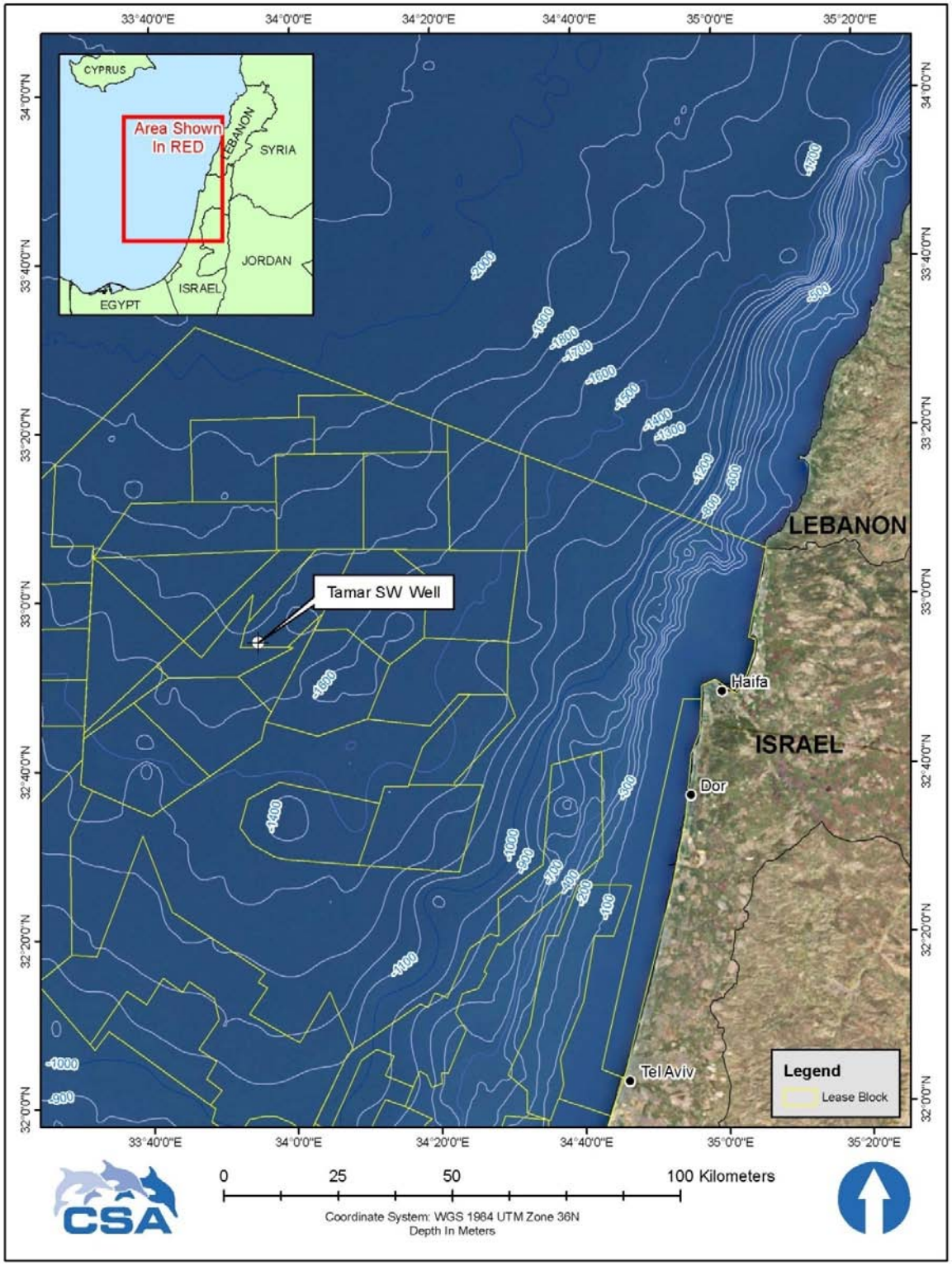

Figure ES-1. Location of the Tamar SW-1 drillsite relative to the Israeli coastline and regional bathymetric contours. The Tamar SW-1 drillsite is located at 32°55'10.20" N latitude and 33°54'54.40" E longitude. X/Y coordinates for the drillsite are E 585,565 and N 3,642,734 (Geodesy: GCS WGS84; UTM 36 North; meters), or E 98,850 and N 759,025 (Geodesy: GCS Israel; Israeli Transverse Mercator; meters).

ES-2 REASONS FOR PREFERENCE OF THE LOCATION OF THE PROPOSED PLAN AND POSSIBLE ALTERNATIVES

ES-2.1 Application Rationale

The Tamar SW-1 drillsite was selected based on the interpretation of seismic and geophysical survey data acquired in the Tamar License, as well as results from previous exploratory wells completed in the region and drilled into similar geological formations.

ES-2.2 Proposed Exploratory Program and Alternatives

The proposed location and trajectory of the Tamar SW-1 exploration well were selected and the well drilling program was designed to minimize the risk of encountering the following shallow hazards:

- Seafloor instability: The proposed well is in a relatively flat location that is at least 600 m from any seafloor channel or fault scarp;
- Shallow faulting: The location of the proposed well avoids all areas of supra-salt thrust faulting and vertical faulting; and
- Anomalies within salt: The proposed well is expected to intersect clastic interbeds where there is minimal deformation.

Casing and drilling program engineering was also considered in the proposed exploratory program. Specifically, the 20-in. casing shoe was planned to be set in a clean halite interval that is free of clastic interbeds. In addition, the well location was selected within an area of undulating seabed. The location was chosen to avoid high dip magnitudes of the seafloor and small faults in the area.

Potential environmental sensitivities and existing infrastructure were also considered by Noble Energy during selection of the Tamar SW-1 drillsite location. No environmentally sensitive habitats were found within the Tamar SW-1 study area based on interpretation of geohazard acoustic data and direct observations from the environmental survey. The known regional infrastructure proximal to the Tamar SW-1 drillsite includes a communications cable (i.e., 2 km from Tamar SW-1) and the Tamar subsea wells and flowlines, located 10 km to the northeast of Tamar SW-1.

Only one area was considered in the selection of the Tamar SW-1 drillsite. Within this broader area, the Tamar SW-1 well location was selected with respect to water bottom, shallow subsurface intervals of possible concern, and the optimal penetration point of the gas reservoir. An enlarged area encompassing Tamar SW-1 was studied to define the original well location, from which a location was set outside of potential gas hazards. The Tamar SW-1 well location was chosen to avoid active seafloor channels, shallow faulting, and potential shallow gas hazards associated with amplitude anomalies and low angle slump escarpments or other seafloor topographic elements. The final location for Tamar SW-1 was adjusted, additionally, to avoid deeper faults proximal to the original wellbore. The choice of location for Tamar SW-1 thus effectively avoids intersection with small faults in the shallow, post-salt section and allows for the setting of two successive casing points in relatively clean salt that is expected to be clean of clastic interbeds. With the close attention to the water bottom and incorporation of improved seismic resolution and interpretation of the shallow subsurface, the safety, environmental and drilling risks at the proposed Tamar SW-1 location have been minimized.

ES-2.3 Target Strata

Noble Energy has described the geological structure, and developed a formation prognosis as part of its geological well plan. The Tamar SW-1 well will target an expected gas reservoir based on previous

drilling results in the Tamar Field and the similarities in geologic structure evident at the proposed drillsite. The Tamar-equivalent reservoir has sand units which are expected to continue across the field. These sands have been established in Tamar-1, 2, and 3.

The predicted reservoir parameters are based upon the reservoir quality determined at the Tamar-1 wellsite. Key reservoir parameters include:

- Gross Thickness: Thickly interbedded sandstone and claystones;
- Hydrocarbon Type/Target: Gas;
- Lithology: Sandstone;
- Expected Quality: 25% mean porosity, estimated 100 m D to 2D permeability; and
- Expected Pressure: Recent work carried out by Noble Energy, based on results of Tamar-1, indicates that pressure at top reservoir is expected to be 10.2 +/- 0.3 ppg EMW.

ES-2.4 Potential for Future Production

The potential for future production will be dependent upon results of the exploratory well drilling and well testing. In the event commercial quantities of natural gas are encountered, Noble Energy will conduct further analyses of costs associated with well (or field) development and transport of produced hydrocarbons to market.

ES-3 PROJECT DESCRIPTION

ES-3.1 Drilling Plan Overview

Noble Energy proposes drilling of the Tamar SW-1 well to a depth of approximately 3,634 m below the sediment surface in a water depth of 1,648 m. The primary purpose of the drilling is to assess the formation for the presence of natural gas. A total of five sections will be drilled – 36 inch (in.), 26 in., 17-1/2 in., 14-3/4 in., and 10-5/8 in. – using a water-based drilling mud (WBM). A portion of the 10-5/8 in. section will be drilled at 12-1/4 in. as a bypass hole through pay sand.

ES-3.2 Description of the Drilling Plan

ES-3.2.1 Drilling Rig and Support Vessels

Noble Energy will utilize the *ENSCO 5006*, a Det Norske Veritas (DNV)-classified Maltese Cross 1A1 column stabilized drilling unit (i.e., a semi-submersible drilling rig), to drill the Tamar SW-1 exploratory well. The *ENSCO 5006* is owned by Ensco PLC. The drilling rig will be mobilized from Cyprus Block 12 (Well A-2). Because the *ENSCO 5006* has been operating in the eastern Mediterranean for an extended period, there is no need to clean the rig of biofouling organisms prior to departure from the Cyprus Block 12 location.

The *ENSCO 5006* will be towed to the Tamar SW-1 drillsite and will be assisted in positioning the drilling rig over the drillsite by two Tidewater Inc.'s anchor handling towing supply (AHTS) vessels – the *Richard M. Currence* and *John P Laborde*. The *Richard M. Currence* and *John P Laborde* are each rated at 24,000 brake horsepower (bhp); each vessel is 85.4 m long and 21 m wide and displaces approximately 3,000 tons.

Supply vessel support will be provided by several vessels, including the M/V *EAS* and/or M/V *Leon*. The M/V *EAS*, a dynamic positioning AHTS measuring 61.8 m in length, is owned by Sea Whale Shipping Ltd.; the M/V *Leon*, a swift crew and supply boat measuring 51 m in length, is owned by Mahita Sea Shipping Ltd. Both vessels are operated by EDT Ship management Ltd. out of the port of Haifa.

Helicopter support will be provided by a Bell 412SP, owned by PHI, Inc. and operated by LAHAK out of Haifa Airport.

ES-3.2.2 Drilling Program

The Tamar SW-1 well drilling program will be completed in several key stages, including:

- Placement of the ENSCO 5006 drilling rig at the Tamar SW-1 drillsite using AHTS vessels and seafloor anchors.
- Installation via jetting (drive pipe) of a 36-in. pipe of approximately 70 m in length (1,742 m total vertical depth [TVD]). Drilling in this well section will be completed using seawater and high viscosity sweeps to carry cuttings out; high viscosity sweeps will be composed of bentonite and guar gum.
- Drilling at a diameter of 26 in. over a length of approximately 1,200 m (~2,900 m TVD). Drilling in this well section will be completed using seawater and high viscosity sweeps; drilling of the last 150 m will occur using saturated NaCl brine.
- Installation of a 20-in. diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Installation of a blowout preventer (BOP) and a riser from the wellbore to the drilling rig, enabling repeated use of drilling mud. All well control equipment will be tested during this phase.
- Drilling at a diameter of 17-1/2 in. over a length of approximately 600 m (~3,522 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of a salt saturated WBM system.
- Installation of a 13-5/8 in.-diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Drilling at a diameter of 12-1/4 in. x 14-3/4 in. over a length of approximately 1,000 m (~4,565 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of an inhibited WBM system.
- Running formation evaluation logs, samples, and pressures.
- Installation of an 11-7/8 in.-diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Drilling of a 10-5/8-in. diameter pilot hole over a length of approximately 735 m to complete the hole (~5,300 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of an inhibited WBM system, similar to that used in the previous well section.
- Running formation evaluation logs, samples, and pressures, then plugging back the wellbore and bypassing at ~4,600 m TVD.
- Drilling 10-5/8 x 12-1/4 in. bypass hole 10 m into pay sand.
- Running and cementing 9-7/8 in. x 9-5/8 in. x 10-3/4 in. production casing.
- Temporarily abandoning the well and demobilizing the drilling rig.

The timeline for drilling is shown in **Figure ES-2**. Note that actual drilling is a relatively short term operation, with running and setting pipe and formation evaluation comprising a significant portion of the total drilling period. Noble Energy expects to spud the Tamar SW-1 well in late September 2013.

ES-3.2.2.1 Drilling Discharges

Drilling discharges will include both used drilling muds and drill cuttings, as well as cement. Noble Energy will be using a WBM and several additives to facilitate drilling and maintain well control. During the initial well sections (36 and 26 in.), there will be no surface returns; muds and cuttings will exit at the borehole, settling near the drillsite and dispersing in the lower portions of the water column. Similarly, with the completion of each hole section, cementing will occur. Excess cement will exit at the borehole between the casing and the formation.

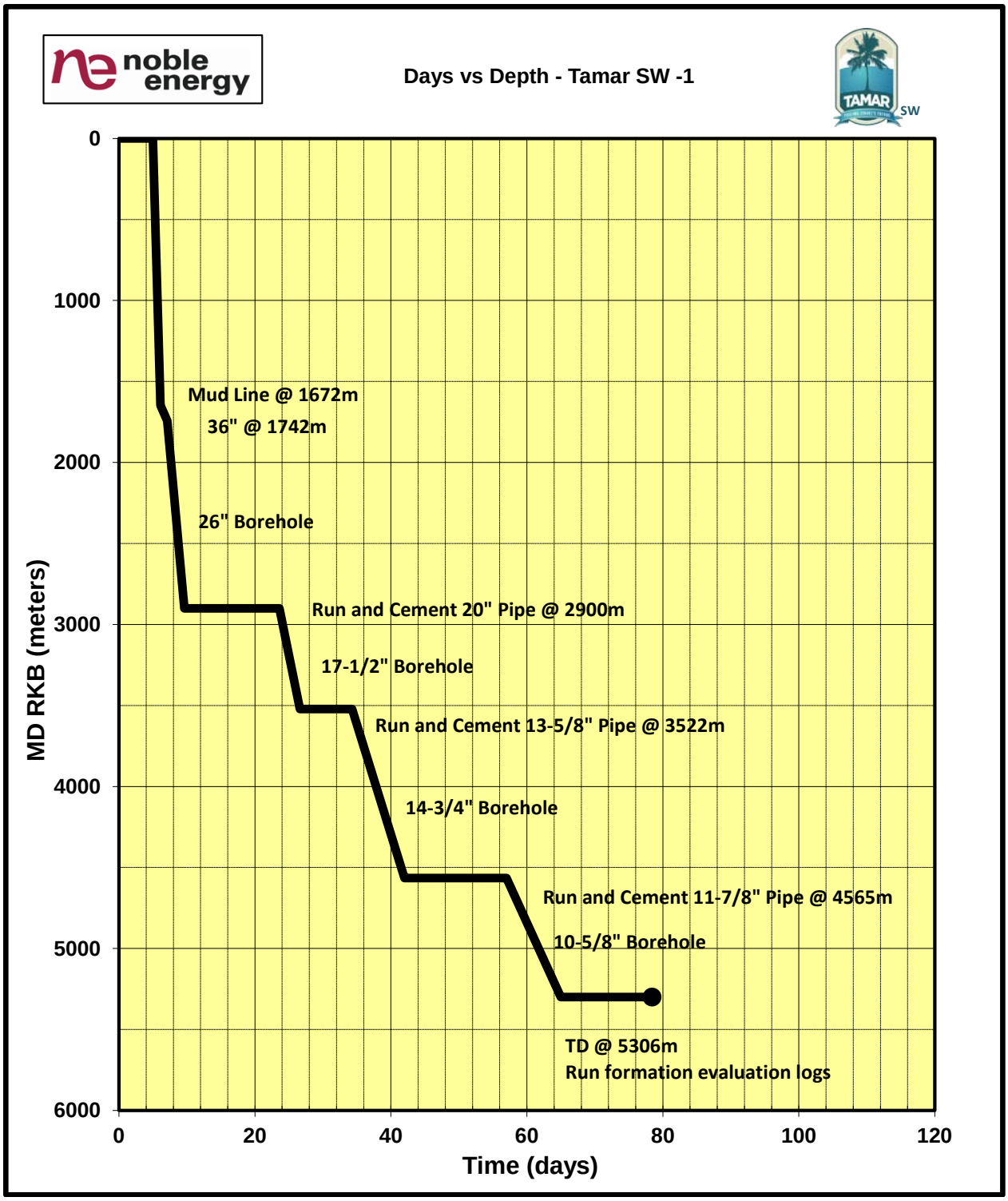

Figure ES-2. Timeline (i.e., days vs. depth) for drilling of the Tamar SW-1 well.

Once the riser has been set, surface returns will commence (i.e., with drilling of the 17-1/2 in. section), allowing for processing of used muds aboard the drilling rig and, as necessary, the discharge of used muds and cuttings from the drilling rig. With surface returns, WBM will be processed on board the drilling rig, passing through screens and shakers to remove cuttings. WBM will be monitored and additives used, as needed. The type and volume of mud additives is determined primarily by the current state of the drilling mud and existing or anticipated downhole conditions.

Cuttings, once removed from the muds and cuttings stream, will be discharged overboard. Drill cuttings are comprised of formation solids (i.e., bits of rock from the formation). Noble Energy expects to use a total of 26,000 bbl of WBM and 27,600 bbl of brine during the drilling of the Tamar SW-1 well. Specific products, their function, packaging parameters, and the estimated weight of WBM drilling-related materials to be used are outlined in the EA; by weight, the predominant products used during drilling are barite and NaCl (brine).

Noble Energy has also identified a series of mud additives which may be used to maintain well control and address specific issues or drilling problems. These contingency products are identified in the EA. Volumes used will be on an "as needed" basis.

Key information regarding drilling muds and cuttings include the following:

- Well Spudding/No Surface Returns: The total amount of drilling-related material to be discharged prior to riser installation is estimated at 18,000 bbl (2,861.8 m^3) of drilling mud and 25,600 bbl of brine.
- Surface Discharge of Drilling Muds: The concentrations and amounts of WBM discharges, including various mud additives, to be discharged at the end of well drilling have been tabularized. The total amount of drilling mud to be discharged from the rig at the completion of drilling is estimated to be 7,400 bbl (1,176.5 m^3). Of these discharges, two components – barite and NaCl – comprise 92% of the discharges by weight. These discharges will occur 14 m below the water line at a rate of <1,000 bbl per hour.
- Cuttings Discharges: A total of 5,454 bbl of cuttings weighing 2,180 tons will be released during drilling; this estimate includes varying percentages for wash out factors, by hole section. Cuttings from the 36-in. and 26-in. sections will be released from the borehole, while cuttings from the remaining sections will be released from the drilling rig. Cuttings and drilling fluids released from the drilling rig will be discharged through a 14-in. x 16-in. x 18-in. line 14 m below sea level.

ES-3.2.2.2 Drilling Discharge Fate

Results of site- and well-specific muds and cuttings discharge modeling are not available for the Tamar SW-1 well. However, modeling results from a similar deepwater location in the eastern Mediterranean are available. Noting that there are only minor differences in the drilling programs between the representative well and the Tamar SW-1 well (e.g., minor differences in well intervals, total depth, cuttings size classes, etc.), consideration of the results from a representative modeling exercise provides a good indication of likely deposition patterns, including expected thicknesses and areas affected.

Maximum thickness of the muds and cuttings deposit occur within tens of meters of the well, extending outward from the well in diminishing thicknesses (i.e., from 50 mm to 0.5 mm) to approximately 400 m from the drillsite. Within 14 m of the wellbore, modeling results indicate that deposition thickness will be approximately 200 mm (7.8 in.). From 14 to 22 m from the well, muds and cuttings deposits will diminish to 100 mm (3.9 in.) thick covering an area of approximately 0.001 km^2 (1,000 m^2), diminishing to 50 mm (2 in.) thick within the next 5 m (i.e., from 22 to 27 m from the well). At approximately 40 m

from the well, muds and cuttings deposits will be 10 mm thick. Results of the representative modeling exercise indicate that the total area of deposition >10 mm will be slightly more than one hectare.

ES-3.2.3 Safe Drilling Practices

Noble Energy will employ safe drilling practices during its activities at the Tamar SW-1 well. Best industry practice will be employed during all drilling phases (e.g., setting of BOP; cementing of concrete between bore and protective pipe).

The proposed location and trajectory of the Tamar SW-1 exploration well was designed to minimize the risk of encountering the following shallow hazards:

- Seafloor instability: the well is in a relatively flat location that is at least 600 m from any seafloor channel or fault scarp;
- Shallow faulting: the well avoids all supra-salt thrust faulting and vertical faulting;
- Anomalies within salt: the well is expected to intersect clastic interbeds where there is minimal deformation; and
- Clastic interbed instabilities: the 20-in. casing shoe is planned to be set in a clean halite interval that is free of clastic interbeds.

ES-3.2.4 Concretization

Noble Energy estimates that a total of 6,900 bbl of concrete will be used during the Tamar SW-1 drilling program. As expected, the single largest component of the cementing operation is a Class G cement (i.e., 167 metric tons), with significantly lower contributions from other additives. In total, an estimated 448,167 lbs of dry product and 2,923 gal. of liquid product are expected to be used in cementing operations on the Tamar SW-1 well. Noble Energy estimates that 1,300 bbl (206.5 m^3) of cement will be discharged at the wellbore.

ES-3.2.5 Anchoring Plan

The *ENSCO 5006* is equipped with four Skagit double drum traction winches, 10,600 ft of 3-3/4-in. wire, 2,500 ft of 3-1/4-in. R3S chain, and eight Vryhof Stevpris MK-5 anchors, each weighing 15 mt (Viking Moorings, 2013). The anchor deployment pattern to be used at the Tamar SW-1 drillsite will be an eight-point pattern. Anchors will extend approximately 3 km from the drilling rig.

ES-3.3 Production Testing

No production testing will be conducted on this well.

ES-3.4 Noise Hazards

Sound emanating from the *ENSCO 5006* can be expected to be continuous, at a level of approximately 154 dB (re 1 µPa at 1 m) while drilling, with most energy in the low frequency bands. During non-drilling periods, sound source levels from the *ENSCO 5006* will originate only from diesel generators, cranes, and crew activity aboard the rig. No propeller or propulsion noise is expected from the *ENSCO 5006* given its lack of these components.

Supply vessels in transit to and from the rig will produce transient sounds in the 128 to 158 dB (re 1 µPa at 1 m) range, with predominant low frequency components. If a supply vessel remains on standby at the rig, it will produce lower, but continuous sound levels, as it would be expected to remain at

idle while on station. In similar fashion, transient helicopter visits to the rig will produce predominantly low frequency sound source levels of 162 dB (re 1 µPa at 1 m), with highest sound levels to be experienced directly below the aircraft.

ES-3.5 Air Quality

Activities expected at the Tamar SW-1 well, including rig positioning, drilling, cementing, and logging operations, along with associated support operations, will produce emissions from internal combustion engines, including greenhouse gases (GHGs) and varying amounts of other pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x) and sulfur (SO_x), volatile organic compounds (VOCs), and particulate matter (PM). The location and duration of these operations are variable. Engine specifications for all internal combustion engines aboard project vessels and aircraft have been detailed in the EA.

ES-3.6 Hazardous Materials

Hazardous chemicals will be handled in accordance with their Material Safety Data Sheet (MSDS) specified guidelines, as integrated into the operator's guidelines for handling hazardous materials. Materials to be used in drilling (i.e., WBM and additives) and concrete operations have been detailed in the EA.

ES-3.7 Discharges

ES-3.7.1 Overview and Discharge Sources

Discharges released into the sea during exploratory drilling operations at the Tamar SW-1 well can be divided into two main groups, including:

- Effluents originating from personnel aboard the drilling rig and ongoing, routine rig operations exclusive of drilling, such as sanitary and domestic wastes, cooling water, brine/reverse osmosis (RO) water, etc.; and
- Effluents originating directly from the drilling operations, including drilling muds and cuttings and cement.

Highest volumes of non-drilling discharges are cooling water and brine from the RO/water maker units.

ES-3.7.2 Discharge Flow (Comingling)

Comingling occurs between sanitary and domestic waste streams (i.e., sewage and gray water), food scraps discharge, and potable water maker (brine) discharge. These discharges are released through an 8-in. diameter pipe at 14 m below the sea surface. There will be no discharges from the oil water separator (OWS) while the *ENSCO 5006* is moored at the Tamar SW-1 drillsite; any liquids normally processed by the OWS are captured while the drilling rig is moored and shipped to shore by means of shipping tanks.

Cooling water discharge is separate from other waste streams, but is mingled with the discharge of drilling muds and cuttings; these discharges are released through 14-in., 16-in., and 18-in. discharge lines located 14 m below the sea surface. Note that the discharge of muds and cuttings from the drilling rig only occurs in the lower sections of the well; when discharging, cuttings are released nearly continuously, while drilling muds are released at the end of the well (i.e., cooling water will be discharged continuously; cuttings discharged continuously only during drilling of the lower hole sections; drilling muds discharged only at the end of the well).

ES-3.7.3 Discharge Treatment

All discharges from the *ENSCO 5006* and project vessels (e.g., AHTS and supply vessels) will be in compliance with applicable standards (e.g., the International Convention for the Prevention of Pollution from Ships [MARPOL], Barcelona Convention) or consistent with best industry practice. Specific treatment processes are detailed in the EA for individual waste streams, including:

- All sanitary waste will be treated using a marine sanitation device (i.e., via chlorination), producing an effluent with low residual chlorine concentrations and no visible floating solids.
- Domestic wastewater is typically screened to remove any floating solids prior to discharge; domestic waste does not require treatment before discharge.
- Cooling water discharge effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution takes place (i.e., 100 m from the discharge).
- Food waste, a type of domestic waste, will be macerated to <25 mm diameter to meet discharge requirements. Food waste discharges are allowed, when ground, if the vessel is 12 nmi or more from land when within special areas (including the Mediterranean Sea).
- Brine, generated from the water making units, will be discharged directly to the sea; no treatment is required.

The processing of drilling mud, designed to prolong the life of the drilling fluid and minimize the need to discharge, typically includes flow through various equipment to remove cuttings and large particles (i.e., scalper shakers, shale shakers). Once the drilling mud has passed through the shakers, it is pumped into a settling/processing pit (i.e., sand traps). Once in the sand traps, the drilling mud can be circulated and processed by other equipment (e.g., degasser, mud cleaner, desander, desilter, and centrifuge) to further remove unwanted particles. Chemicals may be added to change the rheological properties of the mud specific to addressing downhole needs. Details of drilling mud treatment and processing, including schematics of the mud processing system, are provided as an appendix to the EA.

ES-3.8 Waste

Solid wastes to be generated aboard the drilling rig or supply vessels during drilling will be packaged, containerized, and/or palletized for shipment to shore and proper disposal. No intentional waste disposal will occur from the rig or project vessels, in compliance with MARPOL restrictions. However, occasionally, debris (e.g., welding rods, buckets, pieces of pipe) may accidentally fall overboard.

It is estimated that approximately 2,000 ft^3 (56.6 m^3) of trash and debris will be generated during drilling. Several types of solid wastes are expected, including galley refuse (e.g., food packaging materials), domestic waste (e.g., packaging, shampoo bottles, razors), and wastes associated with normal rig operations (e.g., rags, containers, pallets). Industrial wastes may also include used solvents, paints, and other chemicals. Drilling operations will be conducted under the preferred waste management hierarchy of “reduce, reuse, recycle, recover” prior to designating waste for disposal, whenever possible.

ES-3.9 Well Closure (Permanent or Temporary Abandonment)

The well will be abandoned in accordance with United States Code of Federal Regulations, Title 30 Mineral Resources, Chapter II – Bureau of Safety and Environmental Enforcement, Department of the Interior, Subchapter B - Offshore, Part 250, Section 1721, Temporary Abandoned Wells, revised July 1, 2012.

After the well has reached total depth and wireline evaluation logs have been run, the wellbore will be temporarily abandoned and secured with multiple barriers (i.e., cement plugs). Plugs will be weight

tested and the top plug will also be pressure tested. The wellbore will be filled with sufficient mud weight to provide a hydrostatic pressure equal to or greater than the pore pressure plus 300 psi with a seawater column above the mudline. A 100-m surface cement plug will be set approximately 300 m below the mud line. The wellbore will then be negative pressure tested with a seawater column to the mud line prior to disconnecting the BOP stack and riser. The wellbore will be kept for future gas production.

ES-4 EVALUATION OF ENVIRONMENTAL (AND SOCIAL) IMPACTS AND MITIGATION MEASURES

ES-4.1 Impact Assessment Methodology

Two factors which are utilized to determine the significance of an impact provide the foundation for an environmental assessment – impact consequence and impact likelihood. Impact consequence reflects an assessment and determination of an impact's characteristics on a specific resource (e.g., air quality, water quality, benthic communities, etc.). Such determinations take into account resource-specific sensitivity to an impact, recovery capability, and spatial and temporal occurrence.

Impact consequence classifications include **beneficial**, **negligible**, **minor**, **moderate**, and **severe**. ***Impact likelihood*** is rated according to its estimated potential for occurrence: **likely** (>50% to 100%); **occasional** (>10% to 50%); **rare** (1% to 10%); or **remote** (<1%).

The impact analysis completed for the Tamar SW-1 exploratory well drilling program considered both impact consequence and impact likelihood to determine overall impact significance. The result is an overall impact significance rating that includes beneficial and several negative impact levels that range from Negligible to High. Impacts rated as High or Medium in significance are priorities for mitigation. Mitigation was also considered for some less significant impacts to further reduce the likelihood or consequence of impacts.

ES-4.2 Resources Evaluated

Twelve (12) resources or resource groups were considered in the EA impact analysis, in consideration of the guidelines, including:

- Air Quality;
- Sediments/Sediment Quality;
- Water Quality;
- Plankton, Fish, and Fishery Resources;
- Benthic Communities;
- Marine Mammals and Sea Turtles;
- Marine and Coastal Birds;
- Protected Marine Species and Habitats/Marine Habitats of Interest and Areas of Special Concern;
- Fishing Shipping and Maritime Industry Recreation and Aesthetics/Tourism; and
- Archaeological Resources.

ES-4.3 Impact Producing Factors

Based on the description of the proposed exploratory drilling program, a series of "impact-producing factors" (IPFs) were identified, including:

- **Drilling Rig Arrival, Anchoring, Anchor Removal, and Departure** – The short-term transit of the drilling rig and associated support vessels (e.g., AHTS vessels) from Cyprus and their arrival at the Tamar SW-1 drillsite may cause temporary disruption of other sea uses. Sediment quality, water quality, and benthic communities will be affected by drilling vessel anchoring and anchor removal, and drilling muds and cuttings seafloor releases and surface discharges. Impacts may include turbidity due to anchor placement and retrieval, including resuspension of sediment components (e.g., buried chemical species).
- **Well Drilling, including Release and Discharge of Drilling Muds and Cuttings** – Changes to seafloor sediments are expected from the seafloor releases of drilling muds and cuttings and the surface discharge of used drilling muds and cuttings; benthic organisms may be buried by discharged drilling muds and cuttings. Releases and discharges may affect water quality.
- **Establishment of a Safety Zone Around the Drilling Rig** – a 500 m safety zone will be established around the *ENSCO 5006* to exclude non-project related vessels. Exclusion has the potential to affect fishing and shipping and maritime industry activities.
- **Physical Presence (including lights)** – The physical presence of the drilling rig will attract various marine resources, including plankton, fish, and marine and coastal birds.
- **Noise** – The drilling rig, support vessels, and support aircraft (helicopter) will produce noise during routine operations. Most man-made noise associated with offshore oil and gas drilling operations or support activities are in the low frequency bands (<500 to 1,000 Hz). Noise sources include propeller cavitation, propeller singing, and propulsion machinery for vessels; rig machinery, internal combustion engines, and generators for semi-submersible drilling rigs; and engine noise and propeller cavitation for aircraft. Impacts would include ensonification of an area around the sound source, with the potential for changes in behavior or activity level among marine mammals and sea turtles. Excessive noise also has the potential to affect recreation and aesthetics.
- **Combustion Emissions** – Vessel engines and generators for the drilling rig, support vessels, and helicopters will emit air pollutants into the atmosphere during installation, transit, and/or operation. The pollutants, emitted principally from diesel engines and fugitive emissions from fuel tanks, vents, and other emission points are the same as those generated by other ship traffic in the region. There will be temporary, local impacts on air quality near project vessels, but no effects to onshore air quality in Israel are expected due to distances from shore. Support vessel emissions will produce minor impacts on air quality along transit routes (i.e., between the Tamar SW-1 drillsite) and the onshore support base. There will be negligible impacts on air quality from helicopter traffic along travel routes.
- **Routine Discharges** – Routine discharges will be released into the sea in accordance with applicable provisions of MARPOL and the Barcelona Convention, including treated sanitary and domestic wastes and miscellaneous discharges; all discharges are expected to be diluted to background levels within tens to hundreds of meters of project vessels, with little or no impact on water quality or marine biota.
- **Solid Waste** – There will be an incremental contribution of solid wastes from the project requiring landfill usage. The disposal of solid waste from any vessel into the sea is prohibited under MARPOL regulations. Ingestion of, or entanglement with, debris accidentally discarded into the marine environment can kill or injure marine mammals, turtles, and birds. Debris sinking to the seafloor can affect benthic communities. Solid waste (i.e., loss of trash and debris overboard) may also affect sediment quality and water quality. All project vessels will operate under procedures to comply with and satisfy applicable MARPOL provisions.

- **Support Vessel and Helicopter Traffic** – The drilling rig movement and support vessel and helicopter traffic has the potential for vessel strike with marine mammals, turtles, and/or birds. The impacts would be similar to those created by existing shipping and small aircraft traffic in the region. Support vessels would normally follow the most direct route between the drillsite and the shore base and are not expected to interfere with fishing activities along the coast. Shipping and maritime operations in the vicinity of the Tamar SW-1 drillsite may be affected to a very limited degree by support vessel operations. At the onshore support base, a short-term increase in harbor vessel activity is expected.
- **Accidents or Upsets** – The probability of an oil spill during the project is very small especially because gas is the target. An accidental spill of diesel fuel from a ruptured fuel tank on any project vessel or a spill during fueling operations offshore is more likely than a crude oil spill. If a large diesel spill did occur, it could affect marine life such as plankton, fishes, marine mammals, sea turtles, and birds and possibly affect socioeconomic resources. If the spill reached the shoreline, it could affect coastal habitats including beaches and seagrass beds, rocky shores, and associated wildlife. Noble Energy will prepare an Oil Spill Response Plan (OSRP) to respond to a spill and avoid or reduce potential impacts.

ES-4.4 Resource- and IPF-Specific Impacts

Potential impacts from Tamar SW-1 exploratory drilling operations are summarized in **Table ES-1**. The overall significance levels of routine, project-related impacts are expected to be either negligible or low, while those associated with a diesel fuel spill ranged from negligible to moderate.

ES-5 MITIGATION AND MONITORING

ES-5.1 Mitigation

The identification and application of mitigation measures is intended, to the extent possible, to 1) reduce the severity or magnitude of identified impacts, 2) reduce their longevity, and/or 3) reduce their probability of occurrence. The discussion of mitigation measures considered both resource-specific mitigation and issue-specific mitigation measures. Individual mitigation measures for select resources and specific issues are outlined below.

ES-5.1.1 Marine Mammals and Sea Turtles

As appropriate, to reduce, to the extent possible, potential impacts to protected marine species (marine mammals, sea turtles):

- Ensure support vessels and helicopters follow the most direct route possible between the Tamar SW-1 drillsite and the marine and air transportation hubs (Haifa, Tel Aviv), avoiding sensitive areas, wildlife areas, and bird colonies, weather conditions permitting.

ES-5.1.2 Marine and Coastal Birds

As appropriate, to reduce, to the extent possible, potential impacts to marine and coastal birds:

- When feasible and when vessel navigational safety is not compromised, shield lights (i.e., orient downward) to maximize work areas and minimize lighting of the sea surface.

Table ES-1. Summary of impacts, Tamar SW-1 exploratory drilling program.

Resource	Impact Producing Factor	Consequence and Likelihood	Impact Significance
Routine, Project-Related Impacts			
Water and Sediment Quality	Drilling rig arrival, anchoring, anchor removal, and departure	Consequence: Negligible/Likelihood: Likely	Low
	Well drilling, including release and discharge of drilling muds and cuttings	Consequence: Negligible/Likelihood: Likely	Low
	Routine discharges (water quality only)	Consequence: Minor/Likelihood: Likely	Low
	Solid waste (accidental loss)	Consequence: Minor/Likelihood: Likely	Low
Sea Turtles	Lighting	Consequence: Minor/Likelihood: Likely	Low
Marine and Coastal Birds	Lighting	Consequence: Minor/Likelihood: Likely	Low
Marine Mammals	Noise	Consequence: Minor/Likelihood: Likely	Low
Sea Turtles	Noise	Consequence: Minor/Likelihood: Likely	Low
Recreation and Aesthetics/Tourism	Noise	Consequence: Negligible/Likelihood: Likely	Low
Nature and Ecology: Benthic Communities	Drilling rig arrival, anchoring, anchor removal, and departure	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Plankton and Fish	Well drilling, including release and discharge of drilling muds and cuttings	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Benthic Communities	Well drilling, including release and discharge of drilling muds and cuttings	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Marine Mammals	Well drilling, including release and discharge of drilling muds and cuttings	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Sea Turtles	Well drilling, including release and discharge of drilling muds and cuttings	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Fish	Physical presence	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Marine Mammals	Physical presence	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Sea Turtles	Physical presence	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Plankton	Routine discharges	Consequence: Negligible/Likelihood: Likely	Negligible
Nature and Ecology: Fish	Routine discharges	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Marine Mammals, Sea Turtles, and Marine and Coastal Birds	Solid waste (accidental loss)	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Benthic Communities	Solid waste (accidental loss)	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Protected Marine Species and Habitats/Marine Habitats of Interest, and Areas of Special Concern	Solid waste (accidental loss)	Consequence: Minor/Likelihood: Likely	Low
Nature and Ecology: Marine Mammals	Support vessel and helicopter traffic	Consequence: Moderate/Likelihood: Rare	Low

Table ES-1. (Continued).

Resource	Impact Producing Factor	Consequence and Likelihood	Impact Significance
Nature and Ecology: Sea Turtles	Support vessel and helicopter traffic	Consequence: Moderate/Likelihood: Rare	Low
Nature and Ecology: Marine and Coastal Birds	Support vessel and helicopter traffic	Consequence: Minor/Likelihood: Occasional	Low
Archaeological Resources	Drilling rig arrival, anchoring, anchor removal, and departure	Consequence: Minor/Likelihood: Remote	Negligible
Air Quality	Combustion emissions	Consequence: Minor/Likelihood: Likely	Low
Onshore Socioeconomics	Waste	Consequence: Minor/Likelihood: Likely	Low
Fishing and Shipping and the Maritime Industry	Safety zone	Consequence: Negligible/Likelihood: Likely	Negligible
Accident or Upset Impacts			
Air quality	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Water and Sediment Quality	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Plankton and Fish and Fishery Resources	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Benthic Communities	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Marine Mammals, Sea Turtles, and Marine and Coastal Birds	Diesel spill	Consequence: Minor to Moderate/Likelihood: Occasional	Low to Medium
Protected Marine Species and Habitats, Marine Habitats of Interest and Areas of Special Concern	Diesel spill	Consequence: Minor to Moderate/Likelihood: Occasional	Low to Medium
Fishing and Shipping and Maritime Industry	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Recreation and Aesthetics/Tourism	Diesel spill	Consequence: Minor/Likelihood: Occasional	Low
Archaeological Resources	Diesel spill	Consequence: Negligible/Likelihood: Remote	Negligible

ES-5.1.3 Fishing and Shipping and Maritime Industry

No fishing is expected in the vicinity of the well due to water depth; consequently, no mitigation measures are suggested.

ES-5.1.4 Air Quality Mitigation

Noble Energy and its contractors (i.e., drilling contractor, support vessel contractors), will maintain routine maintenance procedures to reduce excess emissions and reduce potential impacts to air quality.

ES-5.1.5 Noise Mitigation

Internal combustion engines and electrical equipment (e.g., draw works) will undergo routine maintenance and monitoring to ensure that all equipment is working within manufacturer's specifications. Proper operation will ensure that noise emissions are within acceptable bounds.

ES-5.1.6 Drilling Muds and Cuttings Mitigation

The discharge plan will establish effluent limitations, monitoring and reporting requirements and other conditions on discharges specific to drilling operations offshore Israel.

ES-5.1.7 Accidents or Upsets

As appropriate, to reduce, to the extent possible, the impact of a diesel spill:

- Noble Energy will maintain its OSRP.

ES-5.1.8 Applicability of Mitigation Measures to Project Phases

With the exception of drilling muds and cuttings mitigation, identified mitigation measures are applicable to all four phases of activity expected at the Tamar SW-1 drillsite.

ES-5.2 Monitoring

Noble Energy has developed an environmental plan for Tamar SW-1 that includes seafloor surveys before and after drilling to document seafloor conditions and potential spatial and temporal changes. During drilling, chemical and toxicity testing will be conducted to assess the relative toxicity of the drilling mud.

ES-5.3 Compliance with Ministry of Enegry and Water Resources Guidelines

This chapter of the EA provided a detailed tabular summary of the compliance measures to be implemented to comply with Ministry of Enegry and Water Resources (MEWR) guidelines during the Tamar SW-1 drilling effort. The table includes cross-references to EA chapters, including text, tables, and appendices, which provide detail regarding vessel operations, drilling, and discharge procedures.

CHAPTER A: INTRODUCTION

A.1 GENERAL OVERVIEW

A.1.1 Application

Noble Energy Mediterranean Ltd (Noble Energy) is planning on drilling the Tamar SW-1 exploration well located in the Tamar License off the coast of Israel (**Figure 1**). The Ministry of Environmental Protection (MoEP) has required Noble Energy to develop an environmental document (hereafter referred to as the Environmental Assessment [EA]) to accompany their Application for Exploration Drilling (hereinafter referred to as the Application). The EA was prepared in accordance with the Ministry of Energy and Water and MoEP "Framework for Guidelines for Environmental Document Accompanying License for Exploration." A translated version of the Guidelines is provided in **Appendix A**.

Noble Energy engaged CSA Ocean Sciences Inc. (CSA) to prepare the EA. The purpose of the EA is to identify environmental consequences early in the project planning and design process in order to facilitate preventing, minimizing, and mitigating potential adverse impacts. The EA sets out to 1) identify the various components of the Tamar SW-1 exploration program, 2) generally characterize the environmental resources of the project area, 3) assess the impacts of exploration drilling, and 4) identify relevant mitigation measures available to reduce or eliminate potentially significant impacts.

The EA has been organized into five key chapters, including:

- **Chapter A:** Introduction, including an overview of the application and proposed project, application boundaries, and synopses of regional and site-specific environmental baseline information.
- **Chapter B:** Reasons for Preference of the Location of the Proposed Plan and Possible Alternatives, including overview and application rationale for proposed exploratory program.
- **Chapter C:** Project Description, including drilling plan overview, description of the drilling plan (e.g., drilling rig and support vessels; drilling program), drilling phases, production testing (e.g., testing method(s), chemical use), noise hazard, air quality (project emissions), hazardous materials, discharges (e.g., overview and discharge sources; discharge treatment; discharge quality and effluent limitations), waste, and well closure (permanent or temporary abandonment).
- **Chapter D:** Evaluation of Environmental Impacts and Mitigation Measures, including introduction and impact assessment methodology, water and sediment quality impacts (including restatement of safe drilling practices and verification of discharge fate/production tests per Ministry of Enegry and Water Resources [MEWR] requirements), emergency response plan for potential accidents or upsets, lighting impacts, noise impacts, nature and ecology, archaeology impacts, air quality impacts, waste, hazardous substances, earthquake preparedness, and monitoring and control (e.g., discharges).
- **Chapter E:** Mitigation and Monitoring and Environmental Management Plant (EMP), including overview, drilling and production performance guidelines, hazardous materials handling guidelines, and EMP guidelines (e.g., water and sediment quality; wellsite environmental monitoring; monitoring systems; drilling muds and cuttings mitigation).

Supporting documentation to the EA is provided in the appendices, including a list of preparers and qualifications (**Appendix B**) and a list of references and data sources (**Appendix C**). Additional appendices have been included, as appropriate, to support the main text of the EA.

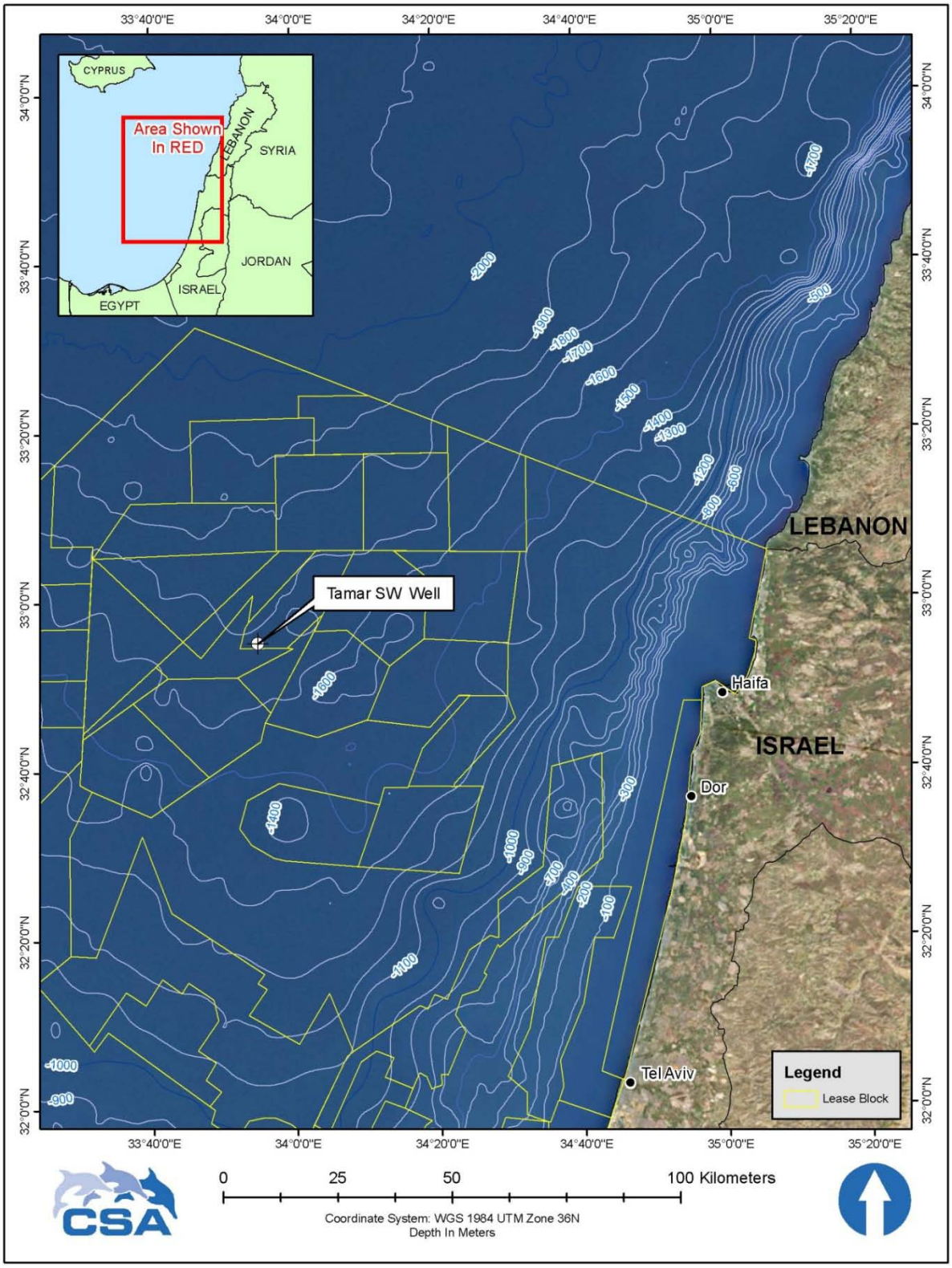

Figure 1. Location of the Tamar SW-1 drillsite relative to the Israeli coastline and regional bathymetric contours.

A.1.2 Boundaries of the Application

The boundaries of the Application include site-specific and regional study areas. The site-specific study area encompasses up to 1 km around the proposed Tamar SW-1 exploration drillsite and will include the water column, seabed and sub-seabed, and the maritime infrastructure and facilities. The Tamar SW-1 drillsite is located at 32°55'10.20" N latitude and 33°54'54.40" E longitude. X/Y coordinates for the drillsite are E 585,565 and N 3,642,734 (Geodesy: GCS WGS84; UTM 36 North; meters), or E 98,850 and N 759,025 (Geodesy: GCS Israel; Israeli Transverse Mercator; meters). The expanded area of the Application includes the entire marine and coastal area that might be environmentally affected as a result of exploration operations from potential transport of discharges or emissions. The expanded area will consider regional infrastructures and support vessel operations with their transit corridors between shore locations and the offshore drillsite.

A.1.3 Regional Setting

The Tamar SW-1 drillsite within the Tamar License is located in the eastern Mediterranean approximately 98 km west-northwest of Haifa, Israel, in the southeastern portion of the Levant Basin (**Figure 1**). **Figure 2** shows the location of the Tamar SW-1 drillsite relative to block boundaries and known regional infrastructure. A Med Nautilus submarine telecommunications cable with a landing in Haifa, Israel, is located less than 2,000 m north of the proposed drillsite. The Tamar SW-1 drillsite is located over 10 km southwest of the existing Noble Energy Tamar Field drillsites, which are the most proximal oil and gas infrastructure to the Tamar SW-1 drillsite (**Figure 2**).

The Levant Basin is highly oligotrophic and characterized by relatively high species diversity, very low biomass, and a higher degree of endemism than other oceans due to its relative isolation. Even within the Mediterranean Sea, the eastern Mediterranean is distinct because of its high salinity, low nutrients, transparency, and the temperature regime of its surface waters, which is higher than other areas of the Mediterranean.

A.2 BASELINE ENVIRONMENT

A.2.1 Bathymetry, Geology, Sediment Characteristics, and Seismic Activity

A.2.1.1 Bathymetry

Regional bathymetry of the eastern Mediterranean was developed by Almagor and Hall (1984) that illustrates the relatively narrow continental shelf bordering the Levant Basin offshore Israel. An updated version of regional bathymetry is available in Hall et al. (2005). In 2008, the Mediterranean Science Commission (CIESM) made available a new CIESM/IFREMER map of the Mediterranean seabed at a scale of 1/3,000,000 (Loubrieu and Mascle, 2008). This new image resulted from a re-analysis and extensive consolidation of previous data-gathering efforts in the western and eastern Mediterranean subbasins. The map provides a detailed morphology of the Mediterranean seafloor. Recent work by Hall et al. (2005) provides further detail regarding bathymetry of the Levant Basin, including the Tamar SW-1 study area.

The Tamar SW-1 drillsite within the Tamar License is located approximately 98 km off the coast of Israel along the gently descending portion of the continental slope in a water depth of approximately 1,648 m. **Figure 3** shows the location of the Tamar SW-1 drillsite relative to regional bathymetric contours, maritime boundaries, and shipping fairways. The Tamar License is in an approximate water depth range of 1,595 to 1,835 m.

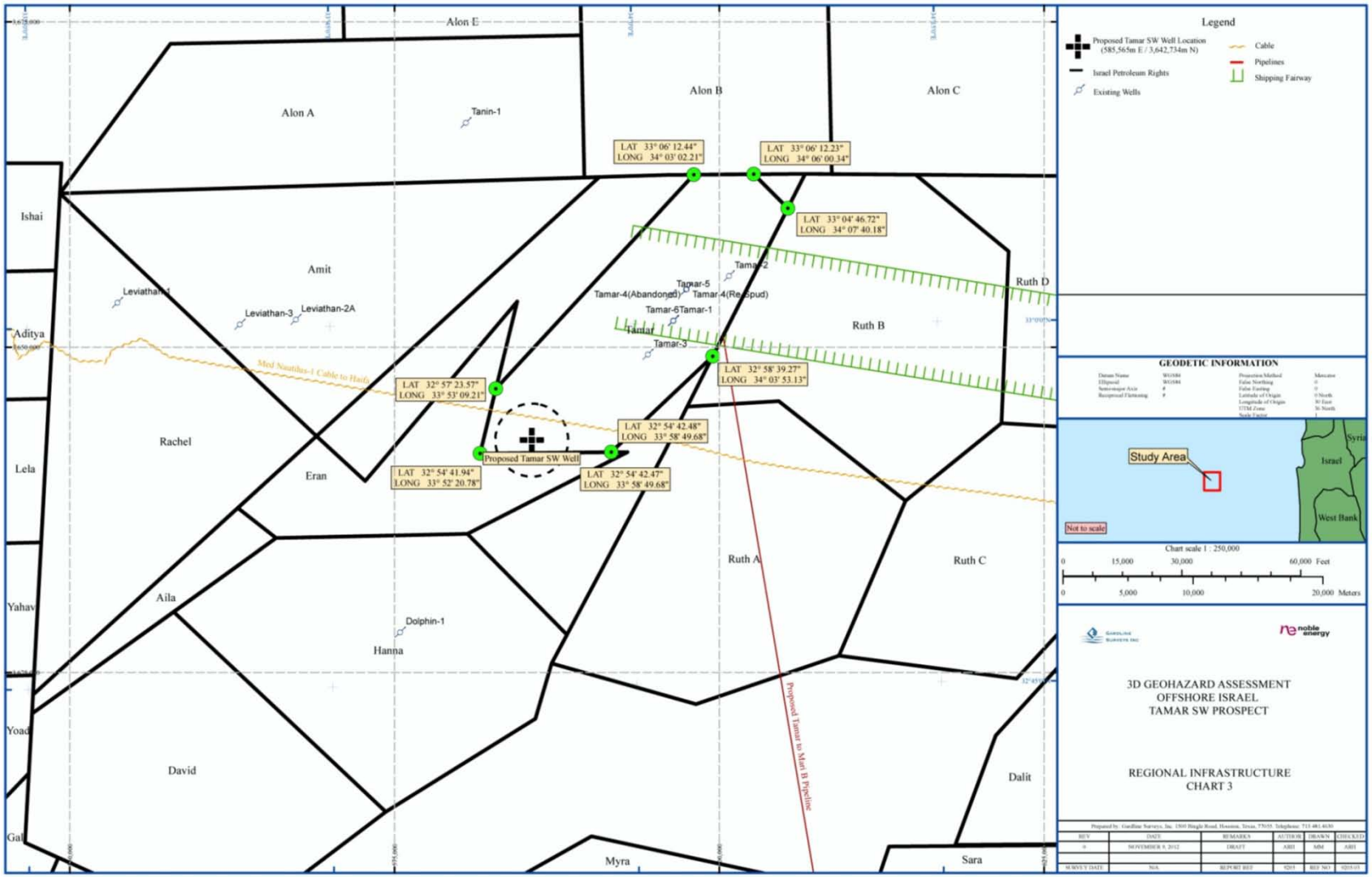

Figure 2. The Tamar SW-1 drillsite within the Tamar License (scale 1:250,000) relative to block boundaries and known regional infrastructure. The Tamar SW-1 drillsite is located at 32°55'10.20" N latitude and 33°54'54.40" E longitude. X/Y coordinates for the drillsite are E 585,565 and N 3,642,734 (Geodesy: GCS WGS84; UTM 36 North; meters), or E 98,850 and N 759,025 (Geodesy: GCS Israel; Israeli Transverse Mercator; meters).

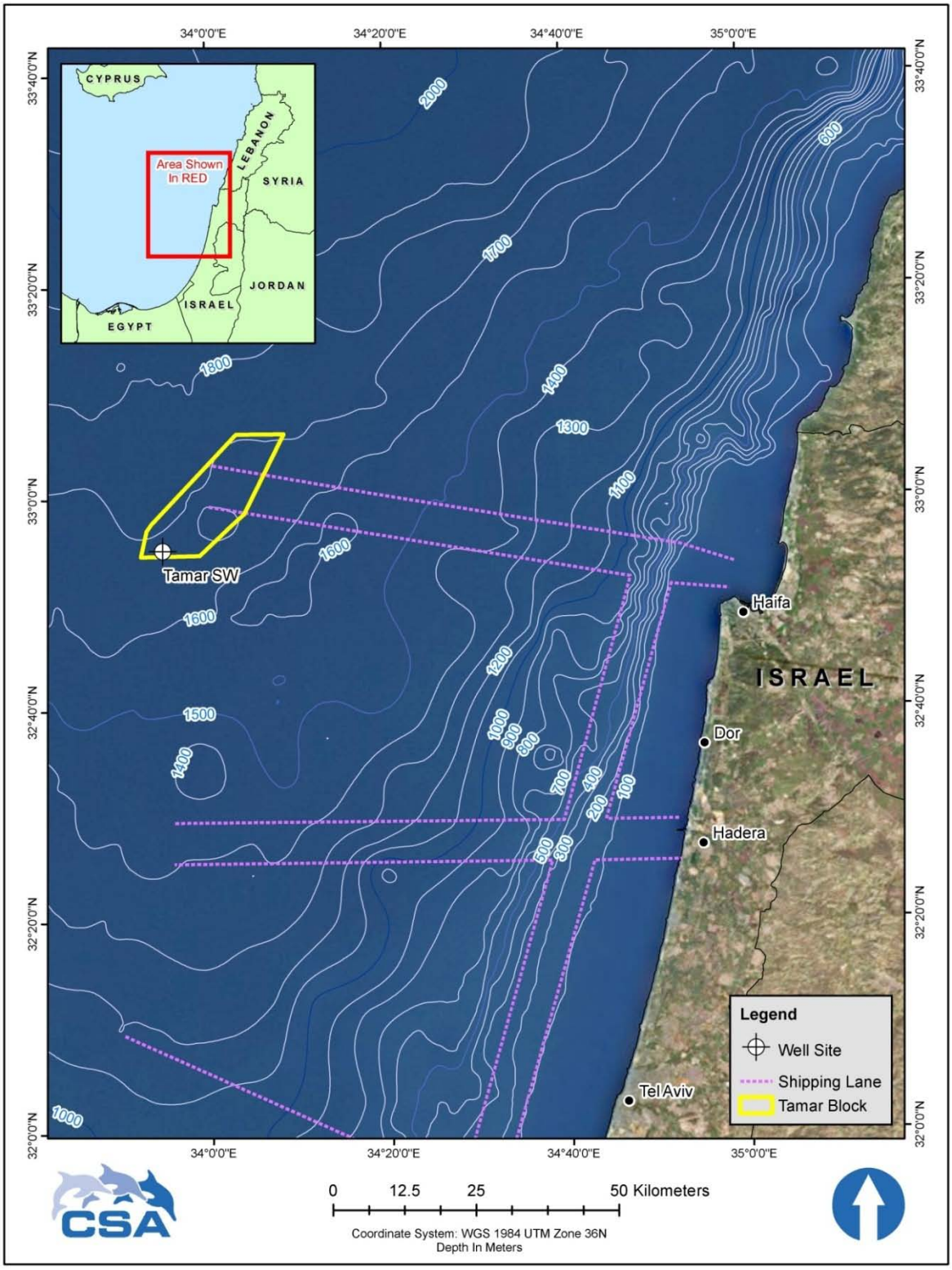

Figure 3. Location of the Tamar SW-1 drillsite relative to regional bathymetric contours, maritime boundaries, and shipping fairways.

Gardline Surveys Inc. (2012) performed an assessment of geohazards based on three-dimensional (3-D) seismic data for the well location. Seabed features and regional bathymetric contours relative to the proposed Tamar SW-1 drillsite are shown in **Figures 4** and **5**. The drillsite is in an area of the seafloor that is smooth and featureless. There are no features that pose a hazard to the drilling operation, no significant features within 500 m of the proposed well location, and no high seabed amplitudes in the records that indicate any fluid seepage within 500 m of the proposed well location. The seabed sediments are believed to be composed of silts and clays, which become firmer with sediment depth.

A.2.1.2 Geology

The eastern Mediterranean has been shaped by the interactions of the African, Arabian, and Eurasian plates since the Permo-Triassic period. The present geotectonic framework of the region is dominated by the collision of the Arabian and African plates with the Anatolian plate. Recent characterizations of the tectonics of the Eastern Mediterranean include the work of Dilek and Sandvol (2009) and Özbakir et al. (2010). A brief descriptive summary of prominent geological features and events of the region is as follows:

Levant Margin: All available information relating to the nature of the Levant margin comes from its southern portion through the work carried out for on-land and offshore exploration in Israel. Garfunkel (2004) has proposed that north-trending normal faults with large throws to the west, active since the Late Permian, were the primary mechanism for the formation of the Levant Basin. As rifting continued, the underlying continental crust would thin and form the basement to the Levant Basin instead of oceanic crust as proposed by Makris et al. (1983).

Levant Basin: The work of Garfunkel (2004) and Abdel Aal et al. (2001) has shown the basement of the Levant Basin to consist of faulted blocks, making a horst (elevated) and graben (recessed) basin floor topography covered by 10 to 15 km of sediments with an age range from the Late Permian to Recent. Their evolutionary model is generation of the Levant Basin by intercontinental rifting and extension that stops short of seafloor spreading and oceanic crust formation. Under this model, basal sediments everywhere would be shallow water clastics and carbonates. In deeper water, turbidites and pelagic carbonates with shales would be dominant, with basin floor sediments being mostly shales and distal turbidites (sheet sands).

Nile Cone: The Nile Cone is chiefly a post-Upper Miocene sedimentary wedge that covers a much older marginal basin sequence. Together they have a thickness of 9 to 10 km, including 1.5 km of Messinian evaporites (Mascle et al., 2006). These post-Messinian sediments, supplied by the Nile River, have undergone significant thin-skin deformation due to downslope movement along slip-surfaces in the underlying evaporites.

Messinian Salinity Crisis: The Messinian Salinity Crisis, when the Mediterranean Sea went through a cycle of partial desiccation, is one of the most unique oceanic events in the last 20 million years. The result of this event was significant deposition of sediments that formed a perfect seal to any hydrocarbons present offshore. These evaporite sediments were first discovered by Hsü et al. (1973). Their formation is attributed to the periodic restriction of seawater inflow from the Atlantic, leading to hypersalinity and deposition of gypsum in shallower basins and halite in the deep basins. The Mediterranean did not dry completely, but at times the sea level dropped by as much as 1,500 m. This fall led to dramatic erosion, with the formation of large canyons and deposition of coarse sediments that make good reservoir rocks.

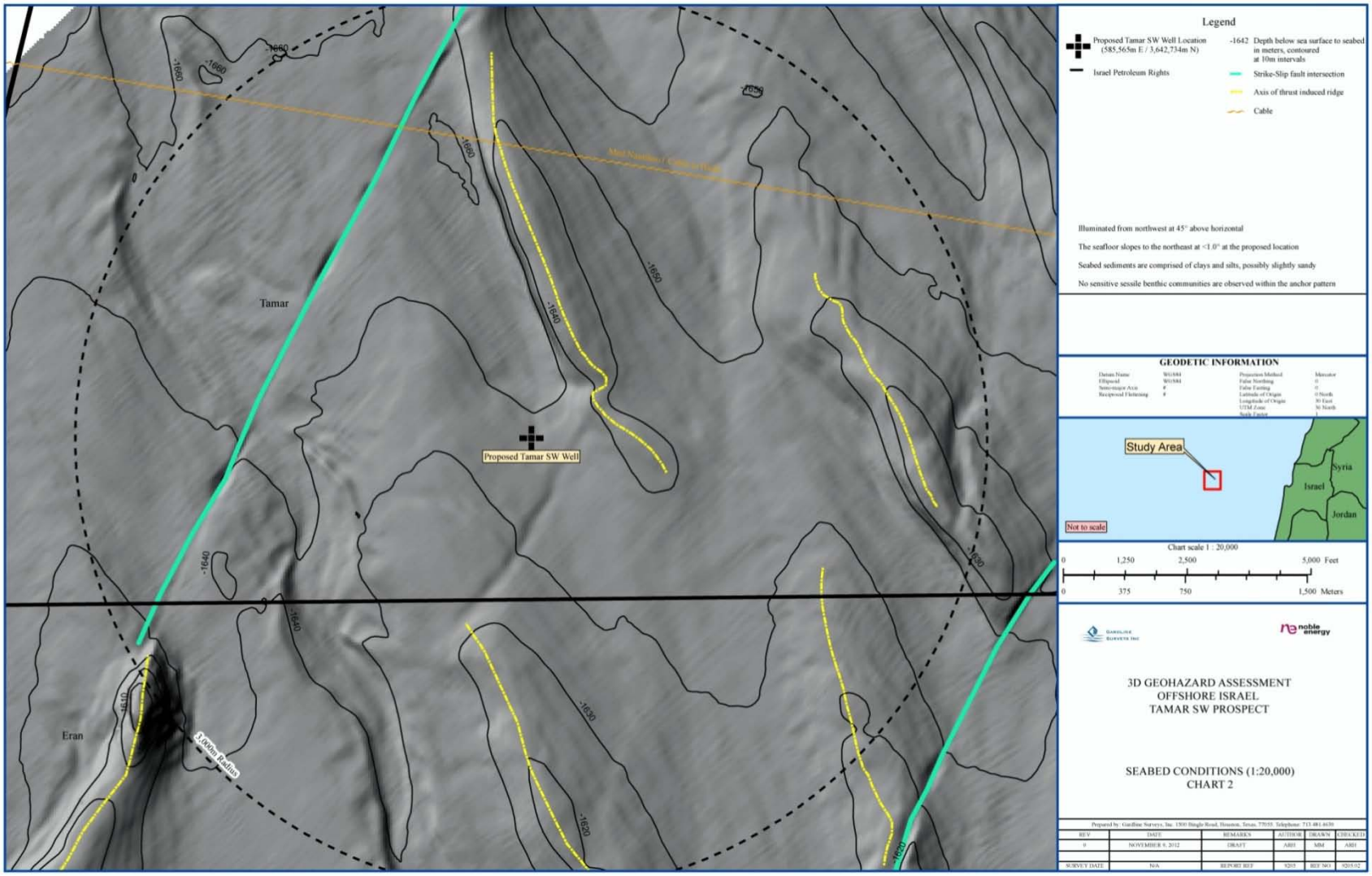

Figure 4. The Tamar SW-1 drillsite within the Tamar License (scale 1:20,000) with bathymetric contours (meters) and seabed features. The Tamar SW-1 drillsite is located at 32°55'10.20" N latitude and 33°54'54.40" E longitude. X/Y coordinates for the drillsite are E 585,565 and N 3,642,734 (Geodesy: GCS WGS84; UTM 36 North; meters), or E 98,850 and N 759,025 (Geodesy: GCS Israel; Israeli Transverse Mercator; meters).

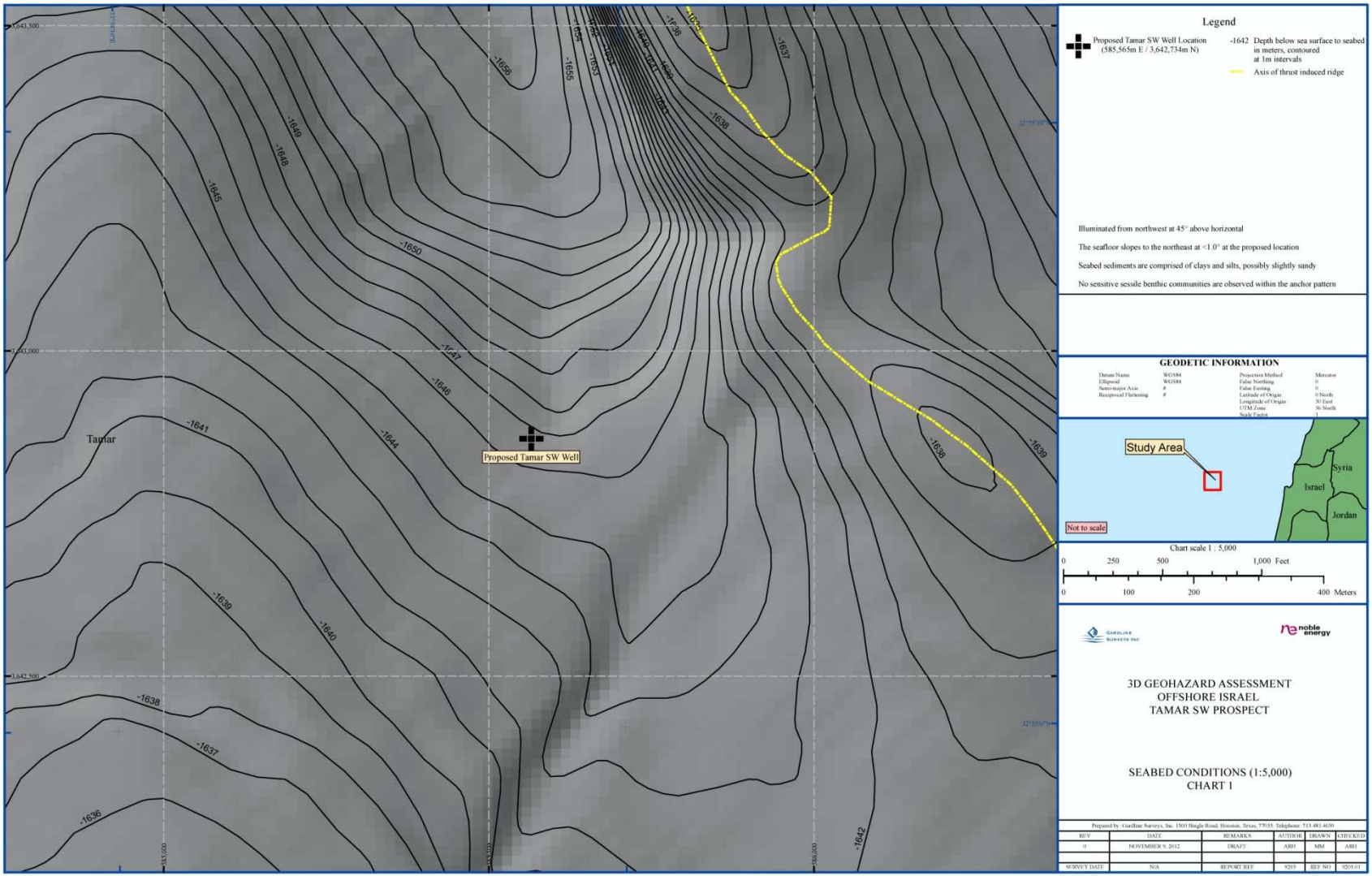

Figure 5. The Tamar SW-1 drillsite within the Tamar License (scale 1:5,000) with bathymetric contours (meters) and seabed features. The Tamar SW-1 drillsite is located at 32°55'10.20" N latitude and 33°54'54.40" E longitude. X/Y coordinates for the drillsite are E 585,565 and N 3,642,734 (Geodesy: GCS WGS84; UTM 36 North; meters), or E 98,850 and N 759,025 (Geodesy: GCS Israel; Israeli Transverse Mercator; meters).

Continental Slope: The lower continental slope in proximity to the study area is characterized by a disturbed area (Almagor and Hall, 1984) designated as the Dor disturbances (**Figure 6**). The disturbed areas where mass slumping has occurred are in a zone of diapirs (e.g., vertically upward geological movement) and associated with Messinian drainage systems such as offshore canyons. These canyons act as conduits for transporting materials from the shelf into the basin developed and were incised onto the Levant continental slope during the Oligocene and Miocene on through the Messinian and are partly reflected in the present day submarine features (Gardosh et al., 2008).

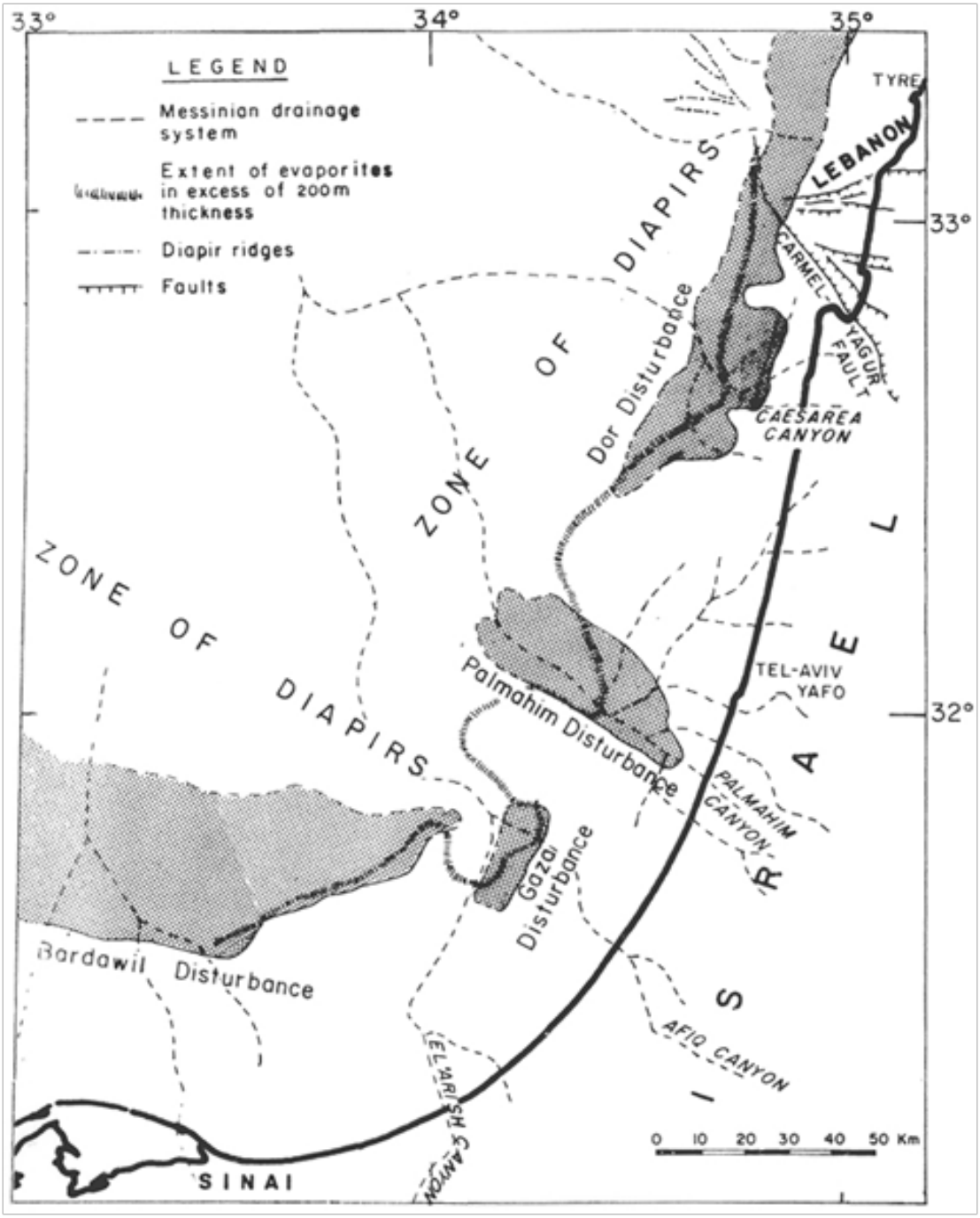

Figure 6. Seabottom areas of disturbance on the continental slope off the Israel coast (From: Almagor and Hall, 1984).

Gardline Surveys Inc. (2012) reported that there were no significant seabed features within 500 m of the proposed Tamar SW-1 drillsite. Specifically, there are no high seabed amplitudes indicative of any fluid seepage or any other seabed features within 500 m that could affect well emplacement. The Tamar SW-1 drillsite is located on a gentle sloping (<1°) anticline that deepens to the north (**Figure 5**). Gardline Surveys Inc. (2012) noted other regional seabed features during the anchor assessment, none of which were considered significant to Tamar SW-1 exploration activities, including 1) drainage channel, 2) strike-slip fault (i.e., lateral movement), and 3) area of ridges caused by reverse faulting.

Gardline Surveys Inc. (2012) interpreted the subsea strata within the study area to a depth of over 1,900 m below the seabed. The expected subsea strata consists of clays and silts, coarser clastic interbeds, and halite (i.e., salt) and anhydrite (i.e., calcium sulfate) deposits. No hard ground layers were interpreted from the shallower subsea soils.

A.2.1.3 Sediments

The nature of the local seabed sediments is important for understanding the potential for sediment movement and is a primary factor for determining the regional presence of flora and fauna. The sediment composition and associated texture influences the amount of sediment transport and the propensity for accumulation of particulate and chemical inputs. Particle size may be indicative of changes in sediment texture due to the presence of and discharges from the oil and gas activities.

Regional and Site-Specific Sediments: CSA conducted an environmental baseline survey (EBS) in July 2012 for the Tamar SW-1 drillsite that provides data specific to the characterization of substrates, water column, and benthic communities (CSA Ocean Sciences Inc., 2013a). These survey programs include all or some of the following sampling components:

- Video imagery;
- Forward-looking sonar;
- Hydrographic profiles; and
- Sediment and water collection.

The purpose of the EBS (CSA International, Inc., 2012) was to provide a baseline description of existing environmental conditions in the area of the Tamar SW-1 drillsite and at two reference locations. The objectives of the survey were to

- determine environmental baseline conditions (i.e., physical, chemical, and biological) at and near the Tamar SW-1 drillsite prior to exploratory drilling operations;
- provide baseline conditions of the environment against which effects from future operations could be compared; and
- identify parameters within the ecosystem that may be sensitive to change and provide a reference point to evaluate future claims of impacts.

The Tamar SW-1 survey area has smooth and relatively flat topography, soft bottom substrate, and sediment comprised primarily of silt and clay (**Image 1**), which corroborates the findings of the geohazards survey by Gardline Surveys Inc. (2012). No sand waves were observed, which would indicate low seafloor currents and slow on-bottom water movement. No consolidated substrates (i.e., hard bottom) or signatures of chemosynthetic communities were observed within the survey area.

Image 1. The Tamar SW-1 survey area characterized by soft bottom substrate (i.e., silt-clay sediments) and smooth, relatively flat seafloor topography.

The Tamar SW-1 EBS included sampling for sediment physicochemical analyses including grain size distribution, total organic carbon (TOC), metals, and hydrocarbons (alkanes and polycyclic aromatic hydrocarbons [PAHs]). The Tamar SW-1 EBS study area had mud sediment with the average composition of clay/silt fine fraction of over 90%. The TOC content of seafloor sediments within the study area was low, ranging from 18.3 to 60.5 ppm. The low TOC content is reflective of the deep-sea environment and oligotrophic nature of the eastern Mediterranean. Metals concentrations in the Tamar SW-1 survey area were generally within the range of concentrations found within average marine sediments and the continental crust (**Table 1**), with the exception of arsenic (As) and copper (Cu). Sediment concentrations of As, Cu, and nickel (Ni) in samples from the survey area were higher than the corresponding Effects Range Low (ERL) value for each respective metal. A concentration below an ERL represents a minimal-effects range where biological effects are rarely observed (Long and Morgan, 1990). The metal concentrations that are above ERL values are likely natural as there have not been any anthropogenic influences in close proximity to the survey area. As expected for deepwater sediment, sediment samples from the Tamar SW-1 EBS study area had very low concentrations of hydrocarbons (i.e., alkanes and PAHs) that were below the analytical limits of detection.

Table 1. Average metals concentrations for the Tamar SW-1 survey area compared to average marine sediments (Salomons and Förstner, 1984) and continental crust (Wedepohl, 1995). Bold values indicate exceeding average marine sediment, continental crust, and Effects Range Low (ERL) values.

Distance	Al (%)	As (ppm)	Ba (ppm)	Be (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Fe (%)	Hg (ppb)	Ni (ppm)	Pb (ppm)	V (ppm)	Zn (ppm)
0 m (drillsite)	0.95	**18.0**	75.0	0.47	0.53	59.5	**51.6**	4.77	56.5	49.7	14.3	84.9	62.0
500 m	2.42	**18.5**	71.5	0.56	0.52	59.2	**51.1**	4.94	51.4	48.9	12.5	83.5	61.0
1,500 m	4.52	**15.3**	86.5	1.07	0.70	62.7	**54.1**	4.92	158.7	53.1	16.2	87.9	65.1
3,000 m (Reference)	1.72	**14.2**	75.2	0.98	0.61	59.4	**50.7**	3.61	103.7	48.9	15.3	76.0	60.1
Average marine sediments	--	7.70	460.00	--	0.17	72.00	33.00	--	190.00	52.00	19.00	150.00	95.00
Continental crust	7.96	1.70	584.00	--	0.10	126.00	25.00	4.32	40.00	56.00	14.80	98.00	65.00
ERL	--	8.20	130.00	--	1.20	81.00	34.00	--	150.00	20.90	46.70	--	150.00

Al = aluminum; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Fe = iron; Hg = mercury; Ni = nickel; Pb = lead; V = vanadium; and Zn = zinc.

Drilling Discharges and Other Bottom Founded Activities: While there are no indications that the Tamar SW-1 drillsite area has been previously affected by drilling operations, the physical and chemical characteristics of indigenous sediments will be altered around the drillsite as a result of proposed drilling activities. Changes in sediment texture and increases in select metals (e.g., barium [Ba]) may be expected within several hundred meters of the drillsite. **Chapter C.2.2.2** (**Drilling Discharge Fate**) summarizes the projected deposition pattern for seafloor releases and surface discharges of drilling muds and cuttings at the Tamar SW-1 drillsite. **Chapters D.2** (**Water and Sediment Quality Impacts**) and **D.6** (**Nature and Ecology Impacts**) address impacts associated with well drilling, including the release and discharge of drilling muds and cuttings.

Anchoring is also expected to produce localized increases in turbidity, increases in localized sedimentation, and furrows on the seafloor, producing localized alternations in sediment contours. **Chapter D.2** (**Water and Sediment Quality Impacts**) and **D.6** (**Nature and Ecology Impacts**) address impacts of anchoring activities on these resources.

A.2.1.4 Seismic Activity

There is very little information available regarding seismic sea waves. Ambrasseys (1962) conducted a survey of reported sea waves from Antiquity to 1961 and came to the conclusion that the region from Cyprus to Jubeil and Acre on the Levantine coast is prone to sea waves of light to rather strong intensity. The term “rather strong” on this intensity scale means that the waves would flood gently sloping areas. The height and destructive power of such waves is by far greater in coastal areas where they traverse shallow water than out in the open seas. Kelletat and Schellmann (2002) examined the western and southeastern coasts of Cyprus for tsunami evidence and reported movement of boulders weighing several tons by an event that took place over 200 years ago. However, the earthquake zone along the south coast of Cyprus appears to provide the most significant overall tsunami threat to the coast of Israel (URS Corporation, 2009).

The primary sources of tsunamis are earthquakes and offshore landslides. Salamon et al. (2007) constructed a list of 21 reliably reported tsunamis that have struck the Levant coast, along with

57 moderate-to-large earthquakes that have occurred along the Dead Sea Transform (DST) system (geological fault between the Arabian and African tectonic plates), since about the mid-second century B.C. Ten of the tsunamis were triggered by earthquakes that originated along the DST system, six of which followed moderate earthquakes and four that followed large earthquakes. These observations indicate that about 14% of the moderate and about 27% of the large DST earthquakes were tsunamigenic.

Geological fault zones, locations of historical earthquakes, and regional bathymetric contours relative to the Tamar SW-1 drillsite are shown in **Figure 7**. Earthquake data for **Figure 7** were provided by http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_rect.php. There has been one recorded earthquake within 25 km of the Tamar SW-1 drillsite since 1979; the magnitude of the earthquake was 4.0. There have been no strong (magnitude 5.6 or greater on the Richter scale) regional earthquakes recorded since 1983 within 200 km of the Tamar SW-1 drillsite.

Salamon et al. (2007) estimated that the threshold of tsunamigenic DST earthquakes likely ranges in magnitude from 6 to 6.5. Meral Ozel et al. (2011) have reported on the tsunami hazard in the eastern Mediterranean and its connected seas, with an emphasis on Turkey. The number of tsunamis attributable to submarine landslides is poorly understood since there are virtually no direct observations of their occurrence. Even in cases where the evidence points to a landslide origin for the tsunami, there are usually no reliable estimates of their extent or the manner in which the movement took place (URS Corporation, 2009). Slump deposits associated with submarine landslides along the continental margin of Israel have been described by Martinez et al. (2005) using 3D seismic data. The high occurrence of slumping processes along the Israeli continental margin was possible because of a combination of seismic activity, presence of gas within the sediments, and relative steep slopes (Martinez et al., 2005).

A.2.2 Physical Oceanography

A.2.2.1 Winds

There is no known wind dataset representative of the drillsite. In the absence of an observed dataset, wind data can be obtained from the output of a numerical atmospheric model. Data were assessed from the National Center for Environmental Predictions (NCEP) Environmental Modeling Center Regional Spectral Model provided by the U.S. National Oceanic and Atmospheric Administration – Cooperative Institute for Research in Environmental Studies (NOAA – CIRES) Climate Diagnostics Center (CDC) (http://www.cdc.noaa.gov). Wind speed and direction data at a 10-m height from the NCEP model grid location closest to the drillsite (approximately 50 km north-northwest) were obtained from the NOAA/CDC data server for the 10-year period from January 1999 to January 2009 as representative for the drillsite location.

Figure 8 shows annual and monthly wind roses developed from the NCEP model grid location. Based on the NCEP dataset, the wind regime is characterized by predominant westerly winds throughout most of the year (January through October) and varied winds in November and December. Winds are generally moderate in speed, with average monthly speeds of ~5 m/s. Overall, strong seasonal variability is not evident in the wind data. Winter winds (December through February) have higher maximum speeds than the remainder of the year; however, average winds are relatively comparable throughout the year.

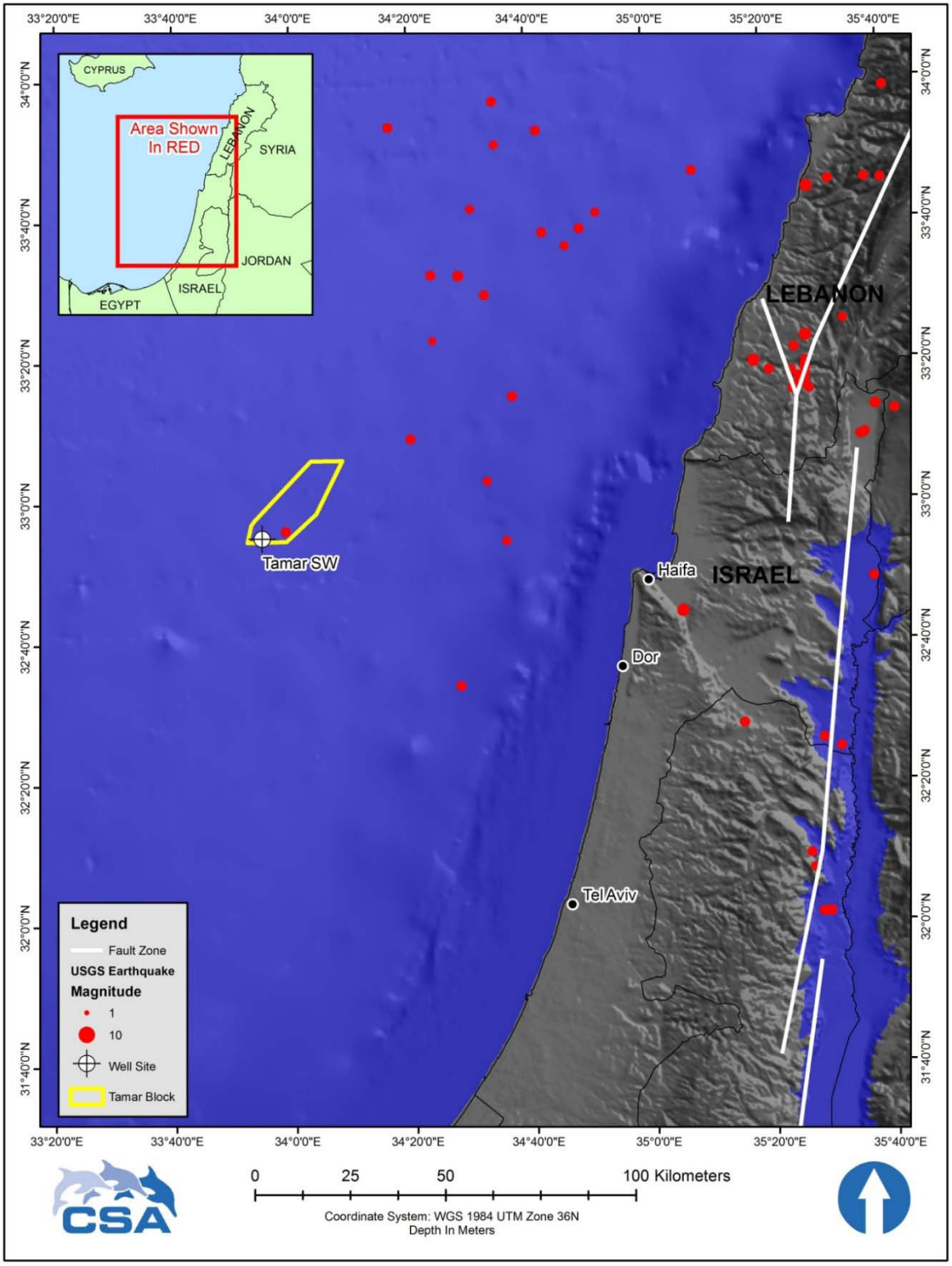

Figure 7. Geological fault zones, locations of historical earthquakes, and regional bathymetric contours relative to the Tamar SW-1 drillsite. Earthquake data were provided by http://earthquake.usgs.gov/earthquakes/eqarchives/epic/epic_rect.php.

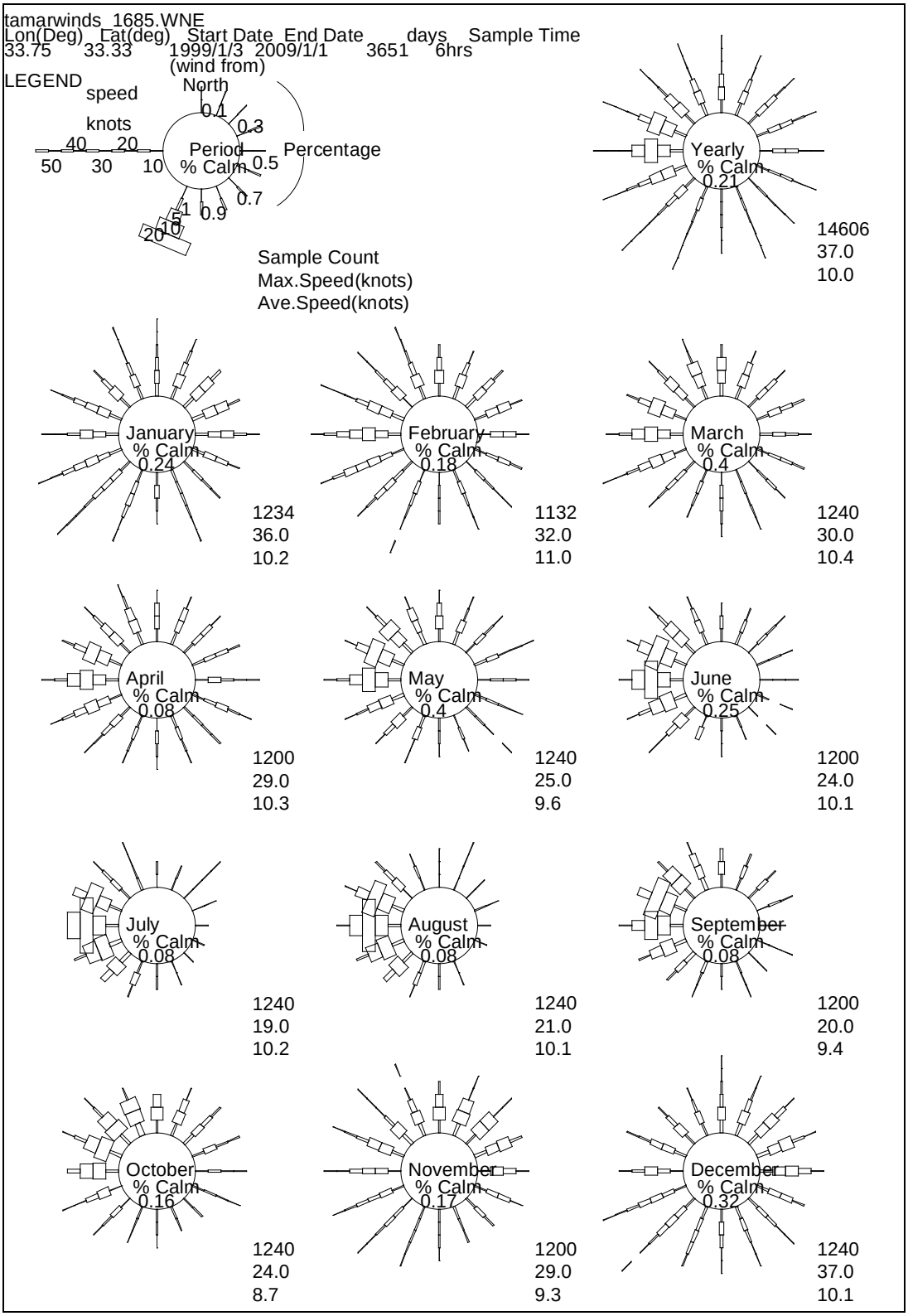

Figure 8. Monthly and yearly wind roses of National Center for Environmental Predictions Wind Station 1685, January 1999 through January 2009.

A.2.2.2 Waves

Table 2 presents significant wave height distribution for a point near the Cyprus Coastal Ocean Forecasting and Observing System (CYCOFOS) MedGoos-3 buoy (33°42'N, 32°08'E) for the period July 2005 to February 2008. This station is located approximately 200 km west of the Tamar SW-1 drillsite. Nearly all of the waves are less than 1.5 m in height, and wave direction is nearly always due eastward at this location (mean of 116°T, standard deviation of 53°) because of the strong westerly winds. While wave height and direction vary across the Levant Basin on a given day, these yearly statistics can be regarded as representative values spatially and temporally for the entire basin (**Figure 9**).

Table 2. Significant wave heights and their frequency of occurrence in the Levant Basin during the period from July 2005 to February 2008.

Wave Height Range[1] (m)	Frequency (Occurrences Over Period of Record)	Percentage
0 to 0.2500	91	1.5230
0.5000	1,132	18.9456
0.7500	2,183	36.5356
1.0000	1,388	23.2301
1.2500	565	9.4561
1.5000	261	4.3682
1.7500	140	2.3431
2.0000	69	1.1548
2.2500	52	0.8703
2.5000	21	0.3515
2.7500	14	0.2343
3.0000	10	0.1674
3.2500	11	0.1841
3.5000	4	0.0669
3.7500	7	0.1172
4.0000	11	0.1841
4.2500	9	0.1506
4.5000	6	0.1004
4.7500	1	0.0167
Total	**5,975**	**100%**

[1] Upper limit of bin.

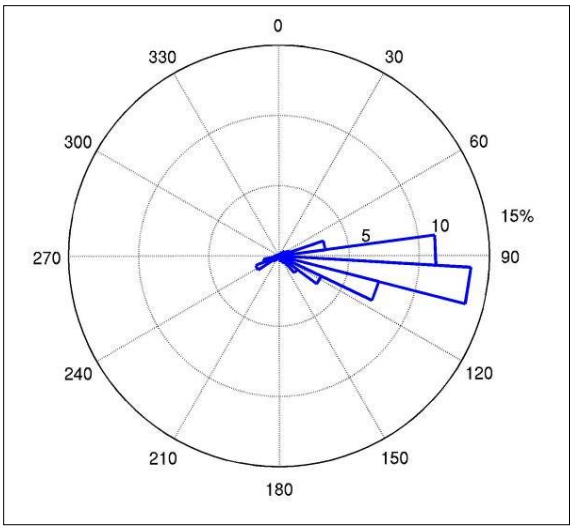

Figure 9. Rose diagram for annual frequency of wave direction per 10° sector across the Levant Basin. Waves predominantly travel towards the east.

A.2.2.3 Weather

The eastern Mediterranean lies between the subtropics and mid-latitudes, and cyclones that develop in this region obtain significant energy from both baroclinicity and surface fluxes (Flocas et al., 2010, 2011). **Figure 10** shows the mean annual cycle of the number of storm tracks that pass through the eastern Mediterranean, based on an analysis of storm data for the period 1962 to 2001. Storm tracks are most numerous during the winter and spring months, from December to April. The occurrence of storms decreases during the warm period, with a tendency to increase again in October. The maximum number of cyclonic tracks over the area is observed in January (11.2% of the annual total) and March (10.3%). The minimum number of tracks occurs in July (5.3%).

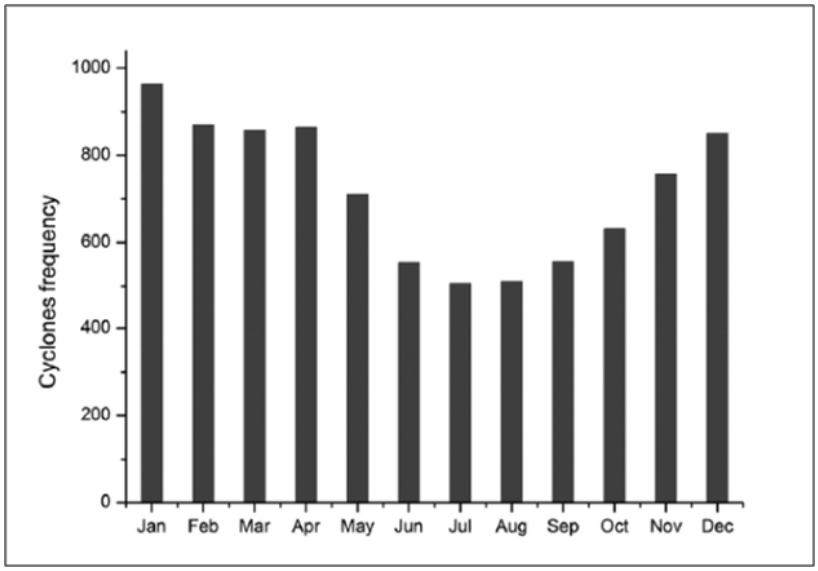

Figure 10. Mean annual cycle of the number of storm tracks that passed through the eastern Mediterranean, 1962 to 2001 (From: Flocas et al., 2011).

On a seasonal basis, Mandel et al. (2006) describe winter in the eastern Mediterranean as concomitantly/alternatively dominating or dominated by interconnected successions of Red Sea Trough, Winter Lows, Polar Cyclones, and Siberian and Mediterranean subtropical anticyclones. The northward and southward advance and withdrawal of the Red Sea Trough during 5 to 7 months of the year (to the InterTropical Convergence Zone) and Persian Trough variability affect the large-scale succession of the temporary cyclonic systems (i.e., Winter Lows, Cyprus Lows, and Sharav). The Red Sea Trough conditions dominate during the winter, while Winter Lows and Cyprus Lows are less prevalent.

During the summer, the Persian Trough is the dominant weather type, with subtropical anticyclones dominating at upper levels. At day-to-day intervals, the Persian Trough has the largest persistence, being rarely interfered by other weather types. For example, the Sharav Cyclones, as temporary partners of the Persian or Red Sea Troughs, have a horizontal scale <1,000 km (Alpert and Ziv, 1989), while the trajectory of Cyprus cyclones is >2,500 km, occurring 8 to 13 times/year and lasting 5 to 7 days (Mandel et al., 2006).

A.2.2.4 Water Column Characteristics

Rohling et al. (2009) provided an update of historical and current characterizations of the local oceanographic processes offshore Israel. Lawrence et al. (2011) conducted a metocean study offshore Israel near the Tamar Field. Currents were measured throughout the water column at a single site near the Field. The current meter array was in a water depth of 1,688 m and located approximately 25 km northeast of the Tamar SW-1 drillsite. Only near-bottom currents were measured at several additional sites along a pipeline corridor to the Mari-B Field and two potential pipeline corridors to shore.

The upper water column currents at the current meter location were dominated by episodes of strong flows, particularly in the winter. At 25-m depth, the maximum recorded current speed was 53.6 cm/s, measured in January 2011. Mean current speeds at this depth were estimated to be as large as 25 cm/s. At 73-m depth, the maximum current speed was 49.1 cm/s, measured in April 2011. Mean current speeds at this depth were estimated to be as large as 22 cm/s. At 121-m depth, the maximum current speed was 41.5 cm/s. Mean currents were estimated to be as large as 17 cm/s. At 233-m depth, the maximum current speed was 25.8 cm/s in January 2011. The dominant flow direction at the near-surface was toward the south and west. Near-bottom currents do not appear to have a significant seasonal trend, with a maximum speed of only 8.7 cm/s. **Figures 11** through **15** show recorded current speed and direction for the 25-, 73-, 121-, 233-, and 1,680-m depths.

The deepwater water column of the eastern Mediterranean is characterized by good water quality and relatively high salinity. The water column has clear water (low turbidity), low nutrients, and high dissolved oxygen (DO). The entire water column is well oxygenated; even the deep waters (e.g., 1,000-m depth) have saturation values greater than 70% to 80%. DO concentrations generally range from ~4.8 mg/L at the surface, increasing to 5.4 mg/L through the surface-mixed layer before gradually stabilizing to 4.1 mg/L for the remainder of the water column to the seafloor (Krom et al., 2005). The yearly ranges for surface salinity and temperature in the eastern Mediterranean are approximately 39.0 to 39.5 psu and 17°C to 28°C, respectively. Salinity remains fairly constant with depth, while temperature decreases with depth to the range of 14°C to 17°C (Zodiatis et al., 2001).

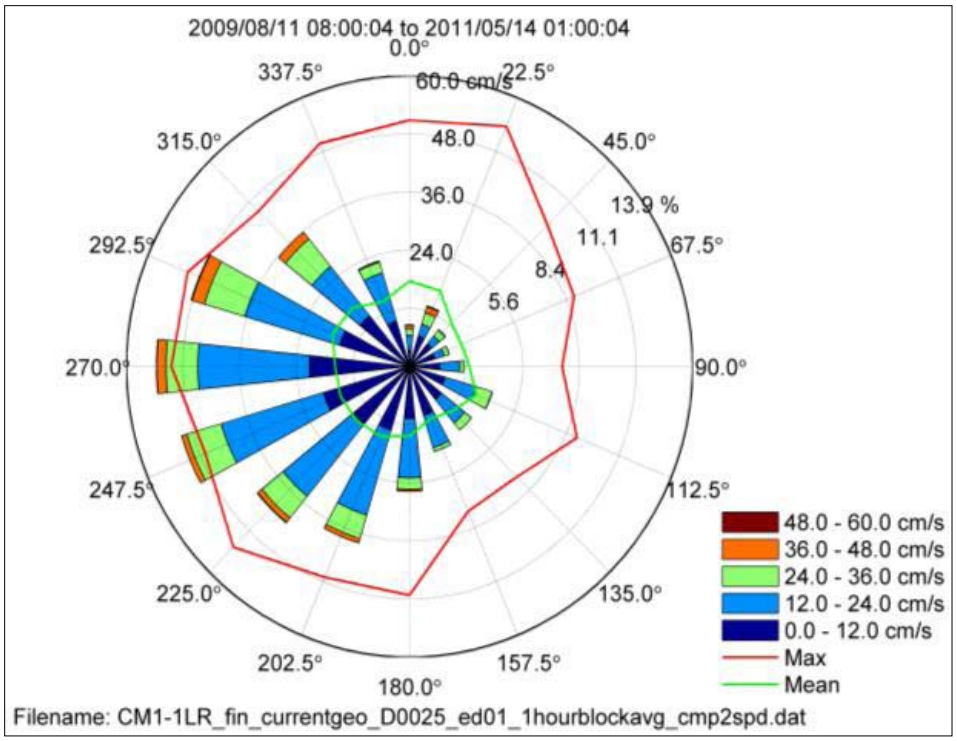

Figure 11. Compass rose plot of the directional distribution of currents recorded at a depth of 25 m near the Tamar Field.

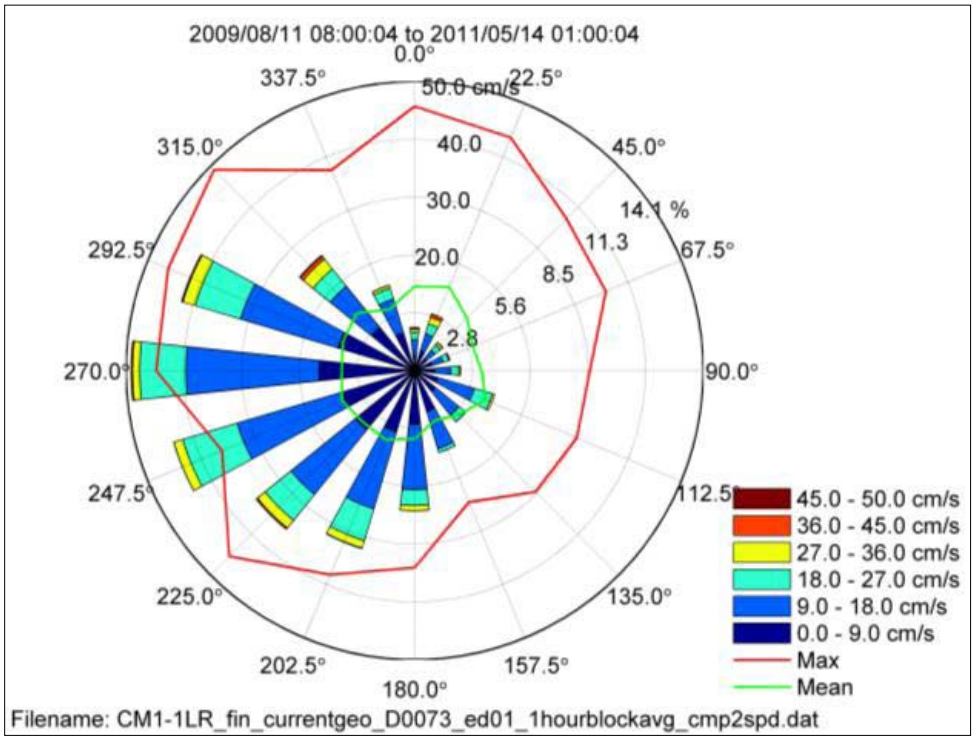

Figure 12. Compass rose plot of the directional distribution of currents recorded at a depth of 73 m near the Tamar Field.

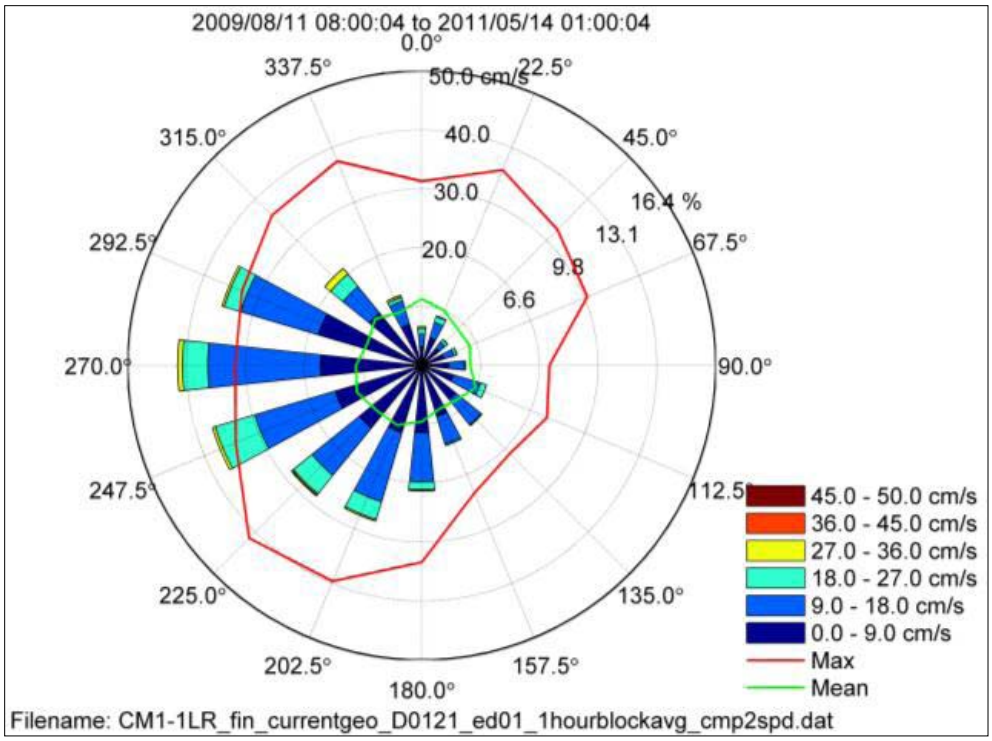

Figure 13. Compass rose plot of the directional distribution of currents recorded at a depth of 121 m near the Tamar Field.

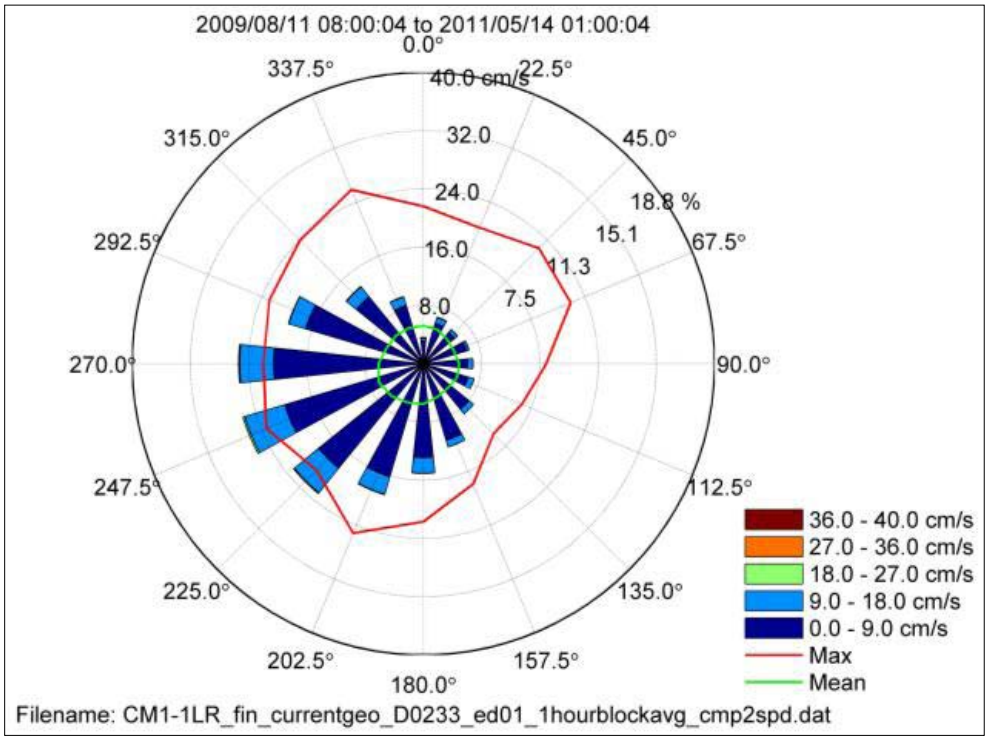

Figure 14. Compass rose plot of the directional distribution of currents recorded at a depth of 233 m near the Tamar Field.

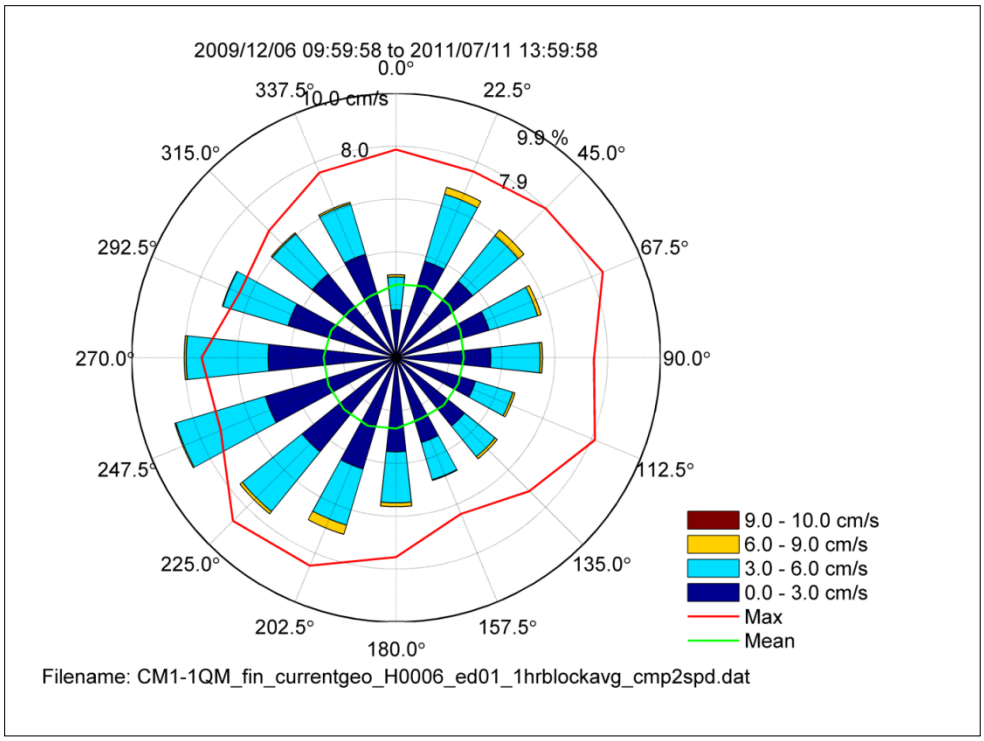

Figure 15. Compass rose plot of the directional distribution of currents recorded at a depth of 1,680 m near the Tamar Field.

Hydrographic data were collected during the EBS at the Tamar SW-1 study area in July 2012 (CSA Ocean Sciences Inc., 2013a). A hydrographic profile (**Figure 16**) collected on 9 July in the vicinity of the Tamar SW-1 drillsite in a water depth of approximately 1,648 m is considered representative of the water column in the survey area.

Hydrographic data from the Tamar SW-1 survey area acquired during water column profiling are typical of summer deepwater subtropical open ocean conditions. Surface waters were warm and relatively isothermal (27.5°C), decreased to 17°C through the thermocline, and gradually stabilized to 14°C through the remainder of the water column to the seafloor. A salinity of 39.5 psu was recorded near the surface, decreased to 38.7 psu through the halocline (salinity gradient), and gradually stabilized with increasing water depth to 38.8 psu at the seafloor. Turbidity was low (~0.2 NTU) throughout the water column. Photosynthetic activity, an estimate of primary productivity within the water column, was estimated through the water column by the use of a fluorometer. The photosynthetic maximum occurred at depths between 50 and 150 m, primarily due to an optimal combination of nutrient and light availability at these depths that promotes phytoplankton growth. Above this layer, nutrient availability for phytoplankton growth is generally limiting, while below this layer a reduction in light penetration inhibits phytoplankton growth.

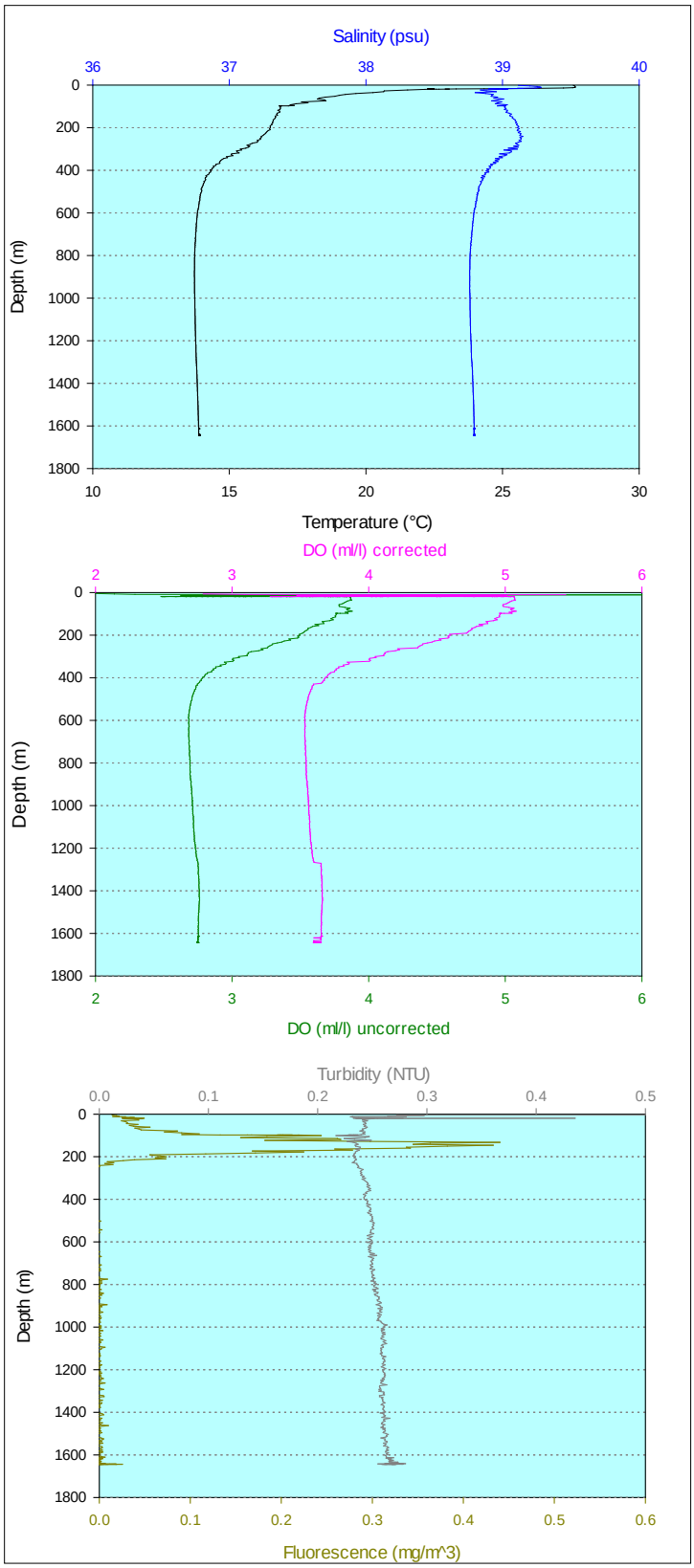

Figure 16. Water column hydrographic profile collected on 9 July 2012 at the Tamar SW-1 drillsite.

Precise DO readings were not obtained during the Tamar SW-1 EBS due to the malfunction of both the primary and back-up DO sensors. However, the back-up sensor was able to record a DO profile that was offset from real values by approximately 1.2 ml/L. Upon recalibration of the DO sensor, a regression was obtained that reported the residual offset of the probe per unit of oxygen (ml/L). Values from this regression were used to back-calculate actual DO values for the Tamar SW-1 survey area. The water column was well oxygenated (5.1 ml/L) at the surface but decreased gradually through the surface-mixed layer before it stabilized to 3.8 ml/L for the remainder of the water column to the seafloor. The near-surface depression of DO may be attributed to the actinic effects of sunlight decreasing photosynthesis. The DO stabilization at water depths below 400 m is typical of the Levant Basin because the amount of organic material sinking from the surface waters is small, which limits microbial respiration at depth (Krom, 1995).

Alkanes and PAHs were not detected in seawater from the Tamar SW-1 EBS survey area (CSA Ocean Sciences Inc., 2013a). All results representing samples from the water column in the vicinity of the drillsite were below the reported limits of detection. Analytical results for quality control (QC) sample splits for alkanes and PAHs were in agreement. Alkane and PAH concentrations were low and at nondetectable levels for the primary analytical laboratory, indicating that no significant amounts of these hydrocarbons are present in the water column.

Results for the Tamar SW-1 EBS seawater analysis of total metals is provided in **Table 3** along with toxicity reference values (marine Criteria Continuous Concentrations [CCCs] from Buchman, 2008). Marine CCCs, developed to protect aquatic organisms, are reported from the U.S. Environmental Protection Agency's (USEPA's) National Recommended Water Quality Criteria (NRWQC) (Buchman, 2008). Where NRWQCs are not available for some metals, criteria from other countries (e.g., Canada, New Zealand) are provided for reference. All seawater total metals concentrations in the Tamar SW-1 samples were below the CCC reference values. Concentrations of antimony (Sb), As, beryllium (Be), cadmium (Cd), chromium (Cr), Cu, lead (Pb), mercury (Hg), Ni, selenium (Se), silver (Ag), thallium (Tl), vanadium (V), and zinc (Zn) were extremely low and below analytical detection limits. The recorded Ba levels in the survey area water column are considered to be ambient levels.

Table 3. Total metals concentrations (µg/L) in seawater from the Tamar SW-1 survey area, with comparisons to toxicity reference values (Criteria Continuous Concentration* [CCC]; Buchman, 2008).

Sample	Silver (Ag)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Mercury (Hg)	Nickel (Ni)	Lead (Pb)	Antimony (Sb)	Selenium (Se)	Thallium (Tl)	Vanadium (V)	Zinc (Zn)
Near-surface	<0.1	<7	6	<0.5	<0.1	<10	<1	0.05	<1	<0.1	<0.2	<7	<0.1	<10	≤2
Mid-depth	<0.1	<7	8	<0.5	<0.1	<10	<1	0.06	<1	<0.1	<0.2	<7	<0.1	<10	<2
Near-bottom	<0.1	<7	8	<0.5	<0.1	<10	<1	0.06	<1	<0.1	<0.2	<7	<0.1	<10	<2
CCC* Value	0.95** (1/2)	36	200 BC	100 BC	9.3	50	3.1	0.94	8.2	8.1	500 p	71	17 NZ	50 BC	81

p = proposed; (1/2) = Criterion Maximum Concentration has been halved to be comparable to 1985 guidelines for minimum data requirements and derivation procedures; ** = Criterion Maximum Concentration; Sources of CCC Toxicity Reference Values. Primary entry is the U.S. Ambient Water Quality Criteria. BC = British Columbia Water Quality Guidelines; NZ = Australian and New Zealand Environmental Concern Levels and Trigger Values.

A.2.3 Nature and Ecology

The following resource-specific discussions present summaries of pertinent, available information on both a regional (i.e., Eastern Mediterranean Sea, Levant Basin) and site-specific basis (i.e., Tamar SW-1 study area). The Tamar SW-1 EBS, completed in July 2012, did not include infaunal sampling but did encompass remotely operated vehicle (ROV)-based observations to document benthic epifauna (i.e., benthic fauna present on the sediment surface) and evidence of biological activity (e.g., burrows, mounds).

A.2.3.1 Plankton

Marine plankton include organisms with limited swimming capabilities that drift with the prevailing currents. Plankton range in size from <0.2 µm (marine viruses) to >600 mm (large jellyfish) and may derive energy from sunlight (i.e., plant plankton [phytoplankton]), from the consumption of organic material (i.e., animal plankton [zooplankton]) or, in several unique deep-sea habitats, from chemosynthesis of inorganic molecules. In marine systems, phytoplankton, which derive energy from sunlight, form the base of the food web, while zooplankton link phytoplankton to higher trophic levels (e.g., fish). Zooplankton also mediate the transfer of organic material from the surface ocean to the deep sea and thus are indirectly responsible for maintaining benthic community production in most deep ocean ecosystems.

Phytoplankton

Phytoplankton productivity in the Mediterranean Sea is nutrient-limited (Longhurst, 1998). In contrast to other marine systems, Mediterranean phytoplankton production is co-limited by phosphorus and nitrogen (Krom et al., 1991; Thingstad et al., 2005). A west-to-east decrease in nutrient concentrations in the Mediterranean Sea results in extremely nutrient-poor ("ultraoligotrophic") surface waters in the eastern Levant Basin compared to the western Mediterranean. Severe nutrient depletion in the eastern Mediterranean results in low phytoplankton biomass and productivity (Tanaka et al., 2007).

Phytoplankton dynamics in the eastern Levant Basin, including the Tamar SW-1 study area, vary on a seasonal basis. Phytoplankton blooms in the winter and early spring (November to March) because deep winter mixing brings nutrients to surface waters (Vidussi et al., 2001). Phytoplankton growth during this season rapidly depletes phosphorus, and nutrient levels remain low during the summer when the surface ocean stratifies. Thus, the summer phytoplankton biomass (i.e., pigment concentrations [chlorophyll *a*]) is low in the surface mixed layer, up to 10 times lower than observed during the winter (Krom et al., 1991). Herut et al. (2000) reported distinct phytoplankton biomass peaks in surface water (upper 120 m) following autumn and winter storms.

The dominant phytoplankton in eastern Mediterranean assemblages is *Synechococcus* spp. (Pitta et al., 2005), a small (<2 µm) cyanobacterium (blue-green algae). Koppelmann et al. (2003) suggested that *Synechococcus* spp. is one of the primary mechanisms for nitrogen fixation in the Levantine Sea and is common (Li et al., 1993; Detmer, 1995) under oligotrophic conditions (e.g., Kress, 2000; Struck et al., 2001). Analysis of phytoplankton accessory pigments in the eastern Levant Basin also indicates the importance of prymnesiophyte nanoplankton (2 to 20 µm) and the presence of coccolithophorids, diatoms, and dinoflagellates (Psarra et al., 2005). Diatom populations in the study by Psarra et al. (2005) were dominated by *Thalassionema frauenfeldii*.

Phytoplankton in the study area are found primarily in the surface waters (0 to 150 m) where light levels are sufficient for growth; the euphotic zone, with maximum phytoplankton productivity, occurs in the surface mixed layer at a depth of 0 to 50 m (Tanaka et al., 2007). However, phytoplankton pigments (chlorophyll *a*) have been found to 500 m in the deep mixed layer of a warm-core eddy to the south of

Cyprus (Krom et al., 1991). On average, the vertical distribution of phytoplankton pigment concentrations (chlorophyll *a*) in the eastern Levant Basin reaches a maximum at 90 to 110 m, just above the nutricline (Yacobi et al., 1995; Krom et al., 2005). This is corroborated by the fluorescence profile of the water column at the Tamar SW-1 study area during July 2012 (**Figure 16**) (CSA Ocean Sciences Inc., 2013a).

Zooplankton

Zooplankton in the eastern Mediterranean can be categorized by size into microzooplankton (20 to 200 µm), mesozooplankton (>200 µm), and macrozooplankton (>2 mm). Zooplankton in surface waters rely on a phytoplankton-based food web, whereas zooplankton in the deep sea rely on a food web based on organic particulate material sinking out of the surface ocean.

Microzooplankton in the study area is a diverse assemblage of small cells that consume bacteria and small phytoplankton. The microzooplankton community includes heterotrophic nanoflagellates (2 to 10 µm) and ciliates (10 to 350 µm), as well as autotrophic nanoflagellates (2- to 10-µm microzooplankton) that have chloroplasts and can derive energy from sunlight, and are thus "mixotrophic" (Pitta et al., 2005). Ciliate abundances are maximal in the surface mixed layer (0 to 50 m) where phytoplankton production is highest, while autotrophic nanoflagellate abundances are maximal just above the nutricline, at approximately 100-m depth (Tanaka et al., 2007). In contrast, no consistent pattern is found for heterotrophic nanoflagellates in surface and deep waters of the eastern Levant Basin, although their abundance and bacterial abundances decrease with depth (Tanaka et al., 2007).

Mesozooplankton and macrozooplankton in the eastern Levant Basin are extremely diverse. In surface waters between Sicily and Cyprus, for example, zooplankton communities are dominated by copepods (Mazzocchi et al., 1997), specifically the small copepods *Clausocalanus furcatus*, *C. paululus, Oithona plumifera*, and *Farranula rostrata* (Siokou-Frangou et al., 1997). In addition to copepods, at least 21 other zooplankton taxa are found in the eastern Levant Basin, including medusae, siphonophores, ctenophores, heteropods, pteropods, molluscan larvae, polychaetes, cladocerans, ostracods, euphausiids, decapod larvae, isopods, amphipods, echinoderm larvae, chaetognaths, appendicularians, pyrosomes, doliolids, salps, and fish eggs and larvae (Mazzocchi et al., 1997).

Nearshore plankton in the eastern Mediterranean, especially prominent macrozooplankton, is characterized by the presence of gelatinous swarms of scyphomedusan jellyfish and ctenophores. Each summer since the mid-1980s, huge swarms of the jellyfish *Rhopilema nomadica* have appeared along the Levant coast (Galil and Zenetos, 2002). Jellyfish swarms now appear year-round with an unwelcome addition of the comb jelly *Mnemiopsis leidyi* (Fuentes et al., 2009), which has invaded the Black Sea via ballast water and caused a massive commercial collapse of its pelagic fisheries. These massive swarms of voracious planktotrophs, some stretching 100 km long, draw nearer to shore, with the potential to adversely affect tourism, fisheries, and coastal installations. *R. nomadic*-dominated swarms are usually poly-specific and commonly include jellyfish of Atlanto-Mediterranean origin such as *Rhizostoma pulmo* and *Aurelia aurita* and the Lessepsian scyphomedusa *Phyllorhiza punctata* (Australian white spotted jellyfish) (Edelist et al., 2011). These macrozooplankton swarms appear to be a coastal-related event, and it is uncertain if these swarms would occur and affect the offshore habitat in the area of the Tamar SW-1 drillsite.

A.2.3.2 Benthic Communities

The benthos refers to animals (benthic fauna) and plants (benthic flora) that are found on the seabed (epifauna), in the seabed (infauna), or near the seabed. Benthic fauna are often sorted according to size into meiobenthos (<1 mm) and macrobenthos (>1 mm). Regional data were derived from available literature and relevant data sources; site-specific information concerning benthic communities that is

considered representative of the Tamar SW-1 study area is summarized from the Karish-1 environmental monitoring study (EMS) (CSA Ocean Sciences Inc., 2013b). The Karish-1 drillsite is located approximately 48 km northeast of the Tamar SW-1 study area, in a similar deepwater area of the Levant Basin.

A videodocumentation survey recently conducted at the Tamar SW-1 study area (CSA Ocean Sciences Inc., 2013a) characterized the seafloor substrates and associated biological communities. The seafloor of the entire survey area was characterized by a smooth, relatively flat soft bottom. Soft bottom substrate was composed of mud and a fine silt veneer that was subject to resuspension from physical disturbance. Seafloor features included subtle variations in surficial topography and bioturbation in the form of mounds, burrows, and motile biota track lines. No consolidated substrates (i.e., hard bottom) or signatures of chemosynthetic communities were observed within the survey area, which verifies the findings of the geohazard surveys (Gardline Surveys Inc., 2012).

Biological activity was a relatively common observance within the Tamar SW-1 study area and was predominantly motile biota and biologically maintained burrows and mounds (CSA Ocean Sciences Inc., 2013a). The most common organisms observed during the video survey were fish and shrimp. The most common fish observed was the tripod fish (*Bathypterois* sp.). Many of the fish observed during the video survey were unidentifiable by video analysis due to their awkward positioning relative to the camera or small body size. Frequency of occurrence for fish and shrimp averaged approximately two and three individuals per 100 m of survey transect, respectively. Bioturbation was commonly observed along all video transects and included patterned burrows (i.e., small groupings) and small (approximately 15 to 30 cm), conical mounds likely formed by deposit-feeding worms (Polychaeta).

Site-specific infaunal data for the Tamar SW-1 drillsite and environs are not available. However, sediment samples collected during the Karish-1 EMS are available to broadly characterize the infauna assemblage(s) of deepwater communities of the southeastern Levant Basin area. Sampling at the Karish-1 site, including 42 infaunal benthic samples, yielded 888 individual and identifiable organisms, which were assigned to 16 taxa and 60 species groups. Infaunal abundance throughout the survey area ranged from 16 to 1,388 individuals per m^2. Crustacea were the most dominant taxa and accounted for over 60% of the total faunal abundance. Polychaete worms comprised 27% of total abundance, of which approximately 14% were specific to *Notomastus* sp. Molluscs accounted for 10% of the total infaunal abundance (CSA Ocean Sciences Inc., 2013b).

Other community parameters were relatively variable among stations and sampling strata at the Karish-1 study area. For all 42 stations sampled, species richness ranged from 2 to 13 species per station. Species diversity was low to moderate based on the Shannon-Weiner Diversity index (H'), ranging from $H' = 2.303$ to $H' = 0.349$. The Shannon-Weiner Diversity Index operates on a scale of 0 (lowest diversity) to 4 (highest diversity), and the value of diversity index increases when the number of species within the sample increases. Evenness, which reflects the equitable distribution of individuals among species, varied significantly between stations, ranging from a low of 0.209 to 1.00. Depths at each station were nearly equivalent and did not affect species distributions. No correlation between sediment texture and species abundances or diversity was observed from the analysis. There were also no correlations between TOC or total metals and species abundances or diversity. These results indicate considerable natural variability in the benthic community present within the Karish-1 study area and suggest that similar benthic community characteristics are present at the Tamar SW-1 location.

Continental Slope and Deep-Sea Habitats

Continental slope and deep-sea habitats in the Mediterranean Sea are characterized by fauna such as eurybathic (i.e., occupying a wide depth range), with very few true deepwater species (Cartes et al., 2004). Deep-sea fauna found in the eastern Levant Basin have historically been considered to be

extremely impoverished in terms of species number, but recent observations from the R/V *Nautilus* survey conducted off the Israeli slope between 5 and 14 September 2010 (Bell and Fuller, 2011) may indicate that deep-sea species diversity in the Levant Basin is not as low as originally thought. The R/V *Nautilus* survey made observations of exposed rock outcrops in water depths exceeding 500 m along the Palmachim disturbance (geological feature offshore of Tel Aviv) south and inshore of the Tamar SW-1 study area. The rock outcrops provide habitat for relatively dense coverage of soft coral, shrimp, and crabs (Bell and Fuller, 2011).

The abyssal basins of the eastern Mediterranean are extremely unusual deep-sea systems. With water temperatures at 4,000 m in excess of 14°C (rather than <4°C for other deep oceanic basins), the entire benthic environment is as hot as the water around a hydrothermal vent system, but lacks the vents' rich chemical energy supply. The Mediterranean also differs from other deep-sea ecosystems in terms of its species composition, notably the absence of the near-ubiquitous deepwater grenadier fish *Coryphaenoides armatus* and the amphipod *Eurythenes gryllus*. Instead, *Acanthephyra eximia*, a deep-sea shrimp species, appears to have functionally replaced *E. gryllus*, the dominant deep-sea scavenging crustacean throughout most of the world's oceans (Christiansen, 1989).

Danovaro et al. (2010) summarized all available information on benthic biodiversity (i.e., prokaryotes, foraminifera, meiofauna, macrofauna, and megafauna) in different deep-sea ecosystems of the Mediterranean Sea (i.e., from 200- to >4,000-m water depths). Results indicate that the deep-sea biodiversity is similarly high for both the eastern and the western basins of the Mediterranean Sea. In general, the biodiversity components decreased with increasing water depth. Quantitative analyses of macrofauna in deep water of the eastern Mediterranean are limited (Tyler, 2005). However, future environmental work planned at the Tamar SW-1 study area will provide quantitative data concerning macroinfaunal species composition and abundance.

Few studies have examined deepwater meiofauna off Israel, but, based on existing evidence, Galil (2004) has characterized these communities as diverse but scarce, consisting of "autochthonous, self-sustaining populations of opportunistic, eurybathic species." Survey results from 1993 revealed a strong dependence of meiofaunal abundance on depth, distance from the coast, and food (labile organic carbon) availability (Tselepides and Lampadariou, 2004). The meiofaunal community was dominated by nematodes, harpacticoid copepods, and polychaetes.

Chemosynthetic Communities

The presence of chemosynthetic benthic communities, driven by the biological oxidation of sedimentary methane (CH_4), has been documented offshore Israel (Coleman and Ballard, 2001). Coleman and Ballard (2001), using side-scan sonar and ROV ground-truthing techniques, discovered gas seeps and associated calcium carbonate substrate south and inshore of the Tamar SW-1 study in a water depth just over 700 m. The acoustic signature appears as small depressions or surficial pockmarks, which have been similarly described in various locations within the eastern Mediterranean (Dimitrov and Woodside, 2003; Bayon et al., 2009). The biological community associated with the pockmark formations was dominated by polychaetes and bivalves.

Mediterranean seeps appear to represent a rich habitat characterized by megafaunal species richness (e.g., gastropods) or the exceptional size of some species such as sponges (e.g., *Rhizaxinella pyrifera*) and crabs (e.g., *Chaceon mediterraneus*). This contrasts with the perceived non-seep characteristics of low macrofaunal and megafaunal abundance and diversity of the deep eastern Mediterranean (Danovaro et al., 2010). Seep communities in the Mediterranean that include endemic chemosynthetic species and associated fauna differ from the other known seep communities in the world both at the species level and by the notable absence of the large size bivalve genera *Calyptogena* or *Bathymodiolus*. The isolation of the Mediterranean seeps from the Atlantic Ocean after the Messinian crisis led to the development of unique communities that are likely to differ in composition and structure from those in the Atlantic.

A.2.3.3 Fish and Other Nekton

The distribution and abundance of nekton of the Levant Basin are determined, to a large extent, by the mesoscale oceanographic features of the Mediterranean Sea. The Mediterranean gets most of its nutrient salts from surface layers of the Central Atlantic, where nutrient levels are moderate. The Atlantic Water that enters the Mediterranean through the Strait of Gibraltar follows the northern coast of Africa, with various branches from circulation eddies on the way to the eastern Mediterranean. On its way through the Mediterranean, seawater becomes not only oligotrophic but also warmer and very salty, hence denser. In the area offshore Israel, this water (known as Mediterranean Surface Water) sinks in a downwelling pattern to the intermediate layer and moves west during the winter. Ultimately, these waters (i.e., Levantine Intermediate Water) flow out of the Mediterranean and into the Atlantic through the lower strata of the Strait of Gibraltar. With this general pattern, the productivity of the sea offshore of Israel is estimated to be even lower than productivity of the rest of the eastern Mediterranean and is termed ultra-oligotrophic.

The Mediterranean has its own specific fauna and flora as a result of its origins and peculiar hydrography. The marine fishes of the eastern Levant have been studied by several authors. A historical account of these studies was developed by Golani (1996). The first general study of the Israeli marine ichthyofauna was by Ben-Tuvia (1953), who later revised this list (Ben-Tuvia, 1971). Another comprehensive study of the ichthyofauna of this region (Golani, 1996) included species from adjacent countries, such as Cyprus, southern Turkey, and Egypt (Golani, 2005).

The Mediterranean Sea as whole supports over 664 fish species (Golani, 2005). These species are variously distributed in relation to hydrography, physiography, and environmental factors over multiple basins and ridges that shape the Mediterranean. A broad pattern within the Mediterranean proper is that the number of species decreases from west to east; in the easternmost Levant Basin offshore Israel, only 350 indigenous species are reported (Golani, 2005). This gradient of richness is thought to be correlated with gradients of increasing temperature and salinity and decreasing productivity. The waters of the Levant Basin are considered oligotrophic (nutrient-starved) and do not support particularly rich fisheries. Another suspected effect of low productivity is that individuals of some species tend to mature at smaller sizes in the eastern Mediterranean than they do in other parts of their range—a phenomenon known as nanism.

The ichthyofauna is generally composed of species with Atlantic (75%) and cosmopolitan (20%) origins. Important additions to this ichthyofauna are the numerous Indo-Pacific species introduced through the Suez Canal. About 60 fish species of Indo-Pacific origin have invaded the Levant region since the Suez Canal opened in 1869. When these invaders are included, the total list of fishes known from the coast of Israel reaches just over 400, from 130 families. This invasion is significant for local ecosystems as well as fisheries because several invaders have become numerically dominant in some habitats.

Fishes found off the coast of Israel may be broadly classified as either demersal (bottom dwelling) or pelagic (water column dwelling). Demersal species can be further subdivided into soft bottom and hard bottom species, depending on the type of substrate particular species associate with. The following characterizations briefly describe the composition of pelagic and demersal fish assemblages found offshore of Israel.

Pelagic Fishes

Pelagic fishes are generally migratory species that usually form schools and traverse shelf waters. Movements may be onshore to offshore, but usually parallel the coastline. Pelagic species found off the Israeli coast are represented by sharks (Carcharhinidae), anchovies (*Engraulis* sp.), herrings (*Sardinella aurita*), jacks (*Trachurus* sp. and *Seriola dumerili*), mackerels (*Scomber japonicus*), tunas

(*Euthynnus* spp., *Auxis* spp.), mullets (Mugilidae), and barracudas (*Sphyraena* spp.). These species generally respond to vertical and horizontal changes in water temperature driven by seasonal weather patterns as well as prey availability. Smaller pelagic fishes such as anchovies, herrings, and some jacks (*Trachurus* spp.) are planktivores. Larger pelagic species including sharks, tunas, mackerels, jacks, and barracudas feed on the smaller pelagic species.

Demersal Fishes

Demersal fishes associate with either soft or hard (structured) bottom types. On a spatial scale of kilometers, fishes on soft bottom segregate into recognizable assemblages along gradients of water depth (Edelist et al., 2011). Characteristics of the sediments also influence the distribution of soft bottom demersal fishes. Offshore of Israel, medium to coarse sand is found from nearshore and across the shelf to about 80-m depths where it changes to mud. In inner shelf water depths (15 to 38 m), the soft bottom assemblage is composed of porgies (*Boops boops*, *Pagellus erythrinus, Lithognathus mormyrus*), lizardfishes (*Saurida undosquamis*), and goatfishes (*Upeneus pori*). In water depths >84 m, hake (*Merluccius merluccius*), sparids (*Dentex macrophthalmus*), snipefishes (*Macroramphosus scolopax*), and goatfishes (*Mullus barbatus*, *Mullus* spp.) are prevalent. Some demersal species such as dragonets (*Callionymus filamentosus*), gurnards (*Lepidotrigla cavillone*, *Trigla* spp.), and flatfishes (*Bothus podas* and *Citharichthys lingulata*) live in direct contact with the substrate, whereas others, including conger eels (*Ariosoma baelericum*), cusk-eels (*Ophidion barbatum*), weavers (*Trachinus draco*), stargazers (*Uranoscopus scaber*), remain buried (or partially buried) in the sediment. These species feed on a variety of invertebrates and small fishes (Edelist et al., 2011).

Limited study reveals that the assemblages of the basin where water depths range from 1,000 to 4,264 m are numerically dominated by a tripodfish (*Bathypterois mediterraneus*) and a grenadier (*Nezumia sclerorhynchus*) (Jones et al., 2003; Galil, 2004). Other fishes included an anglerfish (*Lophius piscatorius*), forkbeards (*Phycis phycis* and *Phycis blennioides*), ghost shark (*Chimera monstrous*), a dragonfish (*Stomias boa*), and several unidentified hatchetfishes (Sternoptychidae), scorpionfishes (Scorpaenidae), gurnards (Triglidae), and flatfishes (Bothidae and Scophthalmidae). Several deep-dwelling shark species such as bluntnose sixgill shark (*Hexanchus griseus*), blackmouth catshark (*Galeus melanostomus*), several gulper shark species (*Centrophorus* spp.), Portuguese dogfish (*Centroscymnus coelolepis*), and velvet belly (*Etmopterus spinax*) were also recorded.

A.2.4 Acoustic Environment

The underwater acoustic environment includes sound produced from a variety of natural and anthropogenic sources. Some natural sounds are biological (e.g., fishes, marine mammals, some invertebrates), while others are environmental (e.g., waves, earthquakes, rain). Among the anthropogenic sources, many produce noise as a byproduct of their normal operations (e.g., shipping, drilling, tidal turbines), whereas others (e.g., sonars, airguns) are produced for specific remote sensing purposes. These sounds combine to give the continuum of noise against which all acoustic receivers have to detect required signals. Ambient noise is generally made up of three constituent types – wideband continuous noise, tonals, and impulsive noise. Ambient noise covers the whole acoustic spectrum from below 1 Hz to well over 100 kHz (Urick, 1983). Above this frequency, the ambient noise level drops below thermal noise levels.

Although there is no specific measurement of ambient noise in the Tamar SW-1 study area, the most likely dominant sources of ambient noise for a location in proximity to one of the busiest sea routes in the world will be industrial noise and distant shipping in the absence of wind and precipitation (**Figure 17**). In addition, the areas affected by different noise contributions likely will vary throughout the year, as acoustic propagation loss varies throughout the seasons.

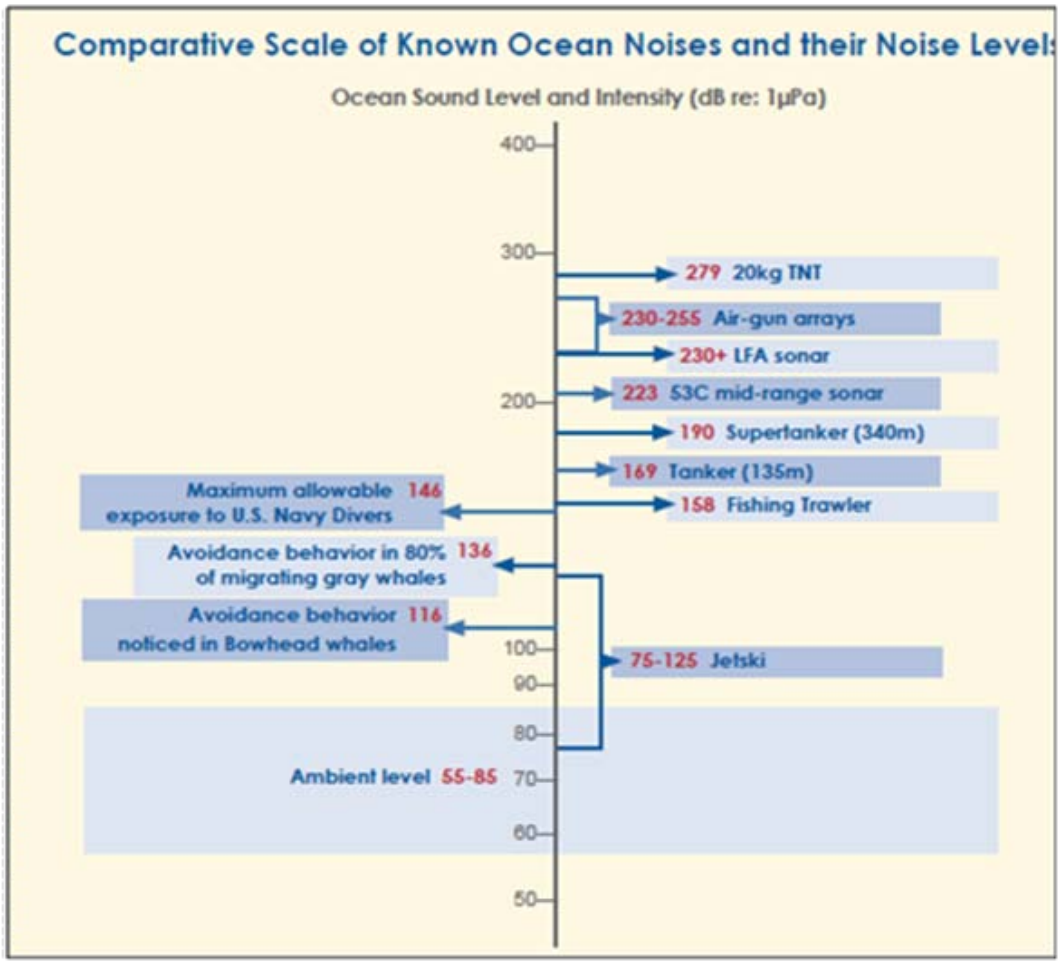

Figure 17. Sound source levels for various offshore anthropogenic noise sources. (LFA = low-frequency active; TNT = trinitrotoluene; From: International Ocean Noise Coalition, 2008.)

Potter et al. (1997) measured ambient noise levels in shallow water (i.e., 4 to 5 m water depths) off Haifa, noting that measurements of ambient noise ranged between 100 and 10,000 Hz. It is clear that the Haifa site exhibited moderate shipping activity. Further, biological sound sources (i.e., snapping shrimp) dominated the spectrum above a few hundred hertz, exceeding anticipated levels by 20 dB or more above 10 kHz (up to the anti-aliasing filter pole at 20 kHz).

Galil (2006) broadly characterized the acoustic environment of the Mediterranean and noted that the eastern Mediterranean region represents one of the busiest sea routes in the world with a number of high volume port facilities and crowded shipping lanes. The opening of the Suez Canal has served to significantly increase the volume of shipping traffic, particularly in the eastern Mediterranean. While shipping noise affects large segments of the world's oceans, noise levels are greatest near well-travelled shipping lanes, straits and canals, and busy ports. According to Galil (2006), the ambient noise in areas of heavy shipping could range between 85 and 95 dB. Supertankers, large bulk carriers, container ships, and cargo vessels produce sound with source levels of approximately 190 dB (Ross, 1976; Richardson et al., 1995; National Research Council [NRC], 2003; **Figure 17**).

Marine Mammals and Noise

The effect of sound on cetaceans in the Mediterranean has received interest of late, although much of the research has been conducted in the northwestern parts of the Mediterranean. The presence of whales in the Mediterranean Sea is well documented, with several cetacean species that may potentially be encountered on a regular basis (i.e., minke whale, *Balaenoptera acutorostrata*; fin whale, *Balaenoptera physalus*; sperm whale, *Physeter macrocephalus*; Cuvier's beaked whale, *Ziphius cavirostris*; short beaked common dolphin, *Delphinus delphis*; striped dolphin, *Stenella coeruleoalba*; false killer whale, *Pseudorca crassidens*; rough-toothed dolphin, *Steno bredanensis*; bottlenose dolphin, *Tursiops truncatus*; Risso's dolphin, *Grampus griseus*; Indo-Pacific humpback dolphin, *Sousa chinensis*). As a result of their presence and because of a perceived threat to Mediterranean marine mammals by anthropogenic factors, Italy, France, and Monaco created a cetacean sanctuary in the Ligurian Sea in 1999.

Current information suggests that anthropogenic noise has the potential to affect cetaceans in a number of ways that reduce fitness at either an individual or population level (e.g., see Simmonds and Dolman, 1999). Noise, either natural or anthropogenic, can adversely affect marine mammals in various ways, including altering behavior, reducing communication ranges or orientation capability, damaging auditory systems (either temporarily or permanently, as in temporary threshold shift [TTS] or permanent threshold shift [PTS]), producing habitat avoidance, or causing mortality (Richardson et al., 1995; NRC, 2003, 2005; Nowacek et al., 2007; Southall et al., 2007). Noise impacts may also be cumulative, or may be exacerbated by other environmental stressors (Evans and Miller, 2004; Wright, 2008; Racca et al., 2011). Determining the biological significance of noise exposure impacts remains challenging (NRC, 2005), although recent advances in quantifying the effects of noise on marine mammals are evident.

Playback studies have shown that most bowhead whales (*Balaena mysticetus*) avoid drilling rig or dredging noise with broadband (20 to 1,000 Hz) received levels around 115 dB. In the case of typical drilling and dredging vessels, such levels occur at 3 to 11 km from the source (Richardson et al., 1990). Tolerance of higher noise levels is evident only under conditions where the migration route requires close approach to the sound projector (Richardson and Greene, 1993, in Perry, 1998). It was demonstrated that spatial distribution of bowhead whales was highly correlated to distance from the drilling rig, indicating that the presence of the rig resulted in a significant temporary loss in available habitat (Schick and Urban, 2000). Gray whales reacted in a similar way when 3,500 individuals responded to playback of an oil platform noise (Malme et al., 1983). Avoidance responses began at broadband received levels of 110 dB, and proportions of animals showing avoidance increased with sound intensities, reaching over 80% at received levels >130 dB.

A.2.5 Archaeology

No site-specific archaeological assessment has been conducted for the Tamar SW-1 study area. Geohazard (Gardline Surveys Inc., 2012) and environmental (CSA Ocean Sciences Inc., 2013a) surveys from the study area did not provide any data signatures indicative of potential archaeological resources. Most known and declared antiquity sites are just off the shoreline at a distance of less than 50 m in relatively shallow waters in depths up to 30 m. Archaeological finds, if any, that may be found beyond the 12-nmi boundary for territorial waters will be addressed under various international conventions, as appropriate.

A.2.6 Air Quality

The primary pollutants involved in the photochemical cycles that determine air quality are nitrogen oxides (NO_x), comprised mainly of nitric oxide (NO) and nitric dioxide (NO_2), and volatile organic compounds (VOCs). Another important group of air pollutants are the oxidants (e.g., ozone [O_3] or peroxyacetal [PAN]), which are byproducts of the aforementioned primary compounds. Air quality measurements in

coastal Israel have shown consistent decline during the last century, with recent improvements evident as a result of more stringent emissions regulations. During recent years, shipping and airport activities (i.e., vessel and aircraft emissions, support operations) have become significant regional sources of air pollution (Maritime Communication Services, Inc. et al., 2008).

Air quality offshore Israel is influenced by long-range transport of air pollutants of both anthropogenic and natural origin. Air pollutants of anthropogenic origin that reach Israeli waters originate mainly upstream of the main flow patterns. These pollutants are emitted from sources located in Eastern Europe, the Black Sea, and the Balkan area as well as the Western Mediterranean, Greece, and Turkey. Desert dust that arises from the Sahara is transported offshore into the Mediterranean mainly during the transient seasons of spring and autumn (Michaelidis et al., 1999). Dust transport offshore Israel is a rather episodic phenomenon. Dust is usually transported from the Sahara northward under anticyclonic conditions or ahead of a trough.

In Israel, anthropogenic sources (stationary and mobile) include the most important industrial installations such as energy production and transportation. Airports and seaports may also represent installations that are significant sources of air pollution. The Israel Ministry of Environmental Protection (formerly the Ministry of the Environment), in cooperation with the Central Bureau of Statistics, has prepared annual estimates of the countrywide quantities of pollutants emitted into the atmosphere from fuel combustion. Air quality monitoring data are available online through MoEP's website. The national air monitoring network overseen by MoEP collects air quality data from more than one hundred monitoring stations, including 23 stations maintained by MoEP and the remaining stations by towns (i.e., members of the Association of Towns for the Environment) and the Israel Electric Corporation (Ministry of the Environment, 2005).

A recent summary prepared by Görlach et al. (2011) indicates several key trends in Israel's onshore air quality, including 1) air pollution has increased dramatically over past few decades, attributed primarily to increases in power generated, industrial output, and the number of cars, all of which are linked to population growth and increased income levels; 2) between 2000-2009, more stringent Israeli air quality regulations resulted in noticeable reductions in pollutant emissions and concentration levels (e.g., lead from gasoline has been virtually eliminated; particulate matter emissions have been almost halved since 2000); and 3) Israel's air pollution problems are exacerbated by several factors, including high population density, particularly along the coastal plain, where most of the traffic, power generation, and industry are located. Urban areas exhibiting the most significant air pollution problems include Tel Aviv metropolitan, Jerusalem, and Haifa, with varying contributions from major emission sources. Tel Aviv and Jerusalem, as significant population centers, are prone to traffic issues and attendant transportation-related emissions, while more industrial locations (e.g., Haifa) exhibit higher industry-related air pollution. Concentrations of $PM_{2.5}$ in five large cities (i.e., Haifa, Hadera, Ashkelon, Ashdod, and Gush Dan metropolitan) were 133% to 151% higher in 2008 than the annual standard set by the MoEP, and up to 193% higher near central transportation routes (Görlach et al., 2011).

There are no publicly available air quality data for the offshore areas of Israel. There are no site-specific offshore air quality measurements available for the Tamar SW-1 study area. Given the relatively remote location of the offshore area of interest and prevailing wind patterns (i.e., predominant westerly winds January through October; variable November and December), air quality offshore likely reflects the long-range transport of natural and anthropogenic air pollutants, with contribution from regional sources. The air quality issues noted onshore have not affected offshore air quality in the Tamar SW-1 study area. In the offshore environment of the eastern Mediterranean where the Tamar SW-1 drillsite is located, approximately 98 km west of the Israeli coastline and urban areas, air quality is expected to be good.

A.2.7 Marine Transportation System and Infrastructure

A.2.7.1 Shipping and Maritime Operations

Figures 18 through **21** are based on data available from the Ministry of Transport (Shipping and Ports Authority) and the Israel Port Authority website. These websites present a summary of information on ship visits and source and destination data for containers passing through both the Port of Haifa and Ashdod Port; data are available for both cargo shipping and passenger traffic. **Figure 18** presents the annual number of ship visits to the ports of Israel from 2000 to 2009. Source and destination data for ship visits are presented in **Figures 19** and **20**. **Figure 21** presents the total amount of cargo transported through the ports of Israel from 1995 to 2008.

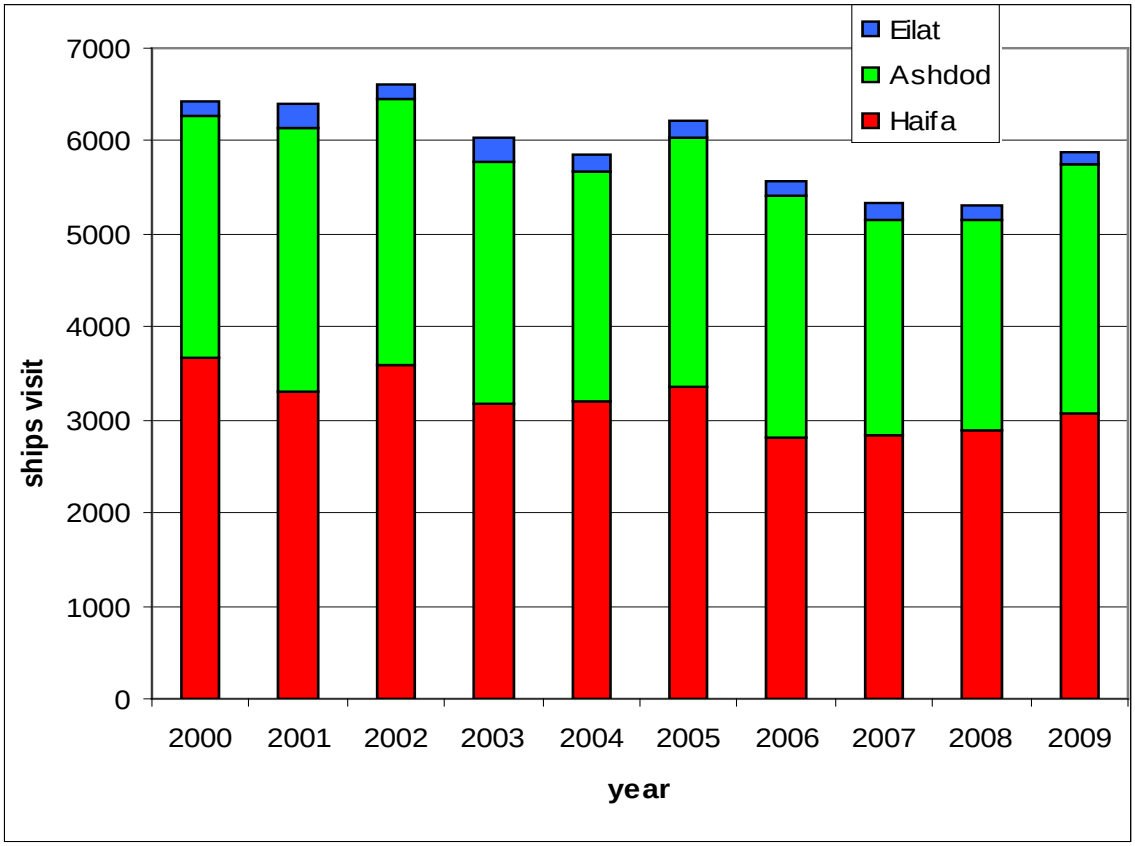

Figure 18. Ship docking at the ports of Israel, 2000–2009 (From: Ministry of Transport and Road Safety, Shipping and Ports Authority, 2009).

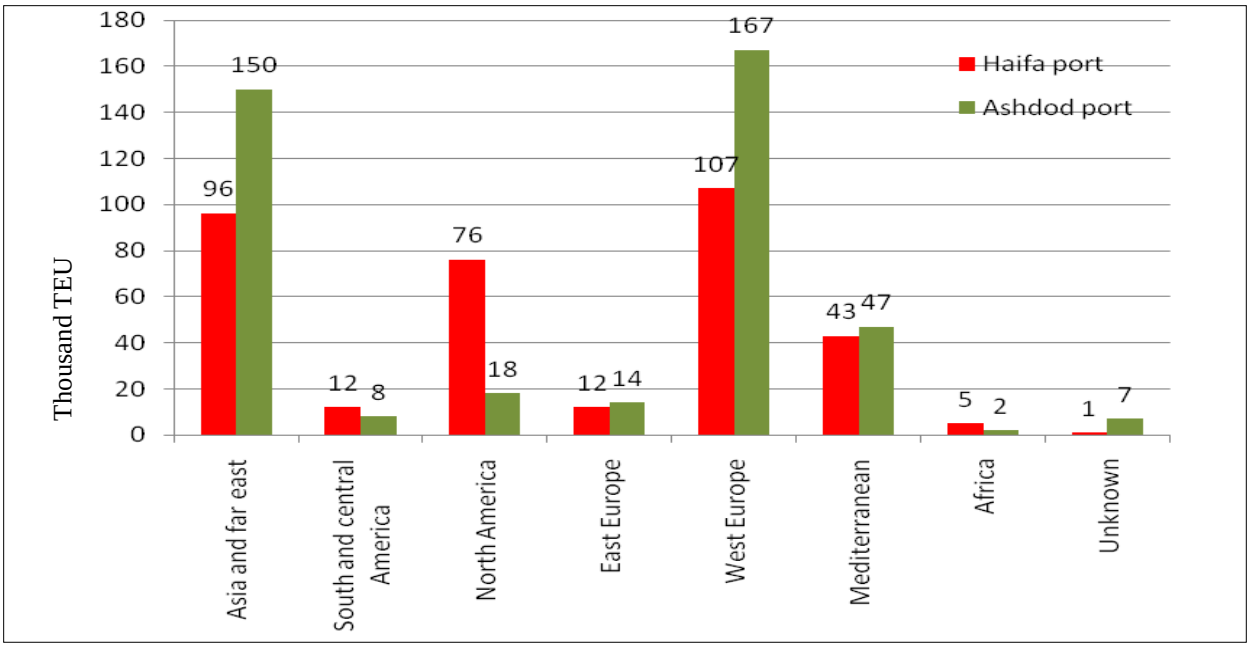

Figure 19. Sources of shipping containers arriving at the main ports of Israel (in thousand 20-ft equivalent units [TEU]) (From: Israel Ports Authority, 2011).

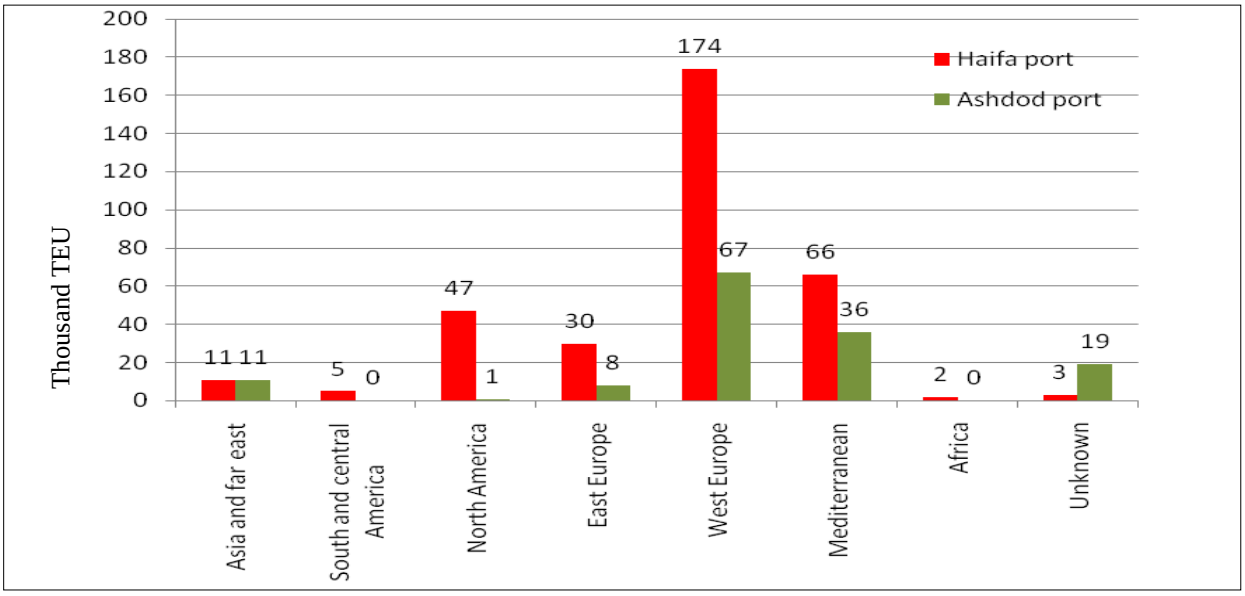

Figure 20. Destination of shipping containers from main ports of Israel (in thousand 20-ft equivalent units [TEU]) (From: Israel Ports Authority, 2011).

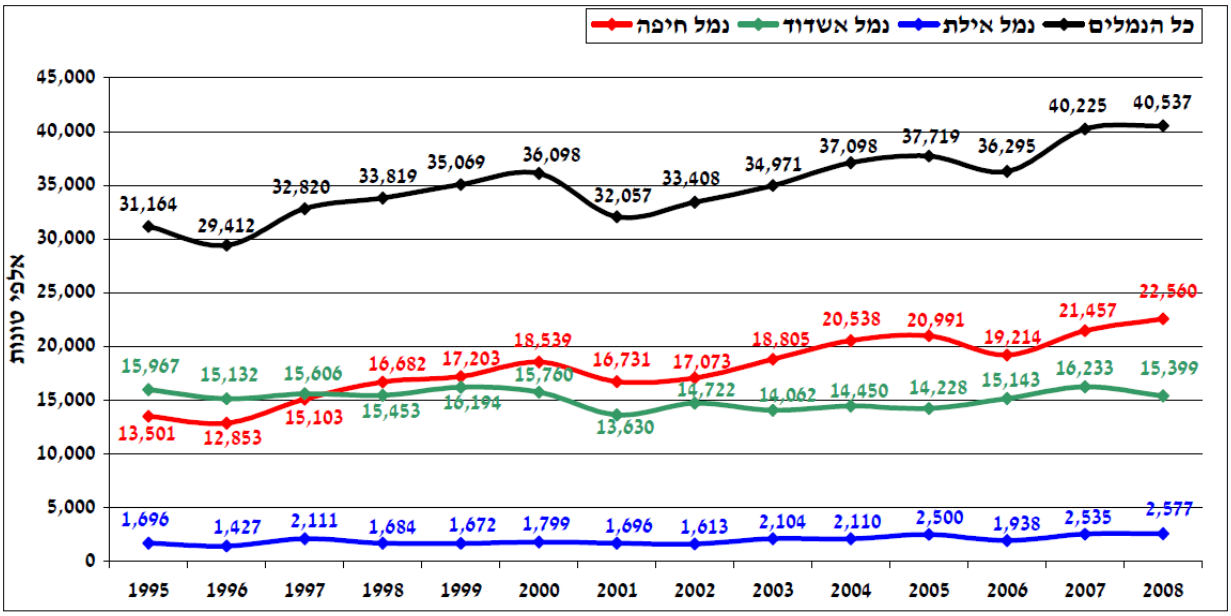

Figure 21. Cargo volumes passing through Israeli commercial ports, 1995–2008 (From: Ministry of Transport and Road Safety, Shipping and Ports Authority, 2009). (Blue = Port of Eilat, green = Ashdod Port, red = Port of Haifa, and black = Total.)

In 2010, the movement of containers at the Port of Haifa, Ashdod Port, and Port of Eilat amounted to approximately 2.281 million containers, in thousand 20-ft equivalent units (TEU), compared to 2.032 million TEU in the same period in 2009, an increase of 12.3% in container traffic. During this period, container traffic increased by 11.5% through the Port of Haifa and 13.9% through the Port of Eilat. Total freight (in tons) at the Port of Haifa, Ashdod Port, Port of Eilat, and at Israel Shipyards (Haifa) in 2010 amounted to approximately 43.3 million tons, compared to about 37 million tons in 2009, an increase of about 20.5% (Israel Ports Authority, 2011).

The Port of Haifa

The Port of Haifa is Israel's largest port. The port contains a broad variety of facilities that allow for the shipping and transportation of all types of cargo as well as docking facilities for large passenger liners; it also is the location for Noble Energy's onshore supply base, located at Israel Shipyards Ltd. The Port of Haifa handled a variety of cargo products in 2011, including local containers (8.19 million tons; 37%), transshipment containers (5.658 million tons; 26%), oil (2.815 million tons; 13%), bulk grain (2.680 million tons; 12%), bulk in grabs (1.412 million tons; 6%), and liquid chemicals (1.084 million tons; 5%) (Port of Haifa, 2012).

The port is operated by the Haifa Port Company, a Government-owned company that is committed to the advancement of Israel's economy and growth. The Haifa Port Company reportedly handled approximately 16 million tons of cargo during 2011, including 1.24 million TEUs of container traffic. Several smaller terminal operators in the port handled another 7 tons, including the Israel Shipyards Port and specialized bulk handlers Dagon Grain Terminal and the Petroleum and Energy Infrastructures oil terminal. During the period 2001 to 2011, ship traffic at the Port of Haifa ranged between 2,602 and 3,066 voyages per year; average annual ship traffic was 2,796 voyages (Port of Haifa, 2012).

Shipping Lanes

Numerous shipping lanes cross Israel's territorial waters, including shipping lanes from the ports of Israel to destinations in southern Europe, Cyprus, and North Africa, and routes between Alexandria and Port Said in Egypt to destinations in Lebanon and Syria. Shipping fairways relative to the Tamar SW-1 drillsite are shown in **Figures 2** and **3**.

Telecommunications

The telecommunication system in Israel is the most developed system in the region. It is based mainly on two sea-based cables operated by Med Nautilus: MED1 and LEV. A Med Nautilus submarine telecommunications cable oriented perpendicular to the Israeli shore is located less than 2,000 m north of the proposed Tamar SW-1 drillsite, as shown in **Figures 2** and **4**. The general locations of the Med Nautilus cables are shown in **Figure 22**. In addition, a number of Israeli firms (Bezeq International, Tamres) have installed two additional fiber optic cables. Any new offshore oil and gas installations planned for offshore Israel will need to consider the presence of the various telecommunication cables.

Figure 22. Map of telecommunication cables connecting Israel (From: http://www.mednautilus.com).

CHAPTER B: REASONS FOR PREFERENCE OF THE LOCATION OF THE PROPOSED PLAN AND POSSIBLE ALTERNATIVES

B.1 OVERVIEW AND APPLICATION RATIONALE

Noble Energy proposes completion of an exploratory drilling program at the Tamar SW-1 well. The Tamar SW-1 drillsite was selected based on the interpretation of seismic and geophysical survey data acquired in the Tamar License, as well as results from previous exploratory wells completed in the region and drilled into similar geological formations. Details regarding the selection of the Tamar SW-1 drillsite location and other complimentary considerations (e.g., environmental, planning, engineering, economics) are outlined in the following text. The primary source of information used in the completion of this chapter was Noble Energy's Geological Well Plan.

B.2 PROPOSED EXPLORATORY PROGRAM

The proposed location and trajectory of the Tamar SW-1 exploration well were selected and the well drilling program was designed to minimize the risk of encountering the following shallow hazards:

- Seafloor instability: The proposed well is in a relatively flat location that is at least 600 m from any seafloor channel or fault scarp;
- Shallow faulting: The location of the proposed well avoids all areas of supra-salt thrust faulting and vertical faulting; and
- Anomalies within salt: The proposed well is expected to intersect clastic interbeds where there is minimal deformation.

Casing and drilling program engineering were also considered in the proposed exploratory program. Specifically, the 20-in. casing shoe was planned to be set in a clean halite interval that is free of clastic interbeds. In addition, the well location was selected within an area of undulating seabed. The location was chosen to avoid high dip magnitudes of the seafloor and small faults in the area.

Potential environmental sensitivities and existing infrastructure were also considered by Noble Energy during selection of the Tamar SW-1 drillsite location. Gardline Surveys Inc. (2012) performed an assessment of geohazards of the proposed drillsite and surrounding areas based on 3-D seismic data for the drillsite location. The drillsite is located at a water depth of 1,648 m, previously shown in **Figure 1**. The seabed at the location is smooth and featureless, and slopes $<1.0^{o}$ to the northeast. There are no significant features within 500 m of the proposed well location. There are no high seabed amplitudes indicative of any fluid within 500 m of the proposed well location. The seabed sediments are believed to be composed of silts and clays, which become firmer with increasing water depth. Known regional infrastructure proximal to the Tamar SW-1 drillsite (see **Chapter A.1.3** and **Figure 2**) includes 1) a Med Nautilus communication cable, approximately 2 km from the drillsite and 2) the Tamar subsea wells and flowlines, located 10 km to the northeast of Tamar SW-1.

In summary, only one area was considered in the selection of the Tamar SW-1 drillsite. Within this broader area, the Tamar SW-1 drillsite was selected with respect to water bottom, shallow subsurface intervals of possible concern, and the optimal penetration point of the gas reservoir. An enlarged area encompassing Tamar SW-1 was studied to define the original drillsite location, from which a location was set outside of potential gas hazards. The Tamar SW-1 drillsite was chosen to avoid active seafloor channels, shallow faulting, and potential shallow gas hazards associated with amplitude anomalies and low angle slump escarpments or other seafloor topographic elements. The final location for the Tamar

SW-1 drillsite was adjusted, additionally, to avoid deeper faults proximal to the original wellbore. The choice of location for Tamar SW-1 thus effectively avoids intersection with small faults in the shallow, post-salt section and allows for the setting of two successive casing points in relatively clean salt that is expected to be clean of clastic interbeds. With the close attention to the water bottom and incorporation of improved seismic resolution and interpretation of the shallow subsurface, the safety, environmental and drilling risks at the proposed Tamar SW-1 drillsite location have been minimized.

B.3 STRUCTURE ANALYSIS AND TARGET STRATA

Noble Energy has described the geological structure and formation depths, and developed a formation prognosis as part of its geological well plan (Noble Energy, 2012a). The Pliocene-Pleistocene through Upper Oligocene section is expected to be similar to the section penetrated in the Tamar wells.

Several other wells have been drilled in the basin, including:

- Hannah-1, a Noble Energy (Samedan) operated well, was drilled in 2003 to a depth of 4,304 m Measured Depth Below Rotary Table (MDBRT) and was abandoned as a dry hole;
- Dalit-1, a Noble Energy operated well was drilled in 2009 to a depth of 3,658 m MDBRT and has been suspended as a gas discovery;
- Tamar-1, a Noble Energy operated wildcat well for Tamar Field, drilled in 2008-2009 to a total depth of 4,900 m measured depth (MD) and has been completed as a gas discovery;
- Tamar-2, a Noble Energy operated appraisal well for Tamar Field, located 5,500 m northeast of Tamar-1, drilled in 2009 to a total depth of 5,145 m MD, and has been suspended as a gas discovery; and
- Leviathan-1, a Noble Energy operated exploration well that found gas in sands that appear to be age-equivalent to the Tamar pay sands; this well was suspended at 6,517 m MDBRT.

The Tamar SW-1 area (field) is based on interpreted seismic features, which have been proved by the drilling of wells in the Tamar (i.e., Tamar-1, Tamar-2) and the Leviathan Fields (i.e., Leviathan-1). Tamar SW-1 is an exploration well in an untested structure near gas discoveries that exhibit similar geological features. Wells that have been drilled along, or near to, the Israeli coast are in a different geological setting. As a consequence, reference to nearshore geologic structure is inappropriate in this context.

The reservoir formation is of Early Miocene to possible latest Oligocene in age, deposited as turbidity current flows from paleo-Nile sources, with possible clastic input from the Lebanon uplift, although redistribution of sediments from local canyons cannot be ruled out. A late Oligocene age for the basal unit has yet to be determined.

The Tamar SW-1 well will target an expected gas reservoir based on previous drilling results in the Tamar Field and the similarities in geologic structure evident at the proposed drillsite. The Tamar-equivalent reservoir has sand units which are expected to continue across the field. These sands have been established in Tamar-1, 2, and 3.

The sands are separated by intraformational claystones and marls sealed by a thick interval of limestone, marls and claystone overlying the reservoir, which is in turn overlain by the Messinian salt. This well was intended to be a low-risk project designed to find gas and test for the upside volumes in the Tamar SW-1 prospect (Noble Energy, 2012a).

The predicted reservoir parameters are based upon the reservoir quality determined at the Tamar-1 wellsite. Key reservoir parameters include:

- Gross Thickness: Thickly interbedded sandstone and claystones;
- Hydrocarbon Type/Target: Gas;
- Lithology: Sandstone;
- Expected Quality: 25% mean porosity, estimated 100 m D to 2D permeability; and
- Expected Pressure: Recent work carried out by Noble Energy, based on results of Tamar-1, indicates that pressure at top reservoir is expected to be 10.2 +/- 0.3 ppg EMW.

B.4 POTENTIAL FOR FUTURE PRODUCTION

The potential for future production will be dependent upon results of the exploratory well drilling and well testing. In the event commercial quantities of natural gas are encountered, Noble Energy will conduct further analyses of costs associated with well (or field) development and transport of produced hydrocarbons to market.

CHAPTER C: PROJECT DESCRIPTION

C.1 DRILLING PLAN OVERVIEW

Noble Energy proposed the drilling of a single exploratory well at the Tamar SW-1 drillsite. Drilling is planned to a depth of approximately 3,634 m below the sediment surface (i.e., the mudline) in a water depth of 1,648 m. The primary purpose of the drilling is to assess the formation for the presence of natural gas. A total of five sections will be drilled – 36 inch (in.), 26 in., 17-1/2 in., 14-3/4 in., and 10-5/8 in. – using a water-based drilling mud (WBM). A portion of the 10-5/8 in. section will be drilled at 12-1/4 in. as a bypass hole through pay sand. Details of the drilling plan and program are outlined in the following text.

C.2 DESCRIPTION OF THE DRILLING PLAN

C.2.1 Drilling Rig and Support Vessels

Noble Energy will utilize the *ENSCO 5006* (**Photo 1**), a Det Norske Veritas (DNV)-classified Maltese Cross 1A1 column stabilized drilling unit (i.e., a semi-submersible drilling rig), to drill the Tamar SW-1 exploratory well. The *ENSCO 5006* is owned by Ensco PLC. The drilling rig will be mobilized from Cyprus Block 12. Because the *ENSCO 5006* has been operating in the eastern Mediterranean for an extended period, there is no need to clean the rig of biofouling organisms prior to departure from Cyprus.

Photo 1. *ENSCO 5006*.

The *ENSCO 5006* will be towed to the Tamar SW-1 drillsite and will be assisted in positioning the drilling rig over the drillsite by two Tidewater Inc. anchor handling towing supply (AHTS) vessels – the *Richard M. Currence* (**Photo 2**) and *John P Laborde*. The *Richard M. Currence* and *John P Laborde* are each rated at 24,000 brake horsepower (bhp); each vessel is 85.4 m long and 21 m wide, with each vessel displacing approximately 3,000 tons.

Photo 2. M/V *John P Laborde*.

Supply vessel support will be provided by several vessels, including the M/V *EAS* and/or M/V *Leon*. The M/V *EAS*, a dynamic positioning AHTS measuring 61.8 m in length, is owned by Sea Whale Shipping Ltd.; the M/V *Leon*, a swift crew and supply boat measuring 51 m in length, is owned by Mahita Sea Shipping Ltd. Both vessels are operated by EDT Ship Management Ltd. out of the port of Haifa.

Helicopter support will be provided by a Bell 412SP owned by PHI, Inc. and operated by LAHAK out of Haifa Airport. Specifications for the project vessels – the *ENSCO 5006*, *Richard M. Currence*, *John P Laborde*, *EAS*, and *Leon* – and aircraft are provided in **Appendix D**.

C.2.2 Drilling Program

The Tamar SW-1 well drilling program will be completed in several key stages (Noble Energy, 2012b,c), including the following:

- Placement of the *ENSCO 5006* drilling rig at the Tamar SW-1 drillsite using AHTS vessels and seafloor anchors.
- Installation via jetting (drive pipe) of a 36-in. pipe of approximately 70 m in length (1,742 m total vertical depth [TVD]). Drilling in this well section will be completed using seawater and high viscosity sweeps to carry cuttings out; high viscosity sweeps will be composed of bentonite and guar gum.
- Drilling at a diameter of 26 in. over a length of approximately 1,200 m (~2,900 m TVD). Drilling in this well section will be completed using seawater and high viscosity sweeps; drilling of the last 150 m will occur using saturated NaCl brine.
- Installation of a 20-in. diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Installation of a blowout preventer (BOP) and a riser from the wellbore to the drilling rig, enabling repeated use of drilling mud. All well control equipment will be tested during this phase.
- Drilling at a diameter of 17-1/2 in. over a length of approximately 600 m (~3,522 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of a salt saturated WBM system.
- Installation of a 13-5/8 in.-diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Drilling at a diameter of 12-1/4 in. x 14-3/4 in. over a length of approximately 1,000 m (~4,565 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of an inhibited WBM system.
- Running formation evaluation logs, samples, and pressures.
- Installation of an 11-7/8 in.-diameter protective pipe and insertion of concrete into the space between the bore and the protective pipe.
- Drilling of a 10-5/8 in.-diameter pilot hole over a length of approximately 735 m to complete the hole (~5,300 m TVD). Drilling in this well section will be completed using a NaCl/KCl/Polymer as part of an inhibited WBM system, similar to that used in the previous well section.
- Running formation evaluation logs, samples, and pressures, then plugging back the wellbore and bypassing at ~4,600 m TVD.
- Drilling 10-5/8 x 12-1/4 in. bypass hole 10 m into pay sand.
- Running and cementing 9-7/8 in. x 9-5/8 in. x 10-3/4 in. production casing.
- Temporarily abandoning the well and demobilizing the drilling rig.

The wellbore schematic for the Tamar SW-1 well is shown in **Figure 23**. The timeline for drilling is shown in **Figure 24**. Note that actual drilling is a relatively short term operation, with running and setting pipe and formation evaluation comprising a significant portion of the total drilling period. Noble Energy expects to spud the Tamar SW-1 well in late September 2013.

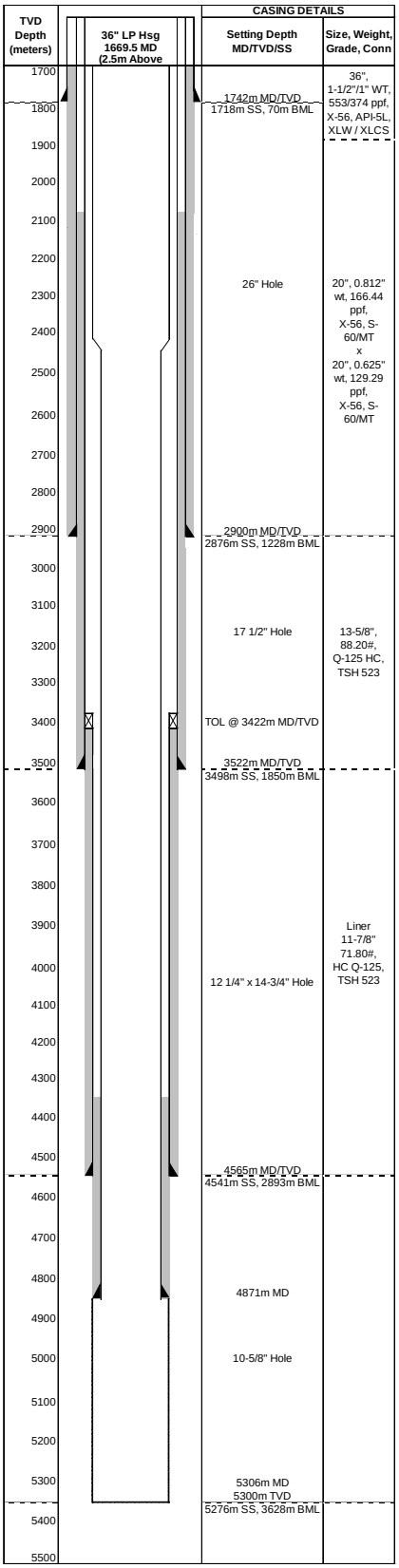

Figure 23. Tamar SW-1 wellbore schematic (From: Noble Energy, 2012b).

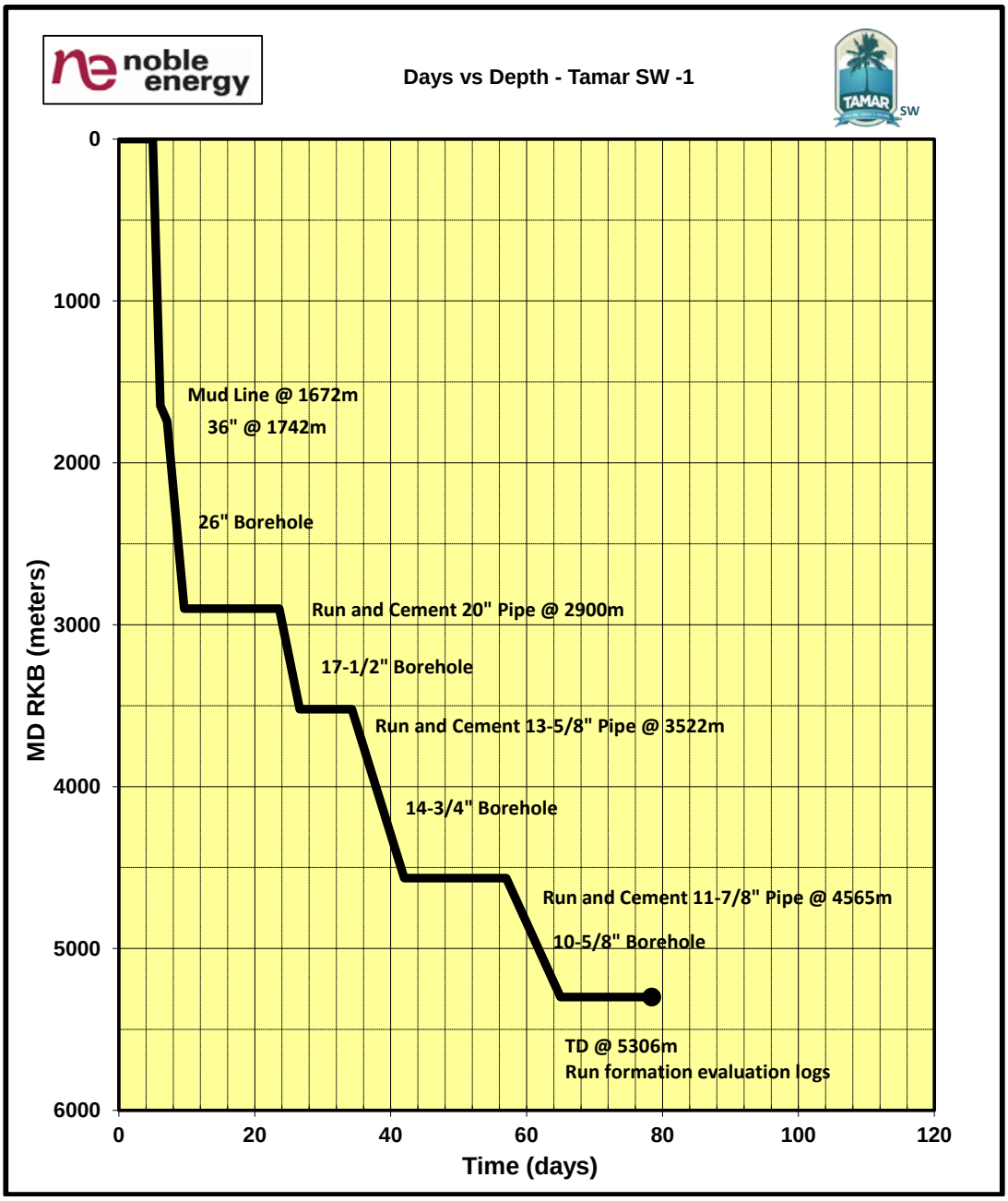

Figure 24. Timeline (i.e., days vs. depth) for drilling of the Tamar SW-1 well (From: Noble Energy, 2012b).

C.2.2.1 Drilling Discharges

Overview: Drilling discharges will include both used drilling muds and drill cuttings, as well as cement. Noble Energy will be using a WBM and several additives to facilitate drilling and maintain well control. During the initial well sections (36 and 26 in.), there will be no surface returns; muds and cuttings will exit at the borehole, settling near the drillsite and dispersing in the lower portions of the water column. Similarly, with the completion of each hole section, cementing will occur. Excess cement will exit at the borehole between the casing and the formation.

Once the riser has been set, surface returns will commence (i.e., with drilling of the 17-1/2 in. section), allowing for processing of used muds aboard the drilling rig and, as necessary, the discharge of used muds and cuttings from the drilling rig. With surface returns, WBM will be processed on board the drilling rig, passing through screens and shakers to remove cuttings. WBM will be monitored and additives used, as needed. The type and volume of mud additives is determined primarily by the current state of the drilling mud and existing or anticipated downhole conditions.

Cuttings, once removed from the muds and cuttings stream, will be discharged overboard. Drill cuttings are comprised of formation solids (i.e., bits of rock from the formation). Clay-sized cuttings are more difficult than larger cuttings to separate from drilling mud. A typical cuttings discharge during drilling with WBM usually contains 5% to 25% drilling fluid solids after passage through the solids control equipment on the drilling rig (Neff, 2005).

Materials To Be Used During Drilling: Noble Energy (2012b) expects to use a total of 26,000 bbl of WBM and 27,600 bbl of brine during the drilling of the Tamar SW-1 well. Specific products, their function, packaging parameters, and the estimated weight of WBM drilling-related materials to be used are outlined in **Table 4**. Material Safety Data Sheets (MSDS) for drilling-related materials are provided as **Appendix E**. By weight, the predominant products used during drilling are barite and NaCl (brine).

Table 4. WBM total material consumption, Tamar SW-1 well (From: Noble Energy, 2012b).

Product	Function	Total Weight		Packaging
		(lbs)	(tons)	
NaCl	Inhibition/weight	3,772,694	1,711.7	Metric ton
KCl	Inhibition/weight	415,657	188.6	Metric ton
Soda ash	Calcium treatment	25,715	11.7	Sx
Sodium bicarbonate	Calcium treatment	5,110	2.3	Sx
Caustic soda	pH control	10,314	4.7	Sx
Citric acid	Alkalinity control	3,868	1.8	Sx
Barite	Weighting agent	3,746,808	1,700.0	Metric ton
Bentonite	Viscosifier	328,396	149.0	Metric ton
Guar gum	Viscosifier	9,900	4.5	Sx
DEXTRID E	Filtration control	7,636	3.5	Sx
BARAZAN D	Viscosifier	32,121	14.6	Sx
PAC LE	Filtration control	18,584	8.4	Sx
PAC RE	Filtration control	5,119	2.3	Sx
PAC ULV	Filtration control	31,716	14.4	Sx
BARA-DEFOAM W300	Defoamer	1,741	0.8	5-gal. can
STARCIDE	Biocide	2,140	1.0	5-gal. can
GEM GP @ 4.5% v/v	Inhibition	128,317	58.2	1,000 kg IBC
CLAYSEAL PLUS	Inhibition	89,481	40.6	275 gal. IBC
BARACARB 5	Bridging agent	81,682	37.1	1,000 kg big bags
BARACARB 25	Bridging agent	260,264	118.1	1,000 kg big bags
BDF-467	Inhibition	8,442	3.8	--
NaBr	Inhibition/weight	354,000	160.6	--
C-250	Corrosion inhibitor	6,664	3.0	--
OS 8	Oxygen scavenger	450	0.2	--

Noble Energy has also identified a series of mud additives which may be used to maintain well control and address specific issues or drilling problems (Noble Energy, 2012b). These contingency products are identified in **Table 5**. Volumes used will be on an "as needed" basis.

Table 5. Listing of contingency products that may be employed during drilling of the Tamar SW-1 well (From: Noble Energy, 2012b).

Product	Function
BARACARB 5, 25, 50, 150, 600, 1200 (Sx)	Bridging agent
BAROFIBRE S/F, R (Sx); BAROFIBRE C (Sx); DIAMOND SEAL; STOPFRAC-D; HYDRO-PLUG; STEELSEAL 100; NUTPLUG-F, M, C (Sx) (equivalent to NUT SHELL; Mica - F, M, C (Sx);	Lost circulation material
AQUAGEL GOLD SEAL	Viscosifier
BARACORE 95; lime	pH control
PAC-L	Filtration control
EZ-MUD; Clay Sync II	Inhibition
OXYGON	Oxygen scavenger
QUIK-FREE; EZ SPOT	Pipe release agent
QUIK-THIN PLUS (Sx)	Thinner

F, M, C = fine, medium, coarse; S/F = super fine; R = regular.

Well Spudding/No Surface Returns: The weights of the individual products to be used during the initial stages of drilling (i.e., with no surface returns) and subsequently discharged at the wellbore are summarized in **Table 6**. The total amount of drilling-related material to be discharged prior to riser installation is estimated to include 18,000 bbl (2,861.8 m^3) of drilling mud and 25,600 bbl of brine.

Table 6. Estimated weights of drilling mud additives, Tamar SW-1 well (From: Noble Energy, 2012b).

Product	Function	Total Weight (lbs)	Total Weight (tons)
NaCl	Salinity control	2,816,000	1,277.7
Soda ash	Calcium reducer	12,595	5.7
Caustic soda	Alkalinity/pH control	3,795	1.7
Bentonite	Viscosifier	328,396	149.0
Guar gum	Stabilizing agent	9,900	4.5
BARAZAN D	Fluid loss control	11,770	5.3
PAC RE	Fluid loss control	1,025	0.5
PAC LE	Fluid loss control	3,818	1.7
Barite	Weighting agent	2,207,400	1,001.5
BARA-DEFOAM W300	Defoamer	596	0.3
DEXTRID E	Filtration control	7,636	3.5
STARCIDE	Biocide	764	0.3

Surface Discharge of Drilling Muds: The concentrations and amounts of WBM discharges, including various mud additives, to be discharged at the end of well drilling are detailed in **Table 7**. These discharges will occur 14 m below the water line at a rate of <1,000 bbl per hour. The total amount of drilling mud to be discharged from the rig at the completion of drilling is estimated to be 7,400 bbl (1,176.5 m^3).

Table 7. WBM discharges from the drilling rig, Tamar SW-1 well (From: Noble Energy, 2012b).

Product	Composition and Function	Concentration (lb/bbl)	Total Weight	
			(lbs)	(tons)
NaCl	NaCl (sodium salt); Inhibition/Weight	75.0	555,000	251.8
KCl	KCl (potassium salt); Inhibition/Weight	35.0	259,000	117.5
Soda ash	Na_2CO_3; Calcium Treatment	0.5	3,700	1.7
Sodium bicarbonate	$NaHCO_3$; Calcium Treatment	0.3	2,220	1.0
Caustic soda	NaOH; pH Control	0.3	2,220	1.0
Citric acid	$C_6H_8O_7$; Alkalinity Control	0.3	1,850	0.8
Barite	Barium Sulfate $BaSO_4$; Weighting Agent	140.0	1,036,000	470.1
BARAZAN D	Xanthan gum; Viscosifier	2.0	14,800	6.7
PAC LE	Polysaccharide; Filtration Control	3.0	22,200	10.1
PAC RE	Polysaccharide;Filtration Control	0.4	2,960	1.3
PAC ULV	Polysaccharide; Filtration Control	3.0	22,200	10.1
BARA-DEFOAM W300	Petroleum distillate, Soybean oil; Defoamer	0.2	1,480	0.7
STARCIDE	N, N' -Methylene bis (5-methyl oxazolidine); Biocide	0.2	1,480	0.7
GEM GP @ 4.5% v/v	Polyalkylene glycol; Inhibition	10.5	77,700	35.3
CLAYSEAL PLUS	Ethoxylated polyamine; Inhibition	7.0	51,800	23.5
BARACARB 5	Calcium Carbonate; Bridging Agent	7.5	55,500	25.2
BARACARB 25	Calcium Carbonate; Bridging Agent	66.2	489,880	222.3
BDF-467	Anionic Polymer; Flocculent	1.0	7,400	3.4

Cuttings Discharges: Estimated cuttings discharge volumes, by hole section, are outlined in **Table 8**. A total of 5,454 bbl of cuttings weighing 2,180 tons will be released during drilling; this estimate includes varying percentages for wash out factors, by hole section. Cuttings from the 36-in. and 26-in. sections will be released from the borehole, while cuttings from the remaining sections will be released from the drilling rig on a continuous basis while drilling. Cuttings and drilling fluids released from the drilling rig will be discharged through a 14-in. x 16-in. x 18-in. line 14 m below sea level.

Table 8. Cuttings volumes and weights, by section, for the Tamar SW-1 well (From: Noble Energy, 2012b).

Hole Size	Interval (MD)	Cuttings Volume with Wash Out Factor (bbl)	Wash Out Factor (%)	Cuttings Volume (m^3)	Cuttings Weight (tons)
36 in. (Drive Pipe)	1,672-1,742 m (70 m)	290	0	47	124.6
26 in.	1,742-2,915m (1,173 m) (with 15 m rathole)	3,160	25	503	1,257.5
17-1/2 in.	2,915-3,537m (622 m) (with 15 m rathole)	730	20	117	257.4
14-3/4-in.	3,537-4,565 m (1,028 m)	820	15	131	347.2
10-5/8-in.	4,565-5,306 m (741 m)	293	10	47	124.6
12-1/4-in.	4,565-4,871 m (306 m)	161	10	26	68.9
Total		5,454	--	871	2,180

C.2.2.2 Drilling Discharge Fate

Two sets of drilling muds and cuttings releases or discharges are expected: 1) the seafloor releases of cuttings, water-based drilling fluids, and excess cement slurry during jetting of the 36-in. section and drilling of the 26-in. section; and 2) surface (i.e., drilling rig) discharges of cuttings and minor amounts of adhering WBM from lower well sections. Impacts on the marine environment from these releases or discharges may arise from 1) localized increases in turbidity within the water column; 2) changes in grain size on the seafloor; and 3) burial and subsequent hypoxia or anoxia from drilling muds and cuttings deposition on the seafloor. The following discussion outlines the generalized fate of seafloor releases and surface discharges of muds and cuttings. Subsequent discussions address the chemical composition of drilling muds and cuttings and the predicted deposition of muds and cuttings from a representative well in the eastern Mediterranean. Testing of drilling muds and associated chemicals are also outlined in this chapter.

Seafloor Releases: During the first well interval when the hole is being jetted into the seafloor and during drilling of the second well interval, cuttings and "spud mud" will be released at the seafloor. These initial discharges will create a mound with a diameter of several meters to tens of meters around the wellbore.

Also, during setting of the casing, cement slurry will be pumped into each well to bond the casing to the walls of the hole. Excess cement slurry will emerge from the hole and accumulate on the seafloor, generally within about 10 to 15 m around each wellbore (Shinn et al., 1989). Cement slurry components typically include cement mix and some of the same chemicals used in water-based drilling fluids (Boehm et al., 2001). Additional discussion of cementing is presented in **Chapter C.2.4** (**Concretization**).

Surface Discharges of Muds and Cuttings: When cuttings and WBM are discharged to the ocean, the larger particles and flocculated solids, representing about 90% of the mass of mud solids, form a plume that settles quickly to the bottom. The remaining 10% of the mass of the mud solids – consisting of fine-grained unflocculated clay-sized particles and a portion of the soluble components of the mud – form another plume in the upper water column that drifts with prevailing currents away from the drilling rig and is diluted rapidly in the receiving waters (Neff, 2005).

After the first two well intervals are completed, the marine riser will be set, allowing muds and cuttings to be returned to the drilling rig where they will be processed through solids control equipment. Drilled cuttings are separated from drilling mud through the use of a shale shaker, though some mud still adheres to the cuttings. Shale shakers contain vibrating screens through which mud passes as it circulates out of the hole, while cuttings continue off the end of the screen. Once cuttings are separated, they are discharged overboard, whereas muds will be returned to the mud tanks, amended (as necessary), and recirculated into the hole until their properties become degraded and they must also be discharged. A bulk discharge of water-based drilling fluids will be discharged overboard upon completion of the well.

Cuttings will be released almost continuously from the drilling rig during drilling of the lower well sections (i.e., 17-1/2, 14-3/4, 10-5/8, and 12-1/4 in. sections). Cuttings typically are coarse particles that settle rapidly to the seafloor near the discharge point, primarily within a few hundred meters. A layer of fine particles (primarily drilling muds) will be dispersed and deposited over a much broader area (Boothe and Presley, 1989). Due to the currents in the area and the water depth, it is likely that muds will be widely dispersed and only the coarse cuttings will settle near the drillsite. Due to the distance from shore, no drilling muds or cuttings will reach coastal waters.

Drilling Mud Composition and Fate: Barite (barium sulfate) is a major insoluble component of drilling fluid discharges (see **Table 4**), and therefore barium concentrations will increase in bottom sediments around the drillsite. However, barium is toxicologically inert and therefore is not a threat to the viability of living organisms in the affected area. Concentrations of other metals in drilling fluids are similar to those in marine sediments, but some metals such as cadmium, copper, lead, mercury, and zinc may be elevated within a few hundred meters of the drillsite (Boothe and Presley, 1989). However, metals in drilling fluids show very low bioavailability to marine animals and do not pose a risk to benthic organisms or their predators (Neff et al., 1989a,b).

According to Neff (2008), only a small percentage of the metals in WBM are in readily exchangeable forms, with the exception of chromium, which may be present as soluble chrome lignosulfonate clay deflocculant. Consequently, toxicity or bioaccumulation is generally not a concern with regards to WBM and their associated releases or discharges. Burial and the potential for changes in sediment oxygen concentration are the primary impact agents associated with WBM and cuttings deposition.

Benthic communities within a few hundred meters of the drillsite may be buried or smothered by drilling muds and cuttings discharges (EG&G Environmental Consultants, 1982; NRC, 1983; Neff, 1987; Continental Shelf Associates, Inc., 2006). The threshold thicknesses for benthic community impact from muds and cuttings deposits are variable, depending in part on the feeding and motility types of the indigenous fauna and the physico-chemical nature of the receiving environment (e.g., ambient levels of sediment organics; oxygen concentration; depth of redox potential layer). Soft bottom areas buried by cuttings and drilling fluids will eventually be recolonized through larval settlement and migration from adjacent areas.

Impacts to the marine environment (i.e., benthic communities, sediment quality) from anchor placement and retrieval and seafloor releases and surface discharges of drilling muds and cuttings are likely. Total area affected is relatively small compared to ubiquitous soft bottom communities of the study area. Total area affected by sediment resuspension (from anchors) and sediment deposition (from drilling releases and discharges) is limited to several hundred meters around the drillsite.

Projected Deposition Pattern: Results of site- and well-specific muds and cuttings discharge modeling are not available for the Tamar SW-1 well. However, modeling results from a similar deepwater location in the eastern Mediterranean (i.e., offshore Cyprus; 1,700 m water depth) are available (**Figure 25**).

Noting that there are only minor differences in the drilling programs between the Cyprus well and the Tamar SW-1 well (e.g., minor differences in well intervals, total depth, cuttings size classes, etc.), consideration of the results from a representative modeling exercise provides a good indication of likely deposition patterns, including expected thicknesses and areas affected.

Results of the representative discharge include area and maximum extent of seafloor affected by various deposition thicknesses (**Table 9**). Maximum thickness of the muds and cuttings deposit occur within tens of meters of the well, extending outward from the well in diminishing thicknesses (i.e., from 50 to 0.5 mm) to approximately 400 m from the drillsite. Within 14 m of the wellbore, modeling results indicate that deposition thickness will be approximately 200 mm (7.8 in.). From 14 to 22 m from the well, muds and cuttings deposits will diminish to 100 mm (3.9 in.) thick covering an area of approximately 0.001 km^2 (1,000 m^2), diminishing to 50 mm (2 in.) thick within the next 5 m (i.e., from 22 to 27 m from the well). At approximately 40 m from the well, muds and cuttings deposits will be 10 mm thick. Results of the representative modeling exercise indicate that the total area of deposition >10 mm was slightly more than one hectare. Discussions of the impacts of this deposition are provided in **Chapters D.2** (**Water and Sediment Quality Impacts**) and **D.6** (**Nature and Ecology Impacts**).

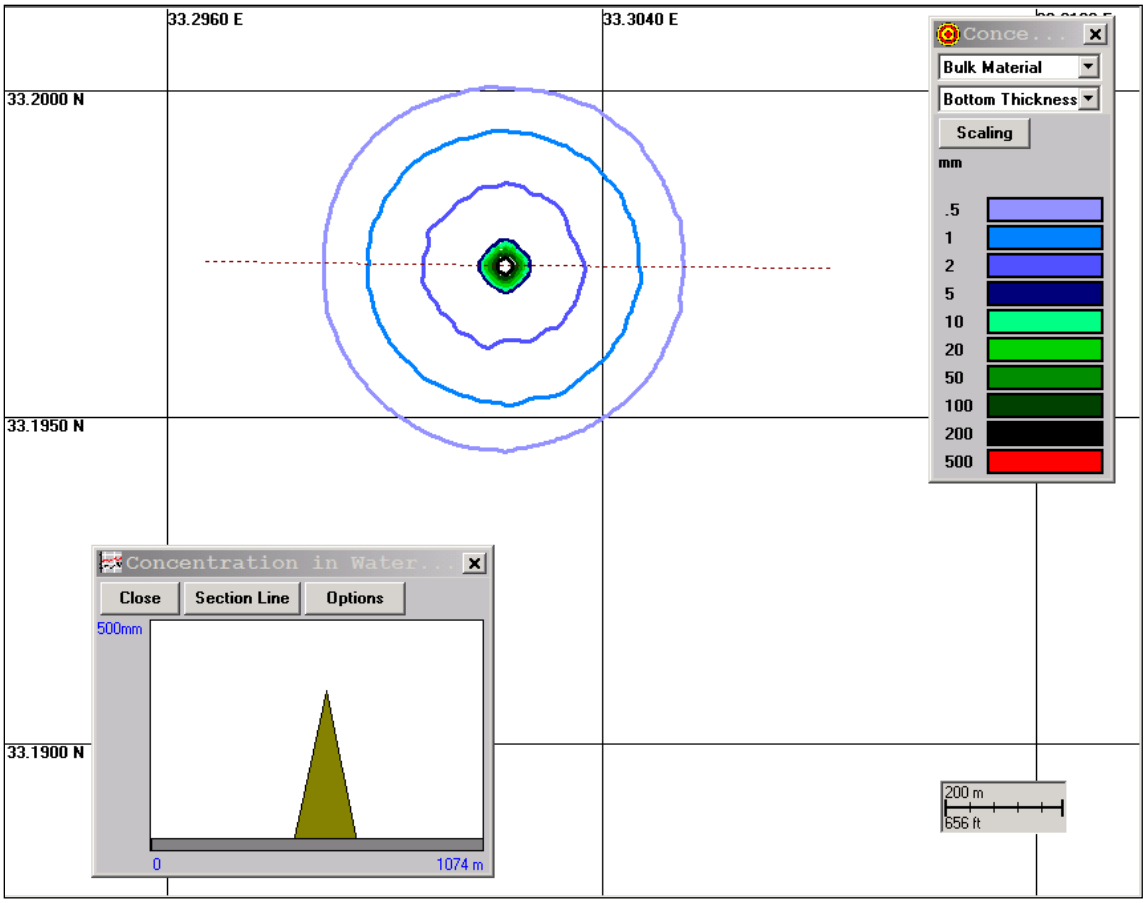

Figure 25. Predicted seabed distribution of mud and cuttings discharges for an exploratory well in 1,700 m of water, eastern Mediterranean (From: CSA International, Inc., 2011).

Table 9. Area and maximum extent of predicted distribution of muds and cuttings deposits by thickness for a representative exploratory well in the eastern Mediterranean, 1,700 m water depth (From: CSA International, Inc., 2011).

Thickness (mm)	Area (km^2)	Maximum Extent (m)	Hectares
0.5	0.294	402	29.39
1	0.164	315	16.41
2	0.053	205	5.29
5	0.005	46	0.48
10	0.004	39	0.38
20	0.003	34	0.28
50	0.002	27	0.18
100	0.001	22	0.12
200	0.001	14	0.07
Total Area of Deposition >10 mm			1.03

Drilling Mud Testing: Testing of drilling muds and associated chemicals will be conducted in compliance with discharge permit requirements. The nature and frequency of testing are outlined in **Table 10**.

Table 10. Summary of testing of drilling muds, Tamar SW-1 well.

Frequency of Testing (minimum)	Type of Test/Target Analyte	Method/Standard
Drilling Muds/Liquids		
Grab Sampling No. 1 Towards the end of the first stage of drilling, before installation of the conductor pipe (riser). Timing: after 5 days of drilling. Diameter of drilling hole: 26” **Grab Sampling No. 2** At the end of the second stage of drilling, ahead of drilling completion. Timing: after about 70 consecutive days of drilling and cementing operations. Diameter of drilling hole: 10-5/8” **Testing Frequency** Grab sampling: Twice total, after ~5 and ~70 days of drilling, as noted above. Toxicity testing: once a month according to the testing carried out by NBL.	Biological Oxygen Demand (BOD_5)	SM-5210 B
	TOC	TOC Cell Test
	Suspended solids 105°C (TSS)	SM-2540 D
	Mineral oil (FTIR)	EPA 418.1
	PAH by GC-MS	EPA 8270
	Phenol	SM-5530 D
	Cresol	SM-5530 D
	Nitrate (as N)	SM-4500-NO_3 B
	Nitrite (as N)	SM-4500-NO_2 B
	Ammonium nitrogen (as N)	SM-4500-NH_3 C
	Kjeldahl nitrogen (as N)	SM-4500-Norg B
	Total nitrogen (calculated)	SM-4500-Norg B + SM-4500-NO_2 B + SM-4500-NO_3 B
	Reaction value (pH)	SM-4500-H+B
	Total dissolved solids (TDS)	SM-2540 C
	DOX/AOX	Hach-Lange Cell Test
	Chlorides	SM-4500-CI-D
	Toxicity testing – once a month	EPA 1619; 96-h Static Acute Toxicity Test (*Mysidopsis bahia*)
	Broad screening for metals (ICP), including P	EPA 6010 B
	GCMS, probability percentages, half quantity concentrations and total concentration	EPA 8270
	VOCs, probability percentages, half quantity concentrations and total concentration	EPA 8260

Toxicity testing will comply with EPA 1619 protocols, the latter of which are consistent with exiting U.S. Gulf of Mexico NPDES discharge requirements for drilling mud discharges (i.e., Section B, Effluent Limitations and Monitoring Requirements, Drilling Fluids). A 96-h static acute toxicity test using the suspended particulate phase (SPP) of used drilling mud will be completed on a monthly basis. Discharged drilling fluids shall meet both a 96-h LC50 of at least 30,000 ppm (3% SPP concentration).

C.2.3 Safe Drilling Practices

Noble Energy will employ safe drilling practices during its activities at the Tamar SW-1 well. Best industry practice will be employed during all drilling phases (e.g., setting of BOP; cementing of concrete between bore and protective pipe).

BOP specifications for the *ENSCO 5006* are outlined in **Appendix D**, and include the following:

- VetcoHD-H4 well head connector 18-3/4 in., 15,000 psi working pressure (WP);
- Two Cameron 18-3/4 in. type TL double 15,000 psi WP H_2S trimmed preventers;
- One Hydril 18-3/4 in. dual annuflex annular 10,000 psi WP H_2S trimmed; and
- Lower marine riser package: Cameron connector model HC, 18-3/4 in. 15,000 psi WP; Oil State 5,000 psi flex joint.

Noble Energy notes that the proposed location and trajectory of the Tamar SW-1 exploration well was designed to minimize the risk of encountering the following shallow hazards:

- Seafloor instability: the well is in a relatively flat location that is at least 600 m from any seafloor channel or fault scarp;
- Shallow faulting: the well avoids all supra-salt thrust faulting and vertical faulting;
- Anomalies within salt: the well is expected to intersect clastic interbeds where there is minimal deformation; and
- Clastic interbed instabilities: the 20-in. casing shoe is planned to be set in a clean halite interval that is free of clastic interbeds.

C.2.4 Concretization

As outlined in **Chapter C.2.2**, the Tamar SW-1 well drilling program will be completed in several key stages (Noble Energy, 2012b,c), four of which will involve placement of concrete into the well, including:

- Following drilling of the 26-in. section, over a length of approximately 1,200 m, installation of a protective pipe into a 20-in. diameter bore will be completed, followed by insertion of concrete into the space between the bore and the protective pipe.
- Following drilling of the 17-1/2 in. section, over a length of approximately 600 m, installation of a protective pipe into a 13-5/8 in. diameter bore will be completed, followed by insertion of concrete into the space between the bore and the protective pipe.
- Following drilling of the 12-1/4 in. section, over a length of approximately 1,000 m, installation of a protective pipe into a 11-7/8 in. diameter bore will be completed, followed by insertion of concrete into the space between the bore and the protective pipe.
- Following drilling of the 10-5/8 x 12-1/4 in. bypass hole 10 m into pay sand, installation and cementing of 9-7/8 in. x 9-5/8 in. x 10-3/4 in. production casing.

Cementing is the process of placing a cement slurry in a well by mixing powdered cement, additives, and water at the surface and pumping it by hydraulic displacement to the desired location. Noble Energy (2012b) estimates that a total of 6,900 bbl of concrete will be used during the Tamar SW-1 drilling program. Compounds and quantities to be employed during cementing operations are outlined in **Table 11**.

As expected, the single largest component of the cementing operation is a Class G cement (i.e., 167 metric tons), with significantly lower contributions from other additives, including barite (29.01 tons), Ecolonite L (i.e., to increase volume and decrease density; 6.83 tons), and HR4-L (4.31 tons). In total, an estimated 448,167 lbs of dry product and 2,923 gal. of liquid product are expected to be used in cementing operations on the Tamar SW-1 well. Noble Energy estimates that 1,300 bbl (206.5 m^3) of cement will be discharged at the wellbore (Noble Energy, 2012b).

Table 11. Products used during cementing operations, Tamar SW-1 well (From: Noble Energy, 2012b).

Product	Quantity		Total Weight (tons)
Barite	63,812 lbs		60.5
Calcium chloride	141 lbs		2.8
D-AIR 3000L	190 gal.		0.67
Cement Class G	167 mt (368,172 lbs)		801.4
ECONOLITE LIQUID	4,703 gal.		24.9
Fluorodye UC	24 gal.		0.1
HALAD-322 CEMENT ADDITIVE	590 lbs		1
HALAD-413 CEMENT ADDITIVE	226 lbs		0.7
HR-4	70 lbs		0.2
HR-4L	2,491 gal.		11.3
HR-5	201 lbs		0.3
KCl	1,565 lbs		4.9
MUSOL SOLVENT	246 gal.		0.84
NF-6	438 gal.		1.54
SILICALITE LIQUID	1,197 gal.		6.33
TUNED SPACER E+	8,973 lbs		2.9
ELASTICEM CEMENT BLEND	2 mt (4,409 lbs)		15
WellLife 734	8 lbs		0.01
LATEX 3000	392 gal.		1.6
Total	448,167 lbs	2,923 gal.	215.084

C.2.5 Anchoring Plan

The *ENSCO 5006* is equipped with four Skagit double drum traction winches, 10,600 ft of 3-3/4-in. wire, 2,500 ft of 3-1/4-in. R3S chain, and eight Vryhof Stevpris MK-5 anchors, each weighing 15 mt. The anchor deployment pattern to be used at the Tamar SW-1 drillsite will be an 8-point pattern. Anchors will extend approximately 3 km from the drilling rig.

C.3 DRILLING PHASES

As outlined in **Chapter C.2.2**, the Tamar SW-1 well drilling program will be completed in several key stages (Noble Energy, 2012b,c), five of which are considered drilling phases. Drilling phases will include:

- 36-in. section: Installation via jetting (drive pipe) of a 36-in. pipe of approximately 70 m in length. Timeframe: estimated to occur from Day 0 into Day 7.
- 26-in. section: Drilling at a diameter of 26 in. over a length of approximately 1,200 m, followed by running and cementing of 20-in. pipe. Timeframe: estimated to occur from Day 7 into Day 24.
- 17-1/2 in. section: Drilling at a diameter of 17-1/2 in. over a length of approximately 600 m, followed by running and cementing of 13-5/8-in. pipe. Timeframe: estimated to occur from Day 24 into Day 34.
- 14-3/4 in. section: Drilling at a diameter of 14-3/4 in. over a length of approximately 1,000 m, followed by running and cementing of 11-7/8-in. pipe. Timeframe: estimated to occur from Day 34 into Day 57.

- 10-5/8 in. section: Drilling at a diameter of 10-5/8 in. over a length of approximately 735 m, followed by running formation evaluation logs, drilling of bypass hole, and running and cementing production casting. Timeframe: estimated to occur from Day 57 into Day 79.

Total well drilling depth (i.e., from the mudline to the bottom of the hole) is expected to be approximately 3,634 m, based on a) 24 m from rotary to water surface; b) a water depth of 1,648 m (i.e., 1,672 m from rotary to mudline); and c) a total depth (TD) of 5,306 m (see **Figure 23**).

C.4 PRODUCTION TESTING

No production testing will be conducted on this well.

C.5 NOISE HAZARDS

Noise characteristics for the *ENSCO 5006* are not available. However, general noise characteristics of a typical semi-submersible drilling unit conducting routine drilling activities and various support operations (e.g., support vessels, helicopters) are available, and have been outlined in **Table 12**, as derived from Richardson et al. (1995).

Table 12. Summary of representative noise source levels for oil and gas exploration-associated drilling operations, vessels, and aircraft (Adapted from: Richardson et al., 1995).

Sound Source	Source Levels (dB re 1 µPa at 1 m)							Highest 1/3 Octave Band	Level Band Level
	Broadband (45-7,070 Hz)	1/3-Octave Band Center Frequency							
		50	100	200	500	1,000	2,000		
Continuous Sound Sources									
Drilling									
Kulluk (45-1780 Hz)	185	174	172	176	176	168	-	400	177
C. Explorer II	174	162	162	161	162	156	148	63	167
Semi-submersible	154	-	-	-	-	-	-	-	-
Transient Sound Sources									
Vessels Underway									
Supply Ship	181	162	174	170	166	164	159	100	174
Supply Vessel	128-158	-	-	-	-	-	-	-	-
Crew Boat	156	-	-	-	-	-	-	-	-
Aircraft									
Bell 212 Helicopter	162	154	155	151	145	142	142	16	159

Note: Richardson et al. (1995) computed aircraft flyover source levels, as initially provided by Malme et al. (1989) for a standard altitude of 305 m; values were changed to a reference range of 1 m by adding 50 dB.

Salient characteristics of these representative noise sources as they apply to proposed operations include the following:

- Most man-made noise associated with offshore oil and gas drilling operations or support activities are in the low frequency bands (<500 to 1,000 Hz).
- Propeller cavitation, propeller singing, and propulsion machinery are primary noise sources for vessels (regardless of size), which is not an issue with the *ENSCO 5006*, but would be associated with AHTS and support vessel operations.

- Semi-submersible drilling units produce sound levels which are generally lower than other drilling vessels or bottom-founded drilling units (e.g., drillships, jack-up rigs) because the rig machinery is mounted on raised decks, which are elevated and benefit from portions of the noise spectrum reflecting off the ocean surface.
- Sound source levels for a semi-submersible are in the range of 154 dB re 1 µPa at 1 m.
- Supply and crew boats produce sound source levels in the range of 128 to 158 dB re 1 µPa at 1 m; these sound sources are considered transient as they move between shorebase and the drilling rig; sound from the standby vessel will be at a lower source level while idling on station.
- Underwater sounds from helicopters, as with all aircraft, reach their highest levels just below the surface and directly under the aircraft. When the aircraft is overhead, sound levels decrease with increasing aircraft altitude or increasing receiver depth. The highest energy of helicopter rotor sound is at frequencies <500 Hz, while helicopter turbines contribute to higher sound levels at frequencies >500 Hz.
- Transmission of airborne sound into the water is a function of source altitude, orientation (e.g., <26° maximizes sound penetration into the water column), receiver water depth and orientation, and sea surface conditions.

Sound emanating from the *ENSCO 5006* can be expected to be continuous, at a level of approximately 154 dB (re 1 µPa at 1 m) while drilling, with most energy in the low frequency bands. During non-drilling periods, sound source levels from the *ENSCO 5006* will originate only from diesel generators, cranes, and crew activity aboard the rig. No propeller or propulsion noise is expected from the *ENSCO 5006* given its lack of these components.

Supply vessels in transit to and from the rig will produce transient sounds in the 128 to 158 dB (re 1 µPa at 1 m) range, with predominant low frequency components. If a supply vessel remains on standby at the rig, it will produce lower, but continuous sound levels, as it would be expected to remain at idle while on station. In similar fashion, transient helicopter visits to the rig will produce predominantly low frequency sound source levels of 162 dB (re 1 µPa at 1 m), with highest sound levels to be experienced directly below the aircraft.

C.6 AIR QUALITY

Activities expected at the Tamar SW-1 well, including rig positioning, drilling, cementing, and logging operations, along with associated support operations, will produce emissions from internal combustion engines, including greenhouse gases (GHGs) and varying amounts of other pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x) and sulfur oxides (SO_x), VOCs, and particulate matter (PM). The location and duration of these operations are variable. For example, while the drilling rig will maintain station at the Tamar SW-1 drillsite, support vessels and helicopters will travel between the onshore support base or airport and offshore. On a weekly basis, one supply vessel round trip and one helicopter round trip will occur during drilling.

The *ENSCO 5006* is equipped with four Caterpillar 3608-TA diesel engines, each rated at 3,055 HP, driving one Baylor AC generator (600 V, 60 Hz, 3,571 kVA). Power distribution is via six silicon-controlled rectifiers, the latter of which are M&I 2,200 amp 750 Vdc units, used for drilling and mooring. Emergency power is provided by a single Caterpillar 3512-DITA diesel engine rated at 1,281 HP, driving a single Caterpillar SR-4 AC generator (480 V, 60 Hz, 1,137 kVA).

Anchor handling and tow capabilities will be provided by two or more vessels. A representative vessel for these capabilities is the anchor handling tow and supply (AHTS) vessel *Richard M. Currence*. The *Richard M. Currence* and *John P Laborde* are each equipped with four EMD 16-265-H7 engines, each rated at 6,300 HP. The M/V *EAS* is equipped with two MaK 12 M453 AK engines, capable of producing

a total 7,760 BHP. The M/V *Leon* is equipped four Caterpillar 3512B TA engines, capable of producing a total of 6,000 BHP. Helicopter support will be provided by a Bell 412SP aircraft, equipped with two Pratt and Whitney Canada PT6T-3BE Twin-Pac turboshafts, each producing 900 SHP (671 kW).

Emissions included pollutants that are similar to other ocean-going vessels and included carbon dioxide (CO_2), NO_x, SO_x, PM, and unburned hydrocarbons (VOCs). Project air emissions were also associated with the operation of supply boats and anchor handling vessels. A summary of projected air emissions from project-related sources is provided in **Table 13**.

Table 13. Summary of maximum daily air emission estimates, by source, for the Tamar SW-1 well.

Source	Emissions (tons/day)							
	CO_2	CO	NO_x	SO_x	VOCs	PM	CH_4	CO_2 equiv
Semisubmersible Drilling Vessel (Drilling)								
ENSCO 5006	157.62	0.72	3.30	0.44	0.10	0.10	0.01	157.81
Supply Vessel (Drilling Support)								
EAS	170.06	0.78	3.56	0.47	0.11	0.10	0.01	170.27
Leon	253.83	1.16	5.31	0.71	0.16	0.15	0.01	254.13
AHTS Vessel (Rig Emplacement and Demobilization)								
Richard M. Currence	834.50	3.81	17.44	2.33	0.52	0.51	0.05	835.50
John P Laborde	834.50	3.81	17.44	2.33	0.52	0.51	0.05	835.50

AHTS = anchor handling towing supply vessel; CO = carbon monoxide; CO_2 = carbon dioxide; CO_2 equiv = carbon dioxide equivalent; CH_4 = methane; NO_x = nitrogen oxides; PM = particulate matter; SO_x = sulfur oxides; VOCs = volatile organic compounds.

- Greenhouse gas emissions include both CO_2 and CH_4; the latter was assumed to have a CO_2 equivalence of 21 (Wilson et al., 2007).
- *ENSCO 5006* emissions based on three (3) generators operating 24 hrs/day, plus a fourth primary generator running 12 hrs/day and the fifth (emergency) generator operating 12 hrs/day.
- *EAS* emissions based on two (2) primary engines operating 18 hrs/day, an auxiliary engine operating 18 hrs/day, and two tunnel thrusters operating 6 hrs/day.
- *Leon* emissions based on four (4) engines operating 18 hrs/day.
- *Richard M. Currence* and *John P Laborde* based on two (2) engines operating 18 hrs/day and two engines operating 12 hrs/day.
- Emissions calculations derived using the U.S. Gulf of Mexico Air Emissions Calculations Instructions and accompanying worksheet (EP_AQ.XLS) developed by the U.S. Department of the Interior, Bureau of Ocean Energy Management and the American Petroleum Industry/Offshore Operators Committee Air Quality Task Force employing USEPA AP-42 emission factors. Vessel engine characteristics derived from owner/operator specifications.

C.7 HAZARDOUS MATERIALS

Hazardous chemicals will be handled in accordance with their MSDS-specified guidelines (**Appendix E**), as integrated into the operator's guidelines for handling hazardous materials. Materials to be used in drilling (i.e., WBM and additives) and concrete operations are listed in **Tables 4**, **5**, and **11**.

C.8 DISCHARGES

C.8.1 Overview and Discharge Sources

Discharges released into the sea during exploratory drilling operations at the Tamar SW-1 well can be divided into two main groups, including:

- Effluents originating from personnel aboard the drilling rig and ongoing, routine rig operations **exclusive** of drilling, such as sanitary and domestic wastes, cooling water, brine/reverse osmosis (RO) water, etc.; and
- Effluents originating directly from the drilling operations, including drilling muds and cuttings and cement.

Discharges also include organic waste (e.g., food waste). Discharges, exclusive of drilling muds and cuttings and cement, are summarized in **Table 14**. Highest volumes of non-drilling discharges are cooling water and brine from the reverse osmosis/water maker units. The chemical composition of drilling discharges has been previously addressed in **Chapters C.2.2.1** and **C.2.2.2**. The discharge of drilling-related discharges is further quantified in **Chapter C.8.4**.

Table 14. Summary of discharges exclusive of drilling muds and cuttings from the *ENSCO 5006* during drilling of the Tamar SW-1 exploratory well.

Source	Capacity (m^3/d)	Pipe diameter (in.)	Discharge Depth (m)
Sanitary waste (black water effluent)	15-35	8	-14
Domestic waste (gray water)	20-24	8	-14
Water maker brine*	160-320	8	-14
Cooling water	5,000-10,000	14, 16, and 18	-14
Organic waste	100-150 kg/d	8	-14

* There are two production units installed on the rig which each produce 30 cubic meters per day. Usually only one unit operates at once – no additives are added to the process.

C.8.2 Discharge Flow (Comingling)

Comingling occurs between sanitary and domestic waste streams (i.e., sewage and gray water), food scraps discharge, and potable water maker (brine) discharge. These discharges are released through an 8-in. diameter pipe at 14 m below the sea surface. Note that there will be no discharges from the oil water separator (OWS) while the *ENSCO 5006* is moored at the Tamar SW-1 drillsite; any liquids normally processed by the OWS are captured while the drilling rig is moored and shipped to shore by means of shipping tanks.

Cooling water discharge is separate from other waste streams, but is mingled with the discharge of drilling muds and cuttings; these discharges are released through 14-in., 16-in., and 18-in. discharge lines located 14 m below the sea surface. Note that the discharge of muds and cuttings from the drilling rig only occurs in the lower sections of the well; when discharging, cuttings are released nearly continuously, while drilling muds are released at the end of the well (i.e., cooling water will be discharged continuously; cuttings discharged continuously only during drilling of the lower hole sections; drilling muds discharged only at the end of the well). A diagram showing the flow of various discharge streams from the *ENSCO 5006* is provided in **Figure 26**. Additional information is provided in **Chapter C.8.4**, **Discharge Timing and Flow Characteristics**.

C.8.3 Discharge Treatment

All discharges from the *ENSCO 5006* and project vessels (e.g., AHTS and supply vessels) will be in compliance with applicable standards (e.g., the International Convention for the Prevention of Pollution From Ships [MARPOL], Barcelona Convention) or consistent with best industry practice. Specific treatment processes are detailed below for individual waste streams. Waste streams are comingled as shown in **Figure 26**.

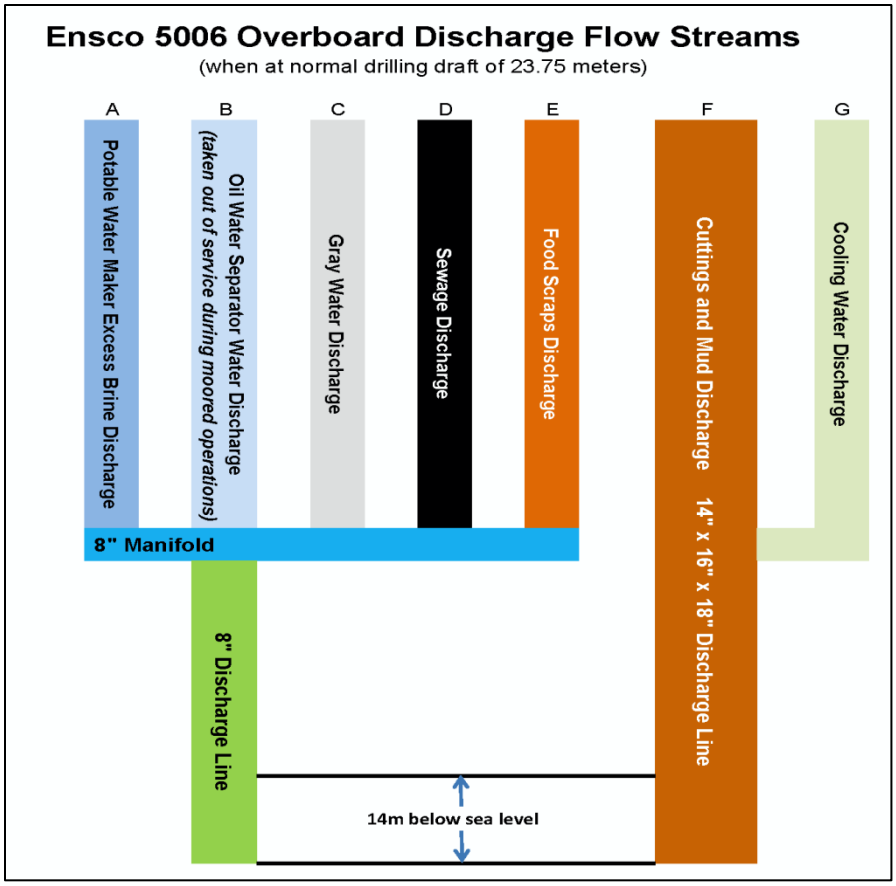

Figure 26. Discharge streams for the *ENSCO 5006*.

Sanitary waste (i.e., also known as black water or sewage) consists of human body wastes from toilets and urinals. All sanitary waste will be treated using a marine sanitation device, producing an effluent with low residual chlorine concentrations and no visible floating solids. Aboard the *ENSCO 5006*, sanitary waste will be treated by one of two Omni-Pure Wastewater Treatment Type II units that are certified by DNV. The Omni-Pure units oxidize and disinfect raw sewage by means of electrochemical reaction. Waste is transferred from a holding tank to a second tank for maceration, then moved via salt water over electrically-charged plats. In this process, chloride salts in seawater are decomposed by electrolysis to form hypochlorite, the latter of which kills coliform bacteria and oxidizes organic compounds. Treated sanitary wastes leave the electrolytic cell through a "down-comer" pipe which acts as a flow stabilizer into a final processed tank; sanitary wastes are then gravity fed overboard. Treatment volume is 10 to 14 m^3/day (i.e., 10,000 to 14,000 liters per day), which is discharged through an 8-in. line 14 m below sea level.

Domestic waste (i.e., also known as gray water) consists of the water generated from showers, sinks, laundries, and galleys, safety showers, and eyewash stations. Domestic wastewater is typically screened to remove any floating solids, then discharged; domestic waste does not require treatment before discharge. Discharge occurs through an 8-in. line 14 m below sea level.

Cooling water is used to control and maintain proper temperatures on internal combustion engines aboard the drilling rig and project vessels. Cooling water discharge effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, the dilution zone is typically considered to be 100 m from the point of discharge.

Thermal discharges must meet MARPOL and Barcelona Convention requirements. No treatment of cooling water is expected. Cooling water is comingled with muds and cuttings discharges; comingled discharges occur through 14-in., 16-in., and 18-in. (diameter) lines 14 m below sea level.

Organic or food wastes are generated from galley and food service operations. Food waste, a type of domestic waste, will be ground prior to discharge (i.e., comminuted), in accordance with Annex V of MARPOL 73/78 requirements (i.e., for vessels 400 gross tonnage and above). Food scraps are ground up in a Gulf Gulp garbage disposal unit. Food waste is typically ground to <25 mm diameter to meet discharge requirements. Food waste discharges are allowed, when ground, if the vessel is 12 nmi or more from land when within special areas (including the Mediterranean Sea). Aside from grinding, no other treatment of organic wastes is expected. Following grinding, food wastes are discharged through an 8-in. line 14 m below sea level.

Freshwater is generated aboard the drilling rig via two RO water makers, generating brine (i.e., concentrated seawater) as a byproduct. At maximum rated capacity, each unit can generate 30 m^3/day of freshwater, or a total of 60 m^3/day. Under normal operating conditions, only one RO unit operates at a time. Maximum feed water flow rate through the unit is 380 m^3/day; maximum brine discharge flow rate is 320 m^3/day. The excess seawater being discharged does not contain any added chemicals. The discharge is through an 8-in. line 14 m below sea level.

The processing of drilling mud, designed to prolong the life of the drilling fluid and minimize the need to discharge, typically includes flow through various pieces of equipment to remove cuttings and large particles (i.e., scalper shakers, shale shakers). Once the drilling mud has passed through the shakers, it is pumped into a settling/processing pit (i.e., sand traps). Once in the sand traps, the drilling mud can be circulated and processed by other equipment (e.g., degasser, mud cleaner, desander, desilter, and centrifuge) to further remove unwanted particles. Chemicals may be added to change the rheological properties of the mud, or to address a specific downhole need. Details of drilling mud treatment and processing, including schematics of the mud processing system, are provided in **Appendix F**.

C.8.4 Discharge Timing and Flow Characteristics

The timing (i.e., frequency) and flow characteristics of discharges expected from the *ENSCO 5006* during drilling activities on the Tamar SW-1 well are summarized in **Table 15**. Additional discussion of discharges was provided in **Chapter C.8.2**, **Discharge Flow (Comingling)**.

Sanitary and domestic waste streams (i.e., sewage and gray water) will be discharged periodically at rates of 10 to 14 m^3/day and 20 to 24 m^3/day, respectively. Organic waste (i.e., food scraps) will be discharged periodically at 100 to 150 kg/d. Potable water maker (brine) discharge will be discharged continuously at a rate of 160 to 320 m^3/d. There will be no discharges from the OWS while the *ENSCO 5006* is moored at the Tamar SW-1 drillsite.

Cooling water discharge will occur continuously at a rate of 5,000 to 10,000 m^3/d. The discharge of muds and cuttings from the drilling rig only occurs in the lower sections of the well; when discharging, cuttings are released nearly continuously, while drilling muds are released at the end of the well. It is estimated that the continuous cuttings discharges (i.e., during drilling of the lower hole sections) will occur continuously at a rate of 21 m^3/d; note that there are periods where work in the lower hole sections does not involve drilling, therefore, cuttings discharges will not occur during these periods. Drilling muds will be discharged from the rig only at the end of the well; the bulk discharge of drilling mud is expected to occur at a rate of 1,749 m^3/d.

Table 15. Summary of discharges expected from the *ENSCO 5006* during drilling of the Tamar SW-1 exploratory well.

Source	Total Volume (m^3)	Duration	Capacity (m^3/d)	Pipe Diameter (in.)	Discharge Depth (m)	Frequency and Treatment
Drilling muds and cuttings – 36” and 26” sections; no surface returns (muds and cuttings released at the wellbore)	Muds: 2,861.8 Cuttings: 550	3 days	Muds: 953.9 Cuttings: 183.3	36 (wellbore)	-1,700	Continuous during drilling; no treatment
Drilling muds and cuttings – 17-1/2”, 14-3/4”, 12-1/4”, and 10-5/8” sections; surface returns (muds and cuttings discharged at the surface)	Muds: 1,176.5 Cuttings: 321	19 days	Muds: 1,176.5 Cuttings: 16.9	14, 16 or 18	-14	Continuous for cuttings while drilling; minor amounts of WBM with cuttings; cuttings separated from muds (see **Appendix F**); WBM bulk discharge at end of well
Cement (at the wellbore)	206.7	1-2 days (total)	~60	36, maximum (wellbore)	-1,700	No treatment
Sanitary waste (black water)			10-14	8	-14	Periodic; chlorinated
Domestic waste (gray water)			20-24	8	-14	Periodic; no treatment
Water maker brine			160-320	8	-14	Continuous; no treatment
Cooling water			5,000-10,000	18	-14	Continuous; no treatment
Organic waste			100-150 kg/d	8	-14	Periodic; macerated

Notes:

- Drilling of 36” and 26” sections estimated to require 3 days total; muds and cuttings to be released from the wellbore continuously during this period;
- Drilling of 17-1/2”, 14-3/4”, 12-1/4”, and 10-5/8” sections estimated to require 19 days total (drilling only); cuttings are discharged continuously while drilling; muds recirculated and discharged as an end of well discharge (at completion of drilling). End of well discharges of WBM will occur at <1,000 bbl/hr; 1 bbl = 0.159 m^3; <159 m^3/hr; total muds: 1,176.5 m^3 discharged in ~7.4 hours, minimum;
- Cementing occurs periodically throughout drilling, at the completion of the drilling of each section, when setting pipe; total estimate of cement to be used: 6,900 bbl (1,097 m^3); cement discharge estimated to be 1,300 bbl (206.7 m^3); and
- Negative entries in the Discharge Depth column indicate water depth below the sea surface.

C.8.5 Discharge Method and Orientation

Processed and unprocessed discharges occur through a series of 8-in., 14-in., 16-in., and 18-in. pipes located 14 m below the ocean surface. Discharges are either gravity fed or pumped, with pipe orientation in a vertical, downward direction.

Discharges from the *ENSCO 5006* include drilling muds and cuttings, sanitary and domestic wastes, cooling water, water maker brine, and organic waste, as detailed previously in **Table 15**. There are two primary waste streams (i.e., waste streams are comingled) – one through an 8 in. pipe located 14 m below the sea surface, the other through 14 in., 16 in., and 18 in. pipes also located at 14 m below the sea surface (see **Figure 23**).

Characteristics of discharges through the 8 in. pipe:

- Sanitary and domestic wastes: periodic; 10-14 m^3/day and 20-24 m^3/day, respectively.
- Organic waste (i.e., food scraps): periodic; 100-150 kg/d.
- Potable water maker (brine): continuous; 160-320 m^3/d.

Characteristics of discharges through the 14 in., 16 in., and 18 in. pipes:

- Cooling water: continuously; 5,000-10,000 m^3/d.
- Drill cuttings (only during drilling of lower hole sections): continuous while drilling; 21 m^3/d.
- Drilling muds (at the end of the well): single bulk discharge; 1,749 m^3/d.

C.8.6 Discharge Quality and Effluent Limitations

All discharges from the *ENSCO 5006* and project vessels (e.g., AHTS and supply vessels) will be in compliance with applicable standards (e.g., MARPOL, Barcelona Convention) or consistent with best industry practice

As outlined in **Chapter C.8.3** (**Discharge Treatment**), sanitary wastes will be treated via chlorination and organic (food) wastes will be macerated to facilitate degradation. Other wastes (i.e., cooling water, domestic waste) do not require treatment.

As outlined initially in **Chapter C.2.2** (**Drilling Program**), the Tamar SW-1 well will be drilled using an NaCl/KCl/Polymer as part of an inhibited WBM system. Drilling fluids are formulated such that water column toxicity is near absent. As noted in **Chapter C.2.2.2**, toxicity (or bioaccumulation) is generally not a concern with regards to WBM and their associated releases or discharges. Monthly end of pipe testing on whole fluids ensures that the fluids meet requirements. Toxicity testing will comply with EPA 1619 protocols, the latter of which are consistent with exiting U.S. Gulf of Mexico NPDES discharge requirements for drilling mud discharges (i.e., Section B, Effluent Limitations and Monitoring Requirements, Drilling Fluids). A 96-h static acute toxicity test using the SPP of used drilling mud will be completed on a monthly basis. Discharged drilling fluids shall meet both a 96-h LC50 of at least 30,000 ppm (3% SPP concentration). While WBM systems are considered to be environmentally friendly, the routine testing of drilling muds during drilling will provide relevant toxicity data.

Drilling muds will be processed during drilling to remove cuttings and to adjust the rheological properties of the fluids. Potential additives have been identified (see **Tables 4** through **7**), and MSDS data have been provided in **Appendix E**. Cement will also be discharged at the wellbore. Products used during cementing operations are identified in **Table 11**.

C.8.7 Discharge Quantity

Total quantities of discharges to occur as a result of *ENSCO 5006* presence at the Tamar SW-1 drillsite are summarized in **Table 16**.

Table 16. Summary of estimated total discharge quantities from the *ENSCO 5006*.

Source	Frequency	Capacity (m^3/d)	Duration (days)	Total Volume (m^3)
Drilling muds and cuttings – 36" & 26" sections; no surface returns (at wellbore)	Continuous	Muds: 953.9 Cuttings: 183.3	3	Muds: 2,861.8 Cuttings: 550
Drilling muds and cuttings – 17-1/2", 14-3/4", 12-1/4", and 10-5/8" sections; surface returns (at surface)	Cuttings: continuous while drilling; Muds: single bulk discharge at end of well	Muds: 1,176.5 Cuttings: 16.9	19	Muds: 1,176.5 Cuttings: 321
Cement (at wellbore)	Periodic	~60	1-2 total	206.7
Sanitary wastes	Continuous	10-14	79	1,185-2,765
Domestic waste (gray water)	Continuous	20-24	79	1,738-3,950
Water maker brine	Continuous	160-320	79	12,640-25,280
Cooling water	Continuous	5,000-10,000	79	197,500-450,300
Organic waste	Periodic	100-150 kg/d	79	7,900-11,850 kg

Note: Estimated duration of *ENSCO 5006* on site – 79 days.

C.8.8 Detailed Characterization, Survey Results, and Drill Mud Testing

At the Tamar SW-1 drillsite, baseline samples have been collected to assess water quality, sediment quality, and benthic infauna as part of an environmental baseline survey (EBS). Preliminary results have been presented in **Chapter B**. Results are summarized in CSA Ocean Sciences Inc. (2013a).

Testing of drilling muds and associated chemicals will be conducted in compliance with discharge permit requirements. The nature and frequency of testing were outlined previously in **Table 10**. Two grab samples taken from the (drilling) mud pits will be analyzed for 19 separate analytes (e.g., BOD, TOC, suspended solids, PAH, total nitrogen, etc.) per applicable testing protocols, and toxicity testing will be completed on drilling mud samples on a monthly basis using static acute toxicity testing protocols.

C.8.9 Alternatives to Onsite Discharge

Alternatives to the onsite discharge of non-drilling related effluents either are not practical or are limited. There are no practical, viable alternatives to cooling water discharges. Alternative disposal methods for brine, organic (food) wastes, and sanitary and domestic wastes include containerization and shipment to shore. The location of the drilling activity in deepwater, well offshore in an open ocean environment indicates that only limited, localized impacts from these discharges are expected. Containerization and shipment will produce their own set of impacts (e.g., air quality, onshore processing, treatment, and disposal impacts), in addition to increasing safety concerns with loading and offloading additional waste containers.

Available alternatives to the onsite discharge of drilling muds (and cuttings) include injection or discharge into wellbores or subsurface formations, and transport of waste to shore for treatment and disposal. These practices are characterized by their own set of environmental effects, costs, and inherent limitations (e.g., practical and technical considerations). For example, the use of onshore disposal methods requires

that the material be transported onshore, with increased risks to the environment and personnel safety through handling, shipping, and transport.

Noble Energy recognizes the potential environmental impacts of discharging WBM and associated cuttings to the marine environment, and has implemented a series of mechanisms and procedures to ensure that impacts to the marine environment from onsite discharge are minimized. Mechanisms include proper containment (e.g., containment of all chemical storage areas; use of catchment drains, particularly on the rig floor and in the mud pits), drilling mud treatment and processing (e.g., use of solids control equipment to minimize the amount of drilling fluid retained on the cuttings prior to discharge; implementation of chemical testing and toxicity testing protocols), consideration of the receiving environment (e.g., assessment of impact to water quality and benthic communities), and estimation of drilling deposition area and effects.

C.9 WASTE

Solid wastes to be generated aboard the drilling rig or supply vessels during drilling will be packaged, containerized, and/or palletized for shipment to shore and proper disposal. No intentional waste disposal will occur from the rig or project vessels, in compliance with MARPOL restrictions. However, occasionally, debris (e.g., welding rods, buckets, pieces of pipe) may accidentally fall overboard.

The U.S. Department of the Interior, Minerals Management Service (USDOI, MMS) (2007a) estimates that, on average, a total of 2,000 ft^3 (56.6 m^3) of trash and debris is generated per exploration well drilled on the U.S. outer continental shelf. Several types of solid wastes are generated during exploratory drilling operations, including galley refuse (e.g., food packaging materials), domestic waste (e.g., packaging, shampoo bottles, razors), and wastes associated with normal rig operations (e.g., rags, containers, pallets). Industrial wastes may also include used solvents, paints, and other chemicals.

In order to meet the objectives of the Noble Energy EHS Policy, the *ENSCO 5006* will properly manage the generation, storage, and disposal of all solid waste. Drilling operations will be conducted under the preferred waste management hierarchy of “reduce, reuse, recycle, recover” prior to designating waste for disposal, whenever possible. In principle, this is accomplished by reducing the amount of waste generated through process efficiencies, reusing waste materials in their original form, recycling by converting waste back into a usable material, and recovering by extracting material or energy from the waste for other uses. Any waste remaining from these efforts will be managed through proper disposal.

Waste streams generated by drilling vessel operations and processes will be identified and classified. Each identified waste stream is to be classified and handled as scheduled waste or non-scheduled waste in accordance with the drilling unit’s EHS management system. The waste classification process includes the following “steps”:

- Determine if waste stream is scheduled waste (hazardous or toxic) or has characteristics that pose threats to human health or the environment; and
- If waste stream is non-scheduled waste, determine proper classification or other type of waste stream classification (e.g., industrial waste, domestic waste, etc.) according to any local waste management regulations.

General refuse and other non-industrial waste streams are typically classified as domestic waste and managed similar to municipal waste onshore. These wastes are typically not regulated to the same extent as industrial wastes.

Waste classification is conducted by using one or more of the following methods:

- Process knowledge – Applying knowledge of the hazardous characteristic(s) of the waste in light of the materials or the processes used; and
- Regulatory listing review – Determining if the waste is listed by waste management regulations or authorities as being considered a hazardous, scheduled, or other type of waste.

Different waste streams will be segregated by type and will not be mixed together or managed in the same container. Under no circumstances will non-hazardous wastes be allowed to be mixed in the same container with hazardous or scheduled wastes. If this occurs, the entire mixture is to be considered hazardous or scheduled waste.

Waste storage areas will be designated on the drilling vessel in areas isolated from other operations. Waste containers will be stored in these areas prior to processing or shipment to the contract waste management vendor. All waste materials will be stored properly in containers that are non-leaking and compatible with the waste being stored. All containers will have their lids, rings, covers, bungs and other means of closure properly installed at all times except when waste is being added or removed.

C.10 WELL CLOSURE (PERMANENT OR TEMPORARY ABANDONMENT)

The well will be abandoned in accordance with United States Code of Federal Regulations, Title 30 Mineral Resources, Chapter II – Bureau of Safety and Environmental Enforcement, Department of the Interior, Subchapter B – Offshore, Part 250, Section 1721, Temporary Abandoned Wells, revised July 1, 2012. Specific details of temporary well abandonment are outlined below.

After the well has reached total depth and wireline evaluation logs have been run, the wellbore will be temporarily abandoned and secured with multiple barriers. A 9-7/8" x 10-3/4" casing string will be run to total depth and cemented in place. The cement will be displaced with sufficient mud weight to provide a hydrostatic pressure equal to or greater than the pore pressure plus 300 psi with a seawater column above the mudline. A mechanical plug will be set at the bottom of the casing string and pressure tested. A 100-m surface cement plug will be set approximately 300 m below the mud line. The wellbore will then be negative pressure tested with a seawater column to the mud line prior to disconnecting the BOP stack and riser. The wellbore will be kept for future gas production.

CHAPTER D: EVALUATION OF ENVIRONMENTAL (AND SOCIAL) IMPACTS AND MITIGATION MEASURES

D.1 INTRODUCTION

D.1.1 Impact Assessment Methodology

Two factors which are utilized to determine the significance of an impact provide the foundation for an environmental assessment – impact consequence and impact likelihood. Impact consequence reflects an assessment and determination of an impact's characteristics on a specific resource (e.g., air quality, water quality, benthic communities, etc.). Such determinations take into account resource-specific sensitivity to an impact, recovery capability, and spatial and temporal occurrence.

Impact consequence also includes whether an impact is

- direct or indirect;
- reversible or irreversible; and
- short term (generally reflecting the duration of a project, which typically is in the range of several weeks to several months) or long term (longer than project duration, which is typically on the order of years to decades).

Impact consequence classifications include **beneficial**, **negligible**, **minor**, **moderate**, and **severe**.

Impact likelihood is rated according to its estimated potential for occurrence:

- **likely** (>50% to 100%);
- **occasional** (>10% to 50%);
- **rare** (1% to 10%); or
- **remote** (<1%).

The impact analysis completed for the Tamar SW-1 exploratory well drilling program considered both factors – impact consequence and impact likelihood – to determine overall impact significance. The matrix that integrates impact consequence with impact likelihood, shown as **Table 17**, provided the basis for determining overall impact significance. To summarize the overall significance of each risk, an impact consequence and likelihood matrix were both used as shown in **Table 17**. The result is an overall impact significance rating that includes beneficial and several negative impact levels that range from Negligible to High. Impacts rated as High or Medium in significance are priorities for mitigation. Mitigation was also considered for some less significant impacts to further reduce the likelihood or consequence of impacts.

Table 17. Matrix combining impact consequence and likelihood to determine overall impact significance.

Likelihood vs. Consequence		Decreasing Impact Consequence ←				
		Beneficial	Negligible	Minor	Moderate	Severe
Decreasing Impact Likelihood ↓	Likely	Beneficial	Negligible	Low	Medium	High
	Occasional	Beneficial	Negligible	Low	Medium	High
	Rare	Beneficial	Negligible	Negligible	Low	High
	Remote	Beneficial	Negligible	Negligible	Low	Medium

D.1.2 Impact Classifications

The impact classifications employed in this EA were broadly divided into negative and beneficial impacts, with negative impacts further subdivided based on severity of impact, spatial and temporal aspects of the impacts, and the sensitivity of various resources to the impact. Impact categories (i.e., **beneficial**, **negligible**, **low**, **medium**, and **high**) are defined in **Table 18**.

D.1.3 Impact Producing Factors

Based on the description of the proposed exploratory drilling program outlined previously in **Chapter C**, a series of "impact-producing factors" (IPFs) have been identified. **Table 19** identifies the sources of impacts associated with the Tamar SW-1 exploratory drilling program and the environmental resources that **may** be affected; **Table 19** has been developed, *a priori*, to focus the impact analysis on those environmental resources which may realize impact as a result of one or more IPFs. The tabular matrix indicates which of the routine activities and accidental events could affect specific resources. These are briefly summarized below and discussed in subsequent subsections.

- **Drilling Rig Arrival, Anchoring, Anchor Removal, and Departure** – The short-term transit of the drilling rig and associated support vessels (e.g., AHTS vessels) from Tanin-2 and their arrival at the Tamar SW-1 drillsite may cause temporary disruption of other sea uses. Sediment quality, water quality, and benthic communities will be affected by drilling vessel anchoring and anchor removal, and drilling muds and cuttings seafloor releases and surface discharges. Impacts may include turbidity due to anchor placement and retrieval, including resuspension of sediment components (e.g., buried chemical species).
- **Well Drilling, including Release and Discharge of Drilling Muds and Cuttings** – Changes to seafloor sediments are expected from the seafloor releases of drilling muds and cuttings and the surface discharge of used drilling muds and cuttings; benthic organisms may be buried by discharged drilling muds and cuttings. Releases and discharges may affect water quality.
- **Establishment of a Safety Zone Around the Drilling Rig** – a 500 m safety zone will be established around the *ENSCO 5006* to exclude non-project related vessels. Exclusion has the potential to affect fishing and shipping and maritime industry activities.
- **Physical Presence (including Lights)** – The physical presence of the drilling rig will attract various marine resources, including plankton, fish, and marine and coastal birds.

- **Noise** – The drilling rig, support vessels, and support aircraft (helicopter) will produce noise during routine operations. Most man-made noise associated with offshore oil and gas drilling operations or support activities are in the low frequency bands (<500 to 1,000 Hz). Noise sources include propeller cavitation, propeller singing, and propulsion machinery for vessels; rig machinery, internal combustion engines, and generators for semi-submersible drilling rigs; and engine noise and propeller cavitation for aircraft. Impacts would include ensonification of an area around the sound source, with the potential for changes in behavior or activity level among marine mammals and sea turtles. Excessive noise also has the potential to affect recreation and aesthetics.
- **Combustion Emissions** – Vessel engines and generators for the drilling rig, support vessels, and helicopters will emit air pollutants into the atmosphere during installation, transit, and/or operation. The pollutants, emitted principally from diesel engines and fugitive emissions from fuel tanks, vents, and other emission points are the same as those generated by other ship traffic in the region. There will be temporary, local impacts on air quality near project vessels, but no effects to onshore air quality in Israel are expected due to distances from shore. Support vessel emissions will produce minor impacts on air quality along transit routes (i.e., between the Tamar SW-1 drillsite) and the onshore support base. There will be negligible impacts on air quality from helicopter traffic along travel routes.
- **Routine Discharges** – Routine discharges will be released into the sea in accordance with applicable provisions of MARPOL and the Barcelona Convention, including treated sanitary and domestic wastes and miscellaneous discharges; all discharges are expected to be diluted to background levels within tens to hundreds of meters of project vessels, with little or no impact on water quality or marine biota.
- **Solid Waste** – There will be an incremental contribution of solid wastes from the project requiring landfill usage. The disposal of solid waste from any vessel into the sea is prohibited under MARPOL regulations. Ingestion of, or entanglement with, debris accidentally discarded into the marine environment can kill or injure marine mammals, turtles, and birds. Debris sinking to the seafloor can affect benthic communities. Solid waste (i.e., loss of trash and debris overboard) may also affect sediment quality and water quality. All project vessels will operate under procedures to comply with and satisfy applicable MARPOL provisions.
- **Support Vessel and Helicopter Traffic** – The drilling rig movement and support vessel and helicopter traffic has the potential for vessel strike with marine mammals, turtles, and/or birds. The impacts would be similar to those created by existing shipping and small aircraft traffic in the region. Support vessels would normally follow the most direct route between the drillsite and the shore base and are not expected to interfere with fishing activities along the coast. Shipping and maritime operations in the vicinity of the Tamar SW-1 drillsite may be affected to a very limited degree by support vessel operations. At the onshore support base, a short-term increase in harbor vessel activity is expected.
- **Accidents or Upsets** – The probability of an oil spill during the project is very small especially because gas is the target. An accidental spill of diesel fuel from a ruptured fuel tank on any project vessel or a spill during fueling operations offshore is more likely than a crude oil spill. If a large diesel spill did occur, it could affect marine life such as plankton, fishes, marine mammals, sea turtles, and birds and possibly affect socioeconomic resources. If the spill reached the shoreline, it could affect coastal habitats including beaches and seagrass beds, rocky shores, and associated wildlife. Noble Energy will prepare an Oil Spill Response Plan (OSRP) to respond to a spill and avoid or reduce potential impacts. Impacts of accidents are addressed in **Chapter D.13**.

Table 18. Definitions of impact significance.

Significance	Physical/Chemical Environment	Biological Environment	Socioeconomic and Cultural Environment
High	One or more of the following impacts: • Widespread, persistent contamination of air, water, or sediment • Frequent, severe violations of air or water quality standards or guidelines	One or more of the following impacts: • Extensive, irreversible damage to sensitive habitats such as sensitive deepwater communities, hard/live bottom communities, seagrass beds, marshes, and/or coral reefs, and other sites identified as MPAs, marine protected habitats, or areas of special concern • Death or injury of large numbers of a species listed by the IUCN as endangered, critically endangered, or vulnerable, or irreversible damage to their critical habitat	One or more of the following impacts: • Extensive, irreversible damage to recreational resources such as beaches, boating areas, and/or tourism • Impacts posing a significant threat to public health or public safety • Impacts of a magnitude sufficient to alter the nation's social, economic, or cultural characteristics, or result in social unrest
Medium	One or more of the following impacts: • Occasional and/or localized violation of air or water quality standards or guidelines • Persistent sediment toxicity or anoxia in a small area	One or more of the following impacts: • Localized, reversible damage to sensitive habitats such as sensitive deepwater communities, hard/live bottom communities, seagrass beds, marshes, and/or coral reefs, and other sites identified as MPAs, marine protected habitats, or areas of special concern • Extensive damage to non-sensitive habitats to the degree that ecosystem function and ecological relationships could be altered • Death, injury, disruption of critical activities (e.g., breeding, nesting, nursing), or damage to critical habitat of individuals of a species listed by the IUCN as endangered, critically endangered, or vulnerable	One or more of the following impacts: • Disruption of fishing activities at any location for more than 30 days or exclusion from more than 10% of the fishable area at a given time • Impacts leading to greater than a 10% change in fishery harvest • Localized, reversible impacts on recreational resources such as beaches, boating areas, and/or tourist area
Low	• Changes that can be monitored and/or noticed but are within the scope of existing variability, and do not meet any of the High or Medium definitions (above)		
Negligible	• Changes unlikely to be noticed or measurable against background activities		
+ Beneficial	• Likely to cause some enhancement to the environment or the social/economic system		

IUCN = International Union for Conservation of Nature; MPA = Marine Protected Area.

Table 19. Matrix of potential impacts (*a priori*). A "●" indicates a potential impact to a resource.

Project Activity/ Source of Impact	Environmental Resource											
	Physical/ Chemical			Biological					Socioeconomic and Cultural			
	Air Quality	Sediments/Sediment Quality	Water Quality	Plankton, Fish, and Fishery Resources	Benthic Communities	Marine Mammals and Sea Turtles	Marine and Coastal Birds	Protected Marine Species and Habitats/Marine Habitats of Interest and Areas of Special Concern	Fishing	Shipping and Maritime Industry	Recreation and Aesthetics/ Tourism	Archaeological Resources
ROUTINE, PROJECT-RELATED ACTIVITIES												
TAMAR SW-1 WELL DRILLING AND DRILLING RIG ANCHORING AND REMOVAL												
Drilling rig arrival, anchoring, anchor removal, departure		●	●		●				●	●		●
Drilling, with release/discharge of drill muds & cuttings		●	●	●	●	●	●	●	●			
Safety zone									●	●		
Physical presence (including lights)				●			●			●		
Noise (including support vessels, aircraft)						●	●				●	
Combustion emissions	●											
Routine (non-drilling muds and cuttings) discharges			●	●		●						
Solid waste		●	●	●	●	●		●				
SUPPORT VESSEL AND HELICOPTER TRAFFIC												
Support vessel traffic						●			●	●		
Helicopter traffic						●						
ACCIDENTAL EVENTS The following impacts are "conditional" – they would occur only in the unlikely event of a spill.												
Large diesel fuel spill	●	●	●	●	●	●	●	●	●	●	●	●
Small diesel fuel spill			●			●	●	●	●		●	

D.2 WATER AND SEDIMENT QUALITY IMPACTS

Potential impacts from Tamar SW-1 exploratory drilling operations upon water and sediment quality may arise from:

- Drilling rig arrival, anchoring, anchor removal, and departure;
- Well drilling, including release and discharge of drilling muds and cuttings;
- Routine discharges (water quality only); or
- Solid waste (accidental loss).

D.2.1 Impacts from Drilling Rig Arrival, Anchoring, Anchor Removal, and Departure

Anchor placement and retrieval, and normal anchor chain movement during drilling rig operation, will disturb surficial sediments, causing increased localized turbidity, possible mobilization, and transport of sediment-associated contaminants, and crushing and/or burial of benthic communities below the anchors.

A total of eight (8) anchors will be employed to secure the *ENSCO 5006*. Each anchor measures 6.4 long x 6.5 m wide (**Table 20**). Further, the setting of each anchor will disturb the seafloor as the anchor is pulled into its final position. The area affected during setting of the anchor depends on several factors, including sediment composition (e.g., penetrability, cohesion) and installation operator efficiency.

Each anchor is also directly connected to a 732-m long section of 2.75-in. chain, the latter of which may "sweep" the seafloor during anchor placement and during normal operations. In a conservative estimate, each anchor may be expected to crush or disturb an area of 1) 171.6 m^2 during emplacement and anchor set; and 2) an area of 219 m^2 due to anchor chain sweep. Per anchor, the area of seafloor expected to be crushed or disturbed is estimated at 390.6 m^2 (**Table 20**); for all eight anchors, seafloor disturbance is estimated at 3,125 m^2. Given the localized nature of this impact and its likely occurrence, overall impact significance is anticipated to be low.

Table 20. Estimated seafloor area disturbed during anchor placement and rig operation.

Anchor Dimensions (m)	Anchor Area (m^2)	Area Disturbed – Anchor Set (m^2)	Anchor Chain Sweep Dimensions (m)	Anchor Chain Sweep Area (m^2)	Total Area Disturbed per Anchor (m^2)
6.4 x 6.5	41.6	130	3 x 73	219	390.6

Notes: Estimates based on the following parameters:

- Anchor set: 20 m required to set anchor; 6.5 m anchor width, or 130 m^2.
- Anchor sweep: 10% of total anchor chain length sweeping the seafloor – 3 m wide x 73 m long, or 219 m^2.

D.2.2 Impacts of Well Drilling, including Release and Discharge of Drilling Muds and Cuttings

Drilling discharges will include both used drilling muds and drill cuttings, as well as cement. Noble Energy will be using a WBM and several additives to facilitate drilling and maintain well control. During the initial well sections (36 and 26 in.), there will be no surface returns; muds and cuttings will exit at the borehole, settling near the drillsite and dispersing in the lower portions of the water column. Similarly, with the completion of each hole section, cementing will occur. Excess cement will exit at the borehole between the casing and the formation.

Once the riser has been set, surface returns will commence (i.e., with drilling of the 17-1/2 in. section), allowing for processing of used muds aboard the drilling rig and, as necessary, the discharge of used muds and cuttings from the drilling rig. With surface returns, WBM will be processed on board the drilling rig, passing through screens and shakers to remove cuttings. WBM will be monitored and additives used, as needed. The type and volume of mud additives is determined primarily by the current state of the drilling mud and existing or anticipated downhole conditions.

Cuttings, once removed from the muds and cuttings stream, will be discharged overboard. Drill cuttings are comprised of formation solids (i.e., bits of rock from the formation); in addition, small amounts of liquid and solid drilling mud components will remain adhering to the cuttings. The amounts of WBM that remain attached to cuttings vary, depending on the grain size of the crushed rock from the strata being drilled. Clay-sized cuttings are more difficult than larger cuttings to separate from drilling mud. A typical cuttings discharge during drilling with WBM usually contains 5% to 25% drilling fluid solids after passage through the solids control equipment on the drilling rig (Neff, 2005).

D.2.2.1 Sediment Quality

Impacts to sediment quality from drilling discharges around the Tamar SW-1 drillsite represent a low level of significance due to the localized alteration of sediment particle size distribution attributed to mud

and cuttings deposition. Drilling fluids and cuttings will accumulate on the seafloor, resulting in changes in bottom contours, grain size, barium concentrations, and perhaps concentrations of other metals (NRC, 1983; Boothe and Presley, 1989; Hinwood et al., 1994). The chemical composition of drill cuttings reflects the geochemistry of the formation being drilled and the amount of drilling mud ingredients adhering to the cuttings at the time of disposal. These changes occur primarily within a few hundred meters around the drillsite and may persist for several years (Continental Shelf Associates, Inc., 2006).

The fate of drilling discharges associated with the Tamar SW-1 well was previously detailed in **Chapter C.2.2.2**. While site-specific discharge modeling has not been conducted for the Tamar SW-1 well, drilling fluids and cuttings discharges have been modeled for a representative deepwater exploratory well in the eastern Mediterranean using the MUDMAP model. MUDMAP is a numerical model developed to predict the near- and far-field transport, dispersion, and bottom deposition of drilling mud and cuttings released or discharged during drilling (Spaulding et al., 1994). Noting that there may be differences in the drilling programs between the representative well and the Tamar SW-1 well (e.g., differences in well intervals, total depth, cuttings size classes, etc.), consideration of the results from a representative modeling exercise does provide a good indication of likely deposition patterns, including expected thicknesses and areas affected.

Results of the representative discharge include area and maximum extent of seafloor affected by various deposition thicknesses (see **Figure 25** and **Table 9**). Thickest deposits of muds and cuttings are expected to result from well spudding and drilling of the first two well intervals. Maximum thickness of the muds and cuttings deposit occur within tens of meters of the well, extending outward from the well in diminishing thicknesses (i.e., from 50 mm to 0.5 mm) to approximately 400 m from the drillsite. With surface muds and cuttings returns and subsequent discharge from the drilling rig, much thinner muds and cuttings deposits are realized down current from the discharge location. Results of the representative modeling exercise indicate that the total area of deposition >10 mm was slightly more than1 ha.

Barite (barium sulfate) is a major insoluble component of drilling fluid discharges, and therefore barium concentrations will increase in bottom sediments around the drillsite. Concentrations of other metals in drilling fluids are similar to those in marine sediments, but some metals such as cadmium, copper, lead, mercury, and zinc may be elevated within a few hundred meters of the drillsite (Boothe and Presley, 1989). Altered grain size, changes in select sediment metal concentrations, and the potential for changes in sediment oxygen concentration (i.e., changes in the location of the redox potential discontinuity [RPD] layer) are the primary impacts to sediment quality associated with WBM and cuttings deposition. Given the localized nature of this impact and its likely occurrence, overall impact significance is anticipated to be low.

D.2.2.2 Water Quality

Release of drilling muds and cuttings from the wellbore during the initial stages of drilling will produce increase turbidity within the lower portions of the water column around the drillsite. This localized and short-term diminution in water quality will diminish shortly after completion of the upper well sections and installation of the BOP and riser.

When WBM and cuttings are discharged to the ocean, the larger particles and flocculated solids, representing about 90% of the mass of mud solids, form a plume that settles quickly to the bottom. The remaining 10% of the mass of the mud solids consisting of fine-grained unflocculated clay-sized particles and a portion of the soluble components of the mud from another plume in the upper water column that drifts with prevailing currents away from the discharge point and is diluted rapidly in the receiving waters (Neff, 2005).

Drilling fluid and cuttings discharges from the surface and releases at the wellbore will produce a visible plume that will move with the currents as these materials are diluted and settle to the seafloor. In general, turbid water may extend between a few hundred meters and several kilometers down current from the discharge point and persist for several hours after each discharge. Studies have demonstrated reductions in water clarity within a few hundred meters to about 2 km of drilling rigs during drilling fluid discharges (Ayers et al., 1980a,b; Ray and Meek, 1980). Neff (2010) reported that field studies of WBM and cuttings discharges in temperate and cold water environments exhibit up to a 30-fold dilution in the discharge pipe; within 30 m of the discharge, the muds and cuttings discharge can be expected to be diluted by an additional 1,000- to 3,000-fold. Dispersion to background levels typically requires several minutes to several hours (Neff, 1987).

Results of discharge modeling conducted for a deepwater well in the eastern Mediterranean (CSA International, Inc., 2011) indicated that water column concentrations of drilling discharges will have only limited areal and linear extent, under worst case conditions. Background levels (i.e., 1 to 2 ppm, or 1 to 2 g/m^3) are reached within approximately 3.6 km of the discharge (**Table 21**). In the upper portions of the water column, the turbidity plume will reduce light penetration for a short period of time. In the lower portions of the water column, increases in turbidity will be limited to several meters above the seafloor.

Table 21. Predicted plume distance and maximum concentrations for a drilling mud discharge from the third well interval of a representative deepwater well, eastern Mediterranean (From: CSA International, Inc., 2011).

Time from Beginning of the Discharge (hr)	Distance Traveled (km)	Maximum Concentration (g/m^3)
12	0.62	10
24	3.6	2
36	5.9	2

Impacts to water quality from drilling muds and cuttings releases from the wellbore and from drilling rig discharges are likely. Turbidity effects will be very localized. Total area affected by increases in water column turbidity will be limited to several hundred meters around the drillsite. Impact consequence of changes to water quality is minor. Given the localized nature of this impact and its likely occurrence, overall impact significance is anticipated to be low.

D.2.3 Impacts of Routine Discharges

Routine discharges will include treated sanitary and domestic wastes, water maker brine, cooling water, and organic waste originating from the *ENSCO 5006* and support vessels. Support vessels, including the AHTS vessels, may discharge sanitary and domestic wastes and small amounts of runoff water (i.e., deck drainage).

Sanitary waste consists of human body wastes from toilets and urinals. Aboard the drilling rig, sanitary wastes will be processed through one of two Omni-Pure Wastewater Treatment Type II units. Sanitary wastes generated aboard the support vessels will be treated by means of a marine sanitation device that produces an effluent with a minimum residual chlorine concentration of 1.0 mg/L and no visible floating solids or oil and grease. Additional details regarding sanitary waste processing were provided previously in **Chapter C.8**.

Domestic waste, or "gray water," includes water from showers, sinks, laundries, galleys, safety showers, and eye-wash stations. Aside from screening to remove solids, domestic waste does not require treatment before discharge.

Freshwater is generated aboard the drilling rig via two (2) reverse osmosis (RO) water makers. Under normal operating conditions, only one RO unit operates at a time. Maximum feed water flow rate through the unit is 380 m^3/day, with a maximum brine discharge flow rate of 320 m^3/day. The excess seawater being discharged does not contain any added chemicals.

Cooling water is used to control and maintain proper temperatures on internal combustion engines aboard the drilling rig and project vessels. Cooling water discharge effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place, typically within 100 m of the discharge source.

Organic waste (i.e., food waste) will be ground prior to discharge in accordance with Annex V of MARPOL 73/78 requirements. Aside from grinding to <25 mm particle size, no other treatment of organic wastes is expected.

Sanitary and domestic waste and organic waste from the *ENSCO 5006* and support vessels may affect concentrations of suspended solids, nutrients, and chlorine in the water column as well as generate increases in biological oxygen demand (BOD). Brine and cooling water discharges will produce localized increases in salinity and water temperature, respectively. However, these discharges are expected to be diluted rapidly in the open ocean (USEPA, 1993; USDOI, MMS, 2007b). Impacts would likely be undetectable beyond tens of meters from the source. Due to the nature of routine discharges and their dilution in the receiving environment, impacts to water quality are expected to be minor. Given the likely nature of this impact, overall impact significance is low.

Due to water depth and the nature of the open sea oceanographic environment at the Tamar SW-1 drillsite, routine discharges will not reach the seafloor. As a result, there will be no impacts of routine discharges on sediment quality.

D.2.4 Impacts of Solid Waste

While the disposal of trash and debris in the sea is prohibited under MARPOL provisions, occasionally, debris such as welding rods, buckets, pieces of pipe, etc., may accidentally fall overboard and accumulate on the seafloor. Pieces of debris reaching the seafloor may be colonized by epibiota and attract fishes (due to their physical structure on the otherwise flat seafloor), with a corresponding minor and localized impact to the benthic community (Shinn et al., 1993). Depending upon the nature of solid waste, leaching of organics or trace metals may occur, resulting in very localized changes in sediment quality. Due to the restrictions on dumping and expected adherence to applicable MARPOL provisions, this impact is anticipated to be minor. Given the likely nature of this impact, overall impact significance is anticipated to be low.

D.3 OIL SPILL RESPONSE PLAN

Noble Energy has developed an OSRP that has previously been submitted to the MoEP. While en route to or from the drillsite location, the drilling rig and support vessels will operate under their MARPOL73/78-required Shipboard Oil Pollution Emergency Plan (SOPEP). The SOPEP details the response of the ship's crew in case of oil pollution, including reporting requirements. Noble Energy and ENSCO have also developed a management interface document which identifies the appropriate

responsibilities and lines of communication during an accidental release. A copy of the *ENSCO 5006* Emergency Response Manual is provided in **Appendix G**.

D.4 LIGHTING IMPACTS

Potential impacts from lighting associated with Tamar SW-1 exploratory drilling operations may affect:

- Sea turtles; and
- Marine and coastal birds.

D.4.1 Impacts to Sea Turtles

Some sea turtles may be attracted to offshore structures (Rosman et al., 1987; Lohoefener et al., 1990). It has been suggested that sea turtle hatchlings could be attracted to brightly lighted offshore structures, including drilling rigs and platforms, where they may be subject to increased predation by birds and fishes (NOAA, National Marine Fisheries Service [NMFS], 2001).

The presence of the drilling rig lights will be a new light source in the study area, however, the drilling rig will only be on site for a relatively short period of time (i.e., several months). Impacts on turtle populations are likely to be limited, if they occur, to only a few individuals; no population level impacts are expected. In the Gulf of Mexico where thousands of offshore structures are present, platform lighting is considered unlikely to appreciably reduce the reproduction, numbers, or distribution of sea turtles (NOAA, NMFS, 2001).

Due to the duration of exploratory drilling operations, this impact is anticipated to be minor with an overall low impact significance.

D.4.2 Impacts to Marine and Coastal Birds

The potential causes for the well-documented attraction of seabirds to structures at sea include attraction to lights and the structure itself (Wolfson et al., 1979; Tasker et al., 1986; Baird, 1990; Wiese et al., 2001), as well as to the increased concentration of food sources around the structure (Baird, 1990; Montevecchi et al., 1999). Seabirds use mostly optical cues for migrating between breeding and wintering areas; navigation aids include internal maps, sunlight and sunrise/sunset cues, starlight and celestial navigation, topography, and an internal magnetic compass (Greer et al., 2010). Birds migrating through an environment which is otherwise flat and very dark at night find offshore platforms an attractive visual cue. It should be noted that visibility is important in itself, to prevent collisions.

The presence of offshore structures has both a positive and negative impact on birds. The presence of offshore structures, whether permanent (e.g., platforms) or temporary (e.g., drilling rigs, support vessels) may have an effect on bird life both as an attractant as well as a harmful agent (Baird, 1990; Montevecchi et al., 1999; Fraser et al., 2006). Some birds may be attracted to offshore structures because of the lights, as well as the fish populations that aggregate around these structures. Particularly sensitive species would be petrels and other Procellariforms who forage on vertically migrating bioluminescent prey.

Birds may use offshore structures for resting, feeding, or as temporary shelter from inclement weather (Russell, 2005). However, birds migrating over water at night have been known to strike offshore structures, resulting in death or injury (Wiese et al., 2001; Russell, 2005).

While the bulk of the bird migration over Israel occurs inland, its margins pass over the nearshore portions of the eastern Mediterranean. The radius of the bird monitoring radar located in Latrun, Israel,

reaches to about 30 km off the shoreline and regularly detects activity up to its margin (Birding Israel, 2013). The bird migration period also extends from March to the end of May and August to the end of November.

Because the Tamar SW-1 drillsite is located approximately 98 km offshore, it is expected that the *ENSCO 5006* will not be visible to migrating birds that routinely migrate along or near the coast. Consequently, the presence of the *ENSCO 5006* is expected to have a negligible impact on marine (seabirds or migratory) birds. Given the likely nature of this impact, overall impact significance is negligible.

D.5 NOISE IMPACTS

Potential impacts from Tamar SW-1 exploratory drilling operations and its associated noise may affect:

- Marine mammals;
- Sea turtles; and
- Recreation and Aesthetics/Tourism.

Expected noise levels from various project sources were previously identified in **Table 12**. Salient characteristics of these representative noise sources as they apply to proposed operations include the following:

- Most man-made noise associated with offshore oil and gas drilling operations or support activities are in the low frequency bands (<500 to 1,000 Hz).
- Propeller cavitation, propeller singing, and propulsion machinery are primary noise sources for vessels (regardless of size), which is not an issue with the *ENSCO 5006*, but would be associated with AHTS and support vessel operations.
- Semi-submersible drilling units produce sound levels which are generally lower than other drilling vessels or bottom-founded drilling units (e.g., drillships, jack-up rigs) because the rig machinery is mounted on raised decks, which are elevated and benefit from portions of the noise spectrum reflecting off the ocean surface.
- Sound source levels for a semi-submersible are in the range of 154 dB re 1 µPa at 1 m.
- Supply and crew boats produce sound source levels in the range of 128 to 158 dB re 1 µPa at 1 m; these sound sources are considered transient as they move between shore base and the drilling rig; sound from the standby vessel will be at a lower source level while idling on station.
- Underwater sounds from helicopters, as with all aircraft, reach their highest levels just below the surface and directly under the aircraft. When the aircraft is overhead, sound levels decrease with increasing aircraft altitude or increasing receiver depth. The highest energy of helicopter rotor sound is at frequencies <500 Hz, while helicopter turbines contribute to higher sound levels at frequencies >500 Hz.
- Transmission of airborne sound into the water is a function of source altitude, orientation (e.g., <26° maximizes sound penetration into the water column), receiver water depth and orientation, and sea surface conditions.

D.5.1 Impacts to Marine Mammals

Some marine mammals may avoid the Tamar SW-1 area due to noise associated with drilling operations. Others might be attracted to fish populations around the drilling rig. The most likely impacts would be short-term behavioral changes such as diving and evasive swimming, disruption of activities, or departure from the area. As resident marine mammals become accustomed to the operation noise, they will return to their routine behavior patterns.

Richardson et al. (1995) defined four zones of potential noise effects on marine mammals. In order of increasing severity, they are 1) audibility; 2) responsiveness (behavioral effects); 3) masking; and 4) hearing loss, discomfort, or injury (physical effects). The levels of sound produced during operations aboard the drilling rig are sufficient to be audible and to produce behavioral responses, but much lower than those known to cause hearing loss, discomfort, or injury.

Low-frequency noise from engines and equipment, including the drilling rotary table, aboard the *ENSCO 5006* can be detected by marine mammals (Richardson et al., 1995). Mysticetes (baleen whales such as the humpback, minke, and Bryde's whales) are more likely to detect low-frequency sounds than are most odontocetes (e.g., dolphins), which have their best hearing in high frequencies. Because of recent, ongoing drilling and installation (i.e., subsea completions, pipelines) operations in the region, marine mammals in the area may have become acclimated to oil and gas operations, vessel transits, and related noise.

Drilling rig noise will be continuous but relatively weak in intensity, estimated to be in the range of 154 dB re 1 µPa. Some of the noise (from support vessel engines and propellers) will be similar to the existing noise associated with shipping traffic in the region, in the range of 128 to 158 dB re 1 µPa.

No absolute sound exposure thresholds exist for marine mammals on a worldwide basis, and few countries have established exposure criteria. Since 1997, the U.S. NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts to a marine mammal such that a take by harassment might occur. Take, as defined under the U.S. Marine Mammal Protection Act (MMPA), means "to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill" any marine mammal. Harassment, as defined under the MMPA, includes two levels: Level A and Level B harassment. Level A harassment is any act which has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment is any act which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns but does not have the potential to injure a marine mammal or marine mammal stock in the wild. To date, few studies have been conducted that examine impacts to marine mammals from continuous sound (e.g., from drilling) from which empirical sound thresholds have been established.

Current NMFS practice regarding exposure of marine mammals to sound (NOAA, NMFS, 2013) is that cetaceans and pinnipeds exposed to sound levels of 180 and 190 dB re 1 µPa root mean square (rms) or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment. Thresholds for behavioral response from impulse sounds are 160 dB rms (received level) for all marine mammals, based on behavioral response data for marine mammals exposed to seismic airgun operations (Malme et al., 1983, 1984; Richardson et al., 1986); this threshold is not applicable in the current context.

Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 120 dB rms for continuous sound, but below injurious thresholds; thresholds for behavioral response for "continuous" (non-impulsive) sounds have been set at 120 dB rms (for some but not all sound sources) based on the results of Malme et al. (1984) and Richardson et al. (1990). Different exposure levels have been established for pinnipeds exposed to airborne sound (i.e., 100 dB [unweighted] for pinnipeds in general; 90 dB [unweighted] for harbor seals), specifically as they pertain to pinniped disturbance (e.g., from haul-outs); these latter exposure criteria are not applicable in this context, as no pinniped or pinniped haul-outs occur near the Tamar SW-1 drillsite location. The applicable exposure threshold for the Tamar SW-1 exploratory drilling operations is 180 dB re 1 µPa (rms) for injury and 120 dB re 1 µPa (rms) for behavioral disturbance. All sound sources are below the threshold for injury (i.e., only the potential for behavioral response exists). The calculated distances from each source to the threshold for behavioral response are provided in **Table 22**.

Table 22. Sound sources associated with the Tamar SW-1 exploratory drilling program and calculated distances to the applicable exposure threshold for behavioral response.

Sound Source	Source Levels (dB re 1 µPa at 1 m) Broadband (45-7,070 Hz)	Applicable Sound Exposure Threshold (dB re 1 µPa rms) – Behavioral Response	Distance from Source to Threshold (m)
Continuous Sound Sources			
Drilling			
Semi-submersible	154	120	50.1
Transient Sound Sources			
Vessels Underway			
Supply Vessel	128-158	120	2.5-74.9
Crew Boat	156	120	63.1
Aircraft			
Bell 212 Helicopter	162	120	125.9

The degree to which underwater sound propagates away from a sound source is dependent on a variety of factors, the most important of which are bathymetry and presence or absence of reflective or absorptive conditions (e.g., in-water structures, sediments). Spherical spreading occurs in a perfectly unobstructed (i.e., free-field) environment not limited by depth or water surface, resulting in a 6 dB reduction in sound level for each doubling of distance from the source (2log[range]). Because the *ENSCO 5006* will be operating in open ocean conditions, spherical spreading criteria are most appropriate to calculate distances to threshold.

Based on calculations presented in **Table 22**, marine mammals (i.e., mysticetes) within 50 m of the drilling rig may experience behavioral disturbance from drilling-related noise. Similarly, marine mammals (i.e., mysticetes) within 2.5 to 74.9 m of transiting vessels may experience behavioral disturbance. In either case, marine mammals will hear the sound source prior to any exposure to these source levels; they may respond by changing course or diving, avoiding or minimizing any further exposure.

Due to the duration of exploratory drilling operations, the nature of the project-related sound sources, and the low radial distances from source to threshold levels (i.e., <75 m), this impact is anticipated to be minor. Given the likely nature of this impact, overall impact significance is low.

D.5.2 Impacts to Sea Turtles

Some sea turtles may be attracted to offshore structures (Rosman et al., 1987; Lohoefener et al., 1990). It has been suggested that sea turtle hatchlings could be attracted to brightly lighted offshore structures, including drilling rigs and platforms, where they may be subject to increased predation by birds and fishes (NOAA, NMFS, 2001) and may be subject to noise exposure from the drilling rig.

Sound exposure criteria for marine mammals have been historically applied to sea turtles. Based on calculations presented in **Table 22**, sea turtles within 50 m of the drilling rig may experience behavioral disturbance from drilling-related noise. Similarly, sea turtles within 2.5 to 74.9 m of transiting vessels may experience behavioral disturbance. As was the case with marine mammals, sea turtles will hear the sound source prior to any exposure to these source levels; they may respond by changing course or diving, avoiding or minimizing any further exposure.

The drilling rig will only be on site for a relatively short period of time (i.e., several months), limiting the potential for noise exposure. Due to the duration of exploratory drilling operations, when coupled with the nature of the project-related sound sources and the low radial distances from source to threshold levels (i.e., <75 m), this impact is anticipated to be minor. Given the likely nature of this impact, overall impact significance is low.

D.5.3 Impacts to Recreation and Aesthetics/Tourism

Offshore structures (e.g., platforms, drilling rigs) typically are visible from shore at distances of 5 to 16 km, with small structures barely visible at 5 km from shore. On a clear night, lights on top of offshore structures may be visible to a distance of approximately 32 km (USDOI, MMS, 2007b,c). Since the *ENSCO 5006* will be located 98 km from the nearest shoreline, the drilling rig will not be visible from shore.

Supply vessels and helicopters will periodically transit between Haifa and the Tamar SW-1 drillsite. During those periods when vessels and aircraft are close to shore, they will be visible to coastal visitors involved in recreation and tourism. The Port of Haifa is one of Israel's busiest ports. Tourists and those involved in coastal recreation will experience a variety of vessel traffic, including tankers, cargo vessels, cruise ships, and a diverse assortment of smaller watercraft. The periodic transit of supply vessels and aircraft does not represent a unique or unexpected event. Impacts on nearshore recreational activities, aesthetics, and tourism are expected to be negligible. With the possible exceptions of fishing and deepwater yachting, it is expected that no other recreational activities will be conducted in the vicinity of or near the Tamar SW-1 drillsite. Given the likely nature of this impact, overall impact significance is negligible.

D.6 NATURE AND ECOLOGY IMPACTS

The topic of nature and ecology includes a variety of resources, including plankton, fish, benthic communities, marine mammals, sea turtles, and birds. Potential impacts from Tamar SW-1 exploratory drilling operations upon nature and ecology may arise from:

- Drilling rig arrival, anchoring, anchor removal, and departure;
- Well drilling, including release and discharge of drilling muds and cuttings;
- Physical presence;
- Routine discharges;
- Solid waste (accidental loss); and
- Support vessel and helicopter traffic.

D.6.1 Impacts from Drilling Rig Arrival, Anchoring, Anchor Removal, and Departure

Drilling rig arrival, anchoring, anchor removal, and departure are unlikely to affect most marine resources (e.g., plankton, fish, marine mammals, sea turtles, birds), but will affect the seafloor, including benthic communities at and near the Tamar SW-1 drillsite. Detailed discussion of anchor placement and retrieval operations and estimates of seafloor disturbed have been provided previously in **Chapter D.2.1**.

Benthic communities immediately below each anchor will be crushed, and benthic fauna will be disturbed as anchors are set; areas of the seafloor affected by anchor chain sweep will also be disturbed. Benthic fauna within several meters of each anchor will be buried as sediments are resuspended and settle during anchor placement and removal. The total area of the benthic community expected to be affected by anchor emplacement and anchor sweep is approximately 3,125 m^2.

Results of the videodocumentation survey recently conducted at the Tamar SW-1 study area (CSA Ocean Sciences Inc., 2013a) indicate that the seafloor of the entire survey area is characterized by a smooth, relatively flat soft bottom. Soft bottom substrate is composed of mud and a fine silt veneer that is subject to resuspension from physical disturbances. Seafloor features included subtle variations in surficial topography; presence of small calcareous debris (i.e., mollusc shells); and bioturbation in the form of mounds, burrows, and motile biota track lines. No consolidated substrates (i.e., hard bottom) or signatures of chemosynthetic communities were observed within the survey area which verifies the finding of the geohazard surveys (Gardline Surveys Inc., 2012).

Biological activity was a relatively common observance within the Tamar SW-1 study area and was predominately motile biota and biologically maintained burrows and mounds (CSA Ocean Sciences Inc., 2013a). The most common organisms observed during the video survey were fish and shrimp. The most common fish observed was the tripod fish (*Bathypterois* sp.). Many of the fish observed during the video survey were unidentifiable by video analysis due to their awkward positioning relative to the camera or small body size. Abundances of fish and shrimp averaged approximately 2 and 3 individuals per 100 m of survey transect, respectively. Bioturbation was commonly observed along all video transects and included patterned burrows (i.e., small groupings) and small (approximately 15 to 30 cm), conical mounds likely formed by deposit feeding worms (Polychaeta). Regional characterizations of the soft bottom community of the Levant Basin indicate that crustaceans and polychaetes are the dominant infaunal groups, with contributions from other phyla (e.g., molluscs, echninoderms, minor phyla).

Soft bottom benthos is predominant and ubiquitous in the Tamar SW-1 study area, with an absence of any significant benthic features (i.e., no hard bottom outcrops, no chemosynthetic communities). Impacts will be localized to anchor and anchor chain locations. Colonization of anchor-affected areas will begin immediately following impact, with colonization expected from adjacent, non-affected areas of soft sediment.

Given their ubiquitous characteristics, impacts on benthic communities from anchor installation and removal (and anchor chain sweep) will be minor. Given the likely nature of this impact, overall impact significance is low.

D.6.2 Impacts from Well Drilling, including Release and Discharge of Drilling Muds and Cuttings

Drilling muds and cuttings have the potential to adversely affect a variety of resources within the marine environment, including plankton and fish, benthic communities, marine mammals, and sea turtles. Each of these resources is evaluated below.

D.6.2.1 Plankton and Fish

Discharges of drilling fluids and cuttings are likely to have little or no impact to plankton or fish due to the low toxicity and rapid dispersion of these discharges (NRC, 1983; Neff, 1987; Hinwood et al., 1994). Water-based drilling fluids proposed for this project have low toxicity, therefore there is little chance of toxic effects on fishes or other water column organisms. Given the localized nature of this impact, the low toxicity of the discharges, and its likely occurrence, overall impact significance is anticipated to be negligible.

D.6.2.2 Benthic Communities

Benthic community effects of drilling discharges have been reviewed extensively by the NRC (1983), Neff (1987), and Hinwood et al. (1994), among others. Due to the low toxicity of most drilling fluids, the

main mechanism of impact to benthic communities is increased sedimentation, possibly resulting in burial or smothering. Most benthic fauna live in the upper few centimeters of offshore, fine-grained sediments, with benthic communities comprised of varying feeding guilds – filter feeders, surface deposit feeders, subsurface deposit feeders, and carnivores. Deposit feeders, in particular, are recognized for their ability to process/injest or move sediment during tube building and feeding (i.e., bioturbation). The maximum depth of bioturbation is in the range of 4 to 5 cm for most infauna, although larger infaunal burrowers are known to extend 20 or more cm into the sediment. Infaunal feeding guilds are important in determining impacts from sediment deposition (i.e., filter feeding species are highly susceptible to increased sedimentation compared to deposit feeders).

Monitoring programs have shown that benthic impacts of drilling are minor and localized within a few hundred meters of the drillsite (EG&G Environmental Consultants, 1982; NRC, 1983; Neff, 1987; Continental Shelf Associates, Inc., 2006). The water depth is expected to facilitate the dispersion of drilling fluids and cuttings discharged from the drilling rig and should minimize benthic impacts. The thickest accumulations may result from release of cuttings and water-based "spud mud" during the initial well interval before the marine riser is set. At the water depths involved, these materials will bury and smother benthic organisms only within tens of meters around the wellbore where the thickness of the cuttings deposits will be 10 to 100 mm (i.e., 1 to 10 cm) or more.

Two sets of drilling muds and cuttings releases or discharges are expected, including: 1) the seafloor release of cuttings, water-based drilling fluids, and excess cement slurry during jetting and drilling of the upper well sections; and 2) the rig discharges of water-based drilling fluids and cuttings from the lower well sections. Impacts on benthic communities from these releases or discharges may arise from changes in grain size, burial and subsequent hypoxia or anoxia, or toxicity.

Impacts to the benthos due to seafloor releases are expected to be of medium significance. During the first well interval when the hole is being jetted into the seafloor, cuttings and "spud mud" will be released at the seafloor. These initial discharges will create a mound with a diameter of several meters to tens of meters around the wellbore. Also, during setting of the casing, cement slurry will be pumped into the well to bond the casing to the walls of the hole. Excess cement slurry will emerge from the hole and accumulate on the seafloor, generally within about 10 to 15 m around the wellbore (Shinn et al., 1989). Cement slurry components typically include cement mix and some of the same chemicals used in water-based drilling fluids (Boehm et al., 2001).

The main impacts of all of these materials will be burial and smothering of benthic organisms within several meters to tens of meters around the wellbore. Water-based muds also typically contain an organic phase that can increase the potential for oxygen depletion in near surface sediments (when deposited in sufficient amounts), with an increase in possible mortality within the benthic community (Schaanning et al., 2008a,b). While field measurements of this phenomenon are very limited, Trannum et al. (2006) observed lowered redox potentials 75 m from a well drilled with WBM. In addition, the deposition of muds and cuttings particles appears to prompt tube building and burrowing activity of indigenous fauna in response to this short-term disturbance of the sediment surface. New tube building and burrowing increases irrigation and solute exchange across the newly deposited muds and cuttings layer (Trannum et al., 2010).

Soft bottom sediments and their associated benthic community disturbed by cuttings, drilling muds, and cement slurry will eventually be recolonized through larval settlement and migration from adjacent areas. Recovery may require several years and is dependent on the nature of the indigenous fauna, their tolerance to burial, life history characteristics (e.g., spawning and settlement characteristics), and their relative abundance in the deposition areas.

Impacts on benthic communities from drilling muds and cuttings releases and discharges will be minor. Given the likely nature of this impact, overall impact significance is low.

D.6.2.3 Marine Mammals

Discharges of drilling fluids and cuttings are likely to have little or no impact to marine mammals due to the low toxicity and rapid dispersion of these discharges (NRC, 1983; Neff, 1987; Hinwood et al., 1994). Water-based drilling fluids proposed for this project have low toxicity and are unlikely to affect marine mammal prey (i.e., plankton, fish). Therefore, there is little chance of impact to marine mammals from the discharge of drilling muds and cuttings.

Impacts on marine mammals from drilling muds and cuttings releases and discharges will be negligible. Given the likely nature of this impact, overall impact significance is negligible.

D.6.2.4 Sea Turtles

Discharges of drilling fluids and cuttings are likely to have little or no impact to sea turtles due to the low toxicity and rapid dispersion of these discharges (NRC, 1983; Neff, 1987; Hinwood et al., 1994). Water-based drilling fluids proposed for this project have low toxicity and are unlikely to affect sea turtle prey (i.e., medusae). Therefore, there is little chance of impact to sea turtles from the discharge of drilling muds and cuttings.

Impacts on sea turtles from drilling muds and cuttings releases and discharges will be negligible. Given the likely nature of this impact, overall impact significance is negligible.

D.6.3 Impacts of Physical Presence

The physical presence of the drilling rig, particularly within an area of open ocean void of other offshore structures, has the potential to affect several resources within the marine environment. Attraction and subsequent impacts associated with lighting were addressed previously in **Chapter D.4**. For example, zooplankton and ichthyoplankton may be attracted to lights associated with offshore structures. Fish larvae are strongly attracted to lights at night (Victor, 1991).

Physical presence has the potential to affect fish and, to a lesser extent, marine mammals and sea turtles. Each of these resources is evaluated below.

D.6.3.1 Fish

The presence of the *ENSCO 5006* will attract fishes, providing shelter and food in the form of attached fouling biota (Gallaway and Lewbel, 1982). Offshore structures typically attract epipelagic fishes such as tunas, dolphin, billfishes, and jacks (e.g., Holland et al., 1990; Higashi, 1994). This “artificial reef effect” is generally considered a beneficial impact.

The effect, either positive or negative, is likely negligible. Given the likely nature of this impact, overall impact significance is negligible.

D.6.3.2 Marine Mammals

Offshore structures are known to attract fish and could function as feeding stations for certain marine mammal species, predominantly odontocetes (e.g., dolphins; Cremer et al., 2009) and pinnipeds (e.g., harbor porpoises; Bach et al., 2010). In this context, the physical presence of an offshore structure

is not the primary attractant for marine mammals, but a secondary consequence where the structure functions as an artificial reef, attracting potential prey species.

Due to the duration of exploratory drilling operations and presence of the *ENSCO 5006*, this impact is anticipated to be negligible. Given the likely nature of this impact, overall impact significance is negligible.

D.6.3.3 Sea Turtles

Some sea turtles may be attracted to offshore structures (Rosman et al., 1987; Lohoefener et al., 1990). It has been suggested that sea turtle hatchlings could be attracted to brightly lighted offshore structures, where they may be subject to increased predation by birds and fishes (NOAA, NMFS, 2001). The presence of the *ENSCO 5006* will be short term, and within an area void of other offshore structures.

Impacts on turtle populations are likely to be minor or negligible. In the Gulf of Mexico where thousands of offshore structures are present, platform lighting is considered unlikely to appreciably reduce the reproduction, numbers, or distribution of sea turtles (NOAA, NMFS, 2001).

Due to the duration of exploratory drilling operations and presence of the *ENSCO 5006*, this impact is anticipated to be minor. Given the likely nature of this impact, overall impact significance is low.

D.6.4 Impacts of Routine Discharges

Routine discharges are unlikely to affect most marine resources (e.g., marine mammals, sea turtles, birds), but may affect plankton and fish which actively or passively pass through the discharge plume. Each of these resources is evaluated below.

D.6.4.1 Plankton

In the upper portions of the water column, the turbidity plume created by routine discharges will reduce light penetration for a short period of time in close proximity to the discharge, with minimal impacts to phytoplankton. Discharges from the drilling rig occur at 14 m below the surface, further reducing the potential for impact to plankton in the upper portions of the water column. Within the water column, potential exposure to routine discharges will be very limited.

Due to rapid dilution and location of the discharge plume, this impact is anticipated to be negligible. Given the likely nature of this impact, overall impact significance is negligible.

D.6.4.2 Fish

While increased turbidity is not expected to physically affect fishes (e.g., via interference with gill function), turbidity increases may alter the foraging success of some fishes when they are present within a plume (De Robertis et al., 2003). Given that the total area affected by these discharges is very small, foraging fish are expected to either avoid or move out of the discharge plume. Turbidity effects will be very localized.

Due to rapid dilution and location of the discharge plume, this impact is anticipated to be negligible. Given the likely, but localized nature of this impact, overall impact significance is anticipated to be low.

D.6.5 Impacts of Solid Waste

The disposal of solid waste from any vessel into the sea is prohibited under MARPOL regulations. Solid waste will be containerized and/or palletized and shipped to shore for proper disposal. However, the accidental loss of solid waste from the drilling rig or support vessels has the potential to adversely affect several marine resources. Ingestion of, or entanglement with, floating debris accidentally discarded into the marine environment can kill or injure marine mammals, turtles, and birds, or may be transported to shore where it may affect coastal habitats. Debris sinking to the seafloor can affect benthic communities. Each of these resources is evaluated below.

D.6.5.1 Marine Mammals, Sea Turtles, and Marine and Coastal Birds

Materials accidentally lost overboard during offshore oil and gas operations could 1) entangle marine fauna or 2) cause injury through the ingestion of trash and debris (Laist, 1996). Marine debris is among the threats affecting the population status of both humpback and sperm whales (NOAA, NMFS, 1991, 2006). Similarly, ingestion of or entanglement with accidentally discarded debris can kill or injure sea turtles (Laist, 1996; Lutcavage et al., 1997). Marine debris is among the threats affecting the endangered population status of several sea turtle species (NRC, 1990). Leatherback turtles are especially attracted to floating debris, particularly plastic bags, because it resembles their preferred food, jellyfish. Ingestion of plastic and Styrofoam can result in drowning, lacerations, digestive disorders or blockage, and reduced mobility.

Marine debris can also injure or kill birds that ingest or become entangled in it. Compliance with the MARPOL restrictions reduce potential impacts to marine mammals, sea turtles, and marine birds.

Impacts on these resources are expected to be minor. Given the occasional nature of this impact, overall impact significance is low.

D.6.5.2 Benthic Communities

The occasional and accidental loss of debris (e.g., welding rods, buckets, pieces of pipe, etc.) will result in an accumulation on the seafloor (see **Chapter D.2.4**). Pieces of debris reaching the seafloor may be colonized by epibiota and attract fishes (due to their physical structure on the otherwise flat seafloor), with a corresponding minor and localized impact to the benthic community (Shinn et al., 1993). Depending upon the nature of solid waste, leaching of organics or trace metals may occur, resulting in very localized changes in sediment quality. Due to the restrictions on dumping and expected adherence to applicable MARPOL provisions, this impact is anticipated to be minor. Given the likely nature of this impact, overall impact significance is anticipated to be low.

D.6.5.3 Protected Marine Species and Habitats/Marine Habitats of Interest, and Areas of Special Concern

Floating debris accidentally lost overboard may be carried by surface currents to shore. Debris accidentally lost overboard, should it reach shore, will produce minor impacts on coastal habitats, including areas where protected marine species and habitats/marine habitats of interest and areas of special concern. Given the occasional nature of this impact, overall impact significance is low.

D.6.6 Impacts of Support Vessel and Helicopter Traffic

Support vessels will transit between Haifa and the Tamar SW-1 drillsite on a regular basis. Initially, relocation of the *ENSCO 5006* from the Tanin-2 well to the Tamar SW-1 location will require the assistance of two AHTS vessels (see **Chapter C.2.1**). Drilling rig transit and anchoring are expected to require several days, during which the AHTS vessels will remain on site. Once anchored, support vessels will provide the drilling rig with personnel and supplies, as needed, conducting round trip visits from the Haifa shore base. It is expected that support vessels and helicopters will visit the drilling rig at least once per week.

D.6.6.1 Marine Mammals

There is a small possibility of a support vessel striking a marine mammal during routine vessel operations. The risk is similar to that associated with existing vessel traffic in the region. Collisions with dolphins or whales are considered highly unlikely; most dolphins are agile swimmers and are unlikely to collide with vessels. Of the 11 marine mammal species known to have been hit by vessels, fin whales are struck most frequently, sperm whales are hit commonly, and records of collisions with Bryde's whales are rare (Laist et al., 2001). Although all sizes and types of vessels can collide with whales, most lethal or severe injuries are caused by ships 80 m or longer and traveling 14 knots or faster (Laist et al., 2001).

Vessel strikes are among the threats affecting the population status of both humpback and sperm whales (NOAA, NMFS, 1991, 2006). Sperm whales are vulnerable to ship strikes because they typically spend up to 10 minutes "rafting" at the surface between deep dives (Jacquet et al., 1998). There have been many reports of sperm whales of different age classes being struck by vessels, including passenger ships and tugboats. There were also instances in which sperm whales approached vessels too closely and were injured by propellers (NOAA, NMFS, 2006).

Due to the short duration of the project, the low number of support vessel trips, and support vessel size, the likelihood of striking a marine mammal is considered remote to rare. Overall significance of vessel strikes to marine mammals is considered to be low.

D.6.6.2 Sea Turtles

There is a remote possibility of a support vessel striking a sea turtle during routine vessel operations. Vessel strikes are among the threats affecting the endangered population status of several sea turtle species (NRC, 1990). The risk for this project is similar to that associated with existing vessel traffic in the region. Studies indicate that sea turtles are at the sea surface only about 10% of the time and readily sound (dive) to avoid approaching vessels (Byles, 1989; Lohoefener et al., 1990; Keinath and Musick, 1993; Keinath et al., 1996).

Due to the short duration of the project and the infrequent nature of the support vessel traffic, the likelihood of striking any sea turtle is considered remote to rare. Overall impact significance is low.

D.6.6.3 Marine and Coastal Birds

Vessel and helicopter traffic could periodically disturb individuals or groups of coastal birds. It is likely that individual birds would experience, at most, a short term behavioral disruption. Review of helicopter flight paths relative to coastal bird habitat will allow for consideration of flight height restrictions. Due to the duration of helicopter support operations, this impact is anticipated to be minor. Given the occasional nature of this impact, overall impact significance is low.

D.7 ARCHAEOLOGY IMPACTS

Potential impacts from Tamar SW-1 exploratory drilling operations upon archaeological resources may arise from:

- Drilling rig arrival, anchoring, anchor removal, and departure.

Offshore Declared Antiquities sites are located mainly at a distance of up to 50 m from the shoreline, and cover most of the shallow waters of Israel (<30 m water depths). Shipwrecks could be expected to be found in shallow offshore waters, some of which may date back for over 3,000 years. The Antiquity Law 1978 requires that the Israel Antiquities Authority be informed of any such discovery. Historically, no major projects have been planned for the deep sea and there has been no need to declare sites farther offshore. Furthermore, the chance of finding archaeological remains decreases with increasing distance from the shore.

While no site-specific archaeological assessment has been conducted for the Tamar SW-1 study area, results of both geohazard (Gardline Surveys Inc., 2012) and environmental (CSA Ocean Sciences Inc., 2013a) surveys from the study area did not provide any data signatures indicative of potential archaeological resources. It is extremely unlikely that significant archaeological remains are present within the Tamar SW-1 study area. Given the remote nature of this impact, overall impact significance would be negligible.

D.8 AIR QUALITY IMPACTS

Potential impacts from Tamar SW-1 exploratory drilling operations upon air quality may arise from:

- Combustion emissions.

Calculated air emissions from various project sources were previously identified in **Table 13**. Screening tools developed by the U.S. Department of the Interior, Bureau of Ocean Energy Management were used to determine whether project emissions were below thresholds of concern, based on a project-specific emissions inventory and distance from shore. Screening results indicated that dispersion modeling was not required; project emissions are sufficiently low and/or the distance from shore sufficiently high that onshore air quality impacts are not expected.

During drilling rig transit, drilling rig operations, and support vessel and helicopter transit, air emissions from vessel engines will increase ambient levels of pollutants near the area of operations. Drilling rig activities at the Tamar SW-1 drillsite are expected to require approximately 79 days. Support vessels moving between the shore base and the Tamar SW-1 drillsite will be periodic and short term in nature, with visits expected on a weekly basis.

All emissions were well below or are expected to be well below emission thresholds of concern, due to the combination of relatively low project emissions and project location (i.e., distance offshore). Impacts to local air quality are expected to be minor. Given the likely nature of this impact, overall impact significance is low.

D.9 WASTE IMPACTS

Waste from the proposed Tamar SW-1 exploratory drilling program will consist of 1) discharges from the drilling rig and support vessels; and 2) solid waste.

D.9.1 Discharges

Discharges released into the sea during exploratory drilling operations at the Tamar SW-1 well were summarized previously (see **Chapters C.2** and **C.8**) and can be divided into two main groups, including:

- Effluents originating from personnel aboard the drilling rig and ongoing, routine rig operations exclusive of drilling, such as sanitary and domestic wastes, cooling water, brine/reverse osmosis (RO) water, etc.; and
- Effluents originating directly from the drilling operations, including drilling muds and cuttings and cement.

Discharges also include organic waste (e.g., food waste). Highest volumes of non-drilling discharges are cooling water and brine from the reverse osmosis/water maker units.

Drilling discharges will include both used drilling muds and drill cuttings, as well as cement. Noble Energy will be using a WBM and several additives to facilitate drilling and maintain well control. During the initial well sections, there will be no surface returns; muds and cuttings will exit at the borehole, settling near the drillsite and dispersing in the lower portions of the water column. Similarly, with the completion of each hole section, cementing will occur. Excess cement will exit at the borehole between the casing and the formation.

Once the riser has been set, surface returns will commence, allowing for processing of used muds aboard the drilling rig and, as necessary, the discharge of used muds and cuttings from the drilling rig. With surface returns, WBM will be processed on board the drilling rig, passing through screens and shakers to remove cuttings. WBM will be monitored and additives used, as needed. The type and volume of mud additives is determined primarily by the current state of the drilling mud and existing or anticipated downhole conditions.

Cuttings, once removed from the muds and cuttings stream, will be discharged overboard. Drill cuttings are comprised of formation solids (i.e., bits of rock from the formation); in addition, small amounts of liquid and solid drilling mud components will remain adhering to the cuttings. The amounts of WBM that remain attached to cuttings vary, depending on the grain size of the crushed rock from the strata being drilled. Clay-sized cuttings are more difficult than larger cuttings to separate from drilling mud. A typical cuttings discharge during drilling with WBM usually contains 5% to 25% drilling fluid solids after passage through the solids control equipment on the drilling rig.

Details regarding material consumption associated with drilling are provided in **Chapter C.2.2**, specifically within **Tables 4** through **7**. The amounts of cement to be used are detailed in **Chapter C.2.4**, specifically **Table 11**.

A summary of discharges expected from the drilling rig during the exploratory drilling program is provided in **Table 23**.

Table 23. Summary of maximum rates, frequency, and treatment of discharges from the *ENSCO 5006* during drilling of the Tamar SW-1 exploratory well.

Source	Total Volume (m^3)	Duration	Capacity (m^3/d)	Pipe Diameter (in.)	Discharge Depth (m)	Frequency and Treatment
Drilling muds and cuttings – 36" and 26" sections; no surface returns (muds and cuttings released at the wellbore)	Muds: 2,861.8 Cuttings: 550	3 days	Muds: 953.9 Cuttings: 183.3	36 (wellbore)	-1,700	Continuous during drilling; no treatment
Drilling muds and cuttings – 17-1/2", 14-3/4", 12-1/4", and 10-5/8" sections; surface returns (muds and cuttings discharged at the surface)	Muds: 1,176.5 Cuttings: 321	19 days	Muds: 1,176.5 Cuttings: 16.9	14, 16 or 18	-14	Continuous for cuttings while drilling; minor amounts of WBM with cuttings; cuttings separated from muds (see **Appendix F**); WBM bulk discharge at end of well
Cement (at the wellbore)	206.7	1-2 days (total)	~60	36, maximum (wellbore)	-1,700	No treatment
Sanitary waste (black water)			10-14	8	-14	Periodic; chlorinated
Domestic waste (gray water)			20-24	8	-14	Periodic; no treatment
Water maker brine			160-320	8	-14	Continuous; no treatment
Cooling water			5,000-10,000	18	-14	Continuous; no treatment
Organic waste			100-150 kg/d	8	-14	Periodic; macerated

Notes:

- Drilling of 36" and 26" sections estimated to require 3 days total; muds and cuttings to be released from the wellbore continuously during this period;
- Drilling of 17-1/2", 14-3/4", 12-1/4", and 10-5/8" sections estimated to require 19 days total (drilling only); cuttings are discharged continuously while drilling; muds recirculated and discharged as an end of well discharge (at completion of drilling). End of well discharges of WBM will occur at <1,000 bbl/hr; 1 bbl = 0.159 m^3; <159 m^3/hr; total muds: 1,176.5 m^3 discharged in ~7.4 hours, minimum;
- Cementing occurs periodically throughout drilling, at the completion of the drilling of each section, when setting pipe; total estimate of cement to be used: 6,900 bbl (890.4 m^3); cement discharge estimated to be 1,300 bbl (206.7 m^3); and
- Negative entries in the Discharge Depth column indicate water depth below the sea surface.

D.9.2 Waste

Solid wastes to be generated aboard the drilling rig or supply vessel during drilling will be packaged or palletized for shipment to shore and proper disposal. No intentional waste disposal will occur from the rig or project vessels, in compliance with MARPOL restrictions. However, occasionally, debris (e.g., welding rods, buckets, pieces of pipe) may accidentally fall overboard.

Well-specific estimates of solid wastes to be generated during the Tamar SW-1 exploratory drilling program are unavailable. However, based on operator data provided in filed plans, the USDOI, MMS has estimated that each exploration well drilled in U.S. waters generates an average of 2,000 cubic feet of trash and debris (Dismukes et al., 2007). The occurrence of wastes is likely, and impacts to onshore socioeconomics (e.g., landfills) are expected to be minor. Overall impact significance is low.

D.10 HAZARDOUS SUBSTANCES

Hazardous chemicals will be handled in accordance with their MSDS specified guidelines (**Appendix E**). A list of materials to be used during drilling and cementing operations at Tamar SW-1, including hazardous materials, are presented in **Tables 4** through **7**, and **11**, respectively. Potential contingency products are listed in **Table 5**.

D.11 MONITORING AND CONTROL

Noble Energy has developed an environmental plan for Tamar SW-1 that includes seafloor surveys before and after drilling to document seafloor conditions and potential spatial and temporal changes.

D.12 OTHER IMPACTS

D.12.1 Impacts to Fishing and Shipping and the Maritime Industry

All vessels (including fishing boats) will be excluded from a 500-m radius around the *ENSCO 5006* for safety reasons. Support vessels will monitor this buffer zone and help minimize the potential for other vessels to enter this area. Any inconveniences associated with the buffer zone are expected to be minimized over time.

Although no conclusive studies have been conducted to quantify catch losses resulting from the temporary emplacement of an exploratory drilling rig, only a limited number of fishing vessels traditionally use the area where the drilling rig will be located. The impacts to commercial fishing activities are expected to be negligible. The *ENSCO 5006* will not be positioned near any major shipping lanes and will be well marked with all the appropriate navigational markers. No impacts on shipping or maritime operations are expected. Given the likely nature of this impact, overall impact significance is negligible.

D.12.2 Cumulative Impacts

Cumulative impacts are those resulting from the incremental effects of a proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes them. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time.

In addition to this project, other sources of impact that may contribute to cumulative impacts include future exploratory and development activity in Israel waters and other human activities in the offshore region, including fishing and ship traffic.

In general, potential impacts from the Tamar SW-1 exploratory drilling project are expected to be of short duration and concentrated mostly within a few hundred to several thousand meters of the Tamar SW-1 drillsite, as well as along the transit corridors between the drillsite and Haifa. Due to the localized nature of the impacts and the absence of other exploratory drilling activity in the area, there is little chance of cumulative or synergistic impacts with other activities in the region. Cumulative impacts to fishing and ship traffic will be minimal, due primarily to the short-term duration of the drilling activities and low levels of impact resulting from ongoing fishing and shipping activity in the region. Therefore, the potential for cumulative impacts is low.

D.12.3 Transboundary Impacts

Impacts from routine activities associated with the Tamar SW-1 exploratory drilling project are localized and transient for short term activities (i.e., drilling). In general, such routine, project-related impacts will diminish in intensity and severity with increasing distance from the source. The potential for routine, project-related impacts to result in transboundary impacts is extremely small.

Small or large diesel spills from the Tamar SW-1 exploratory drilling project are discussed in **Chapter D.14**. In the unlikely event that a spill occurs, diesel fuel is expected to be transported in an easterly or northeasterly direction under the influence of ambient surface currents and winds. Spills occurring at the sea surface will disperse and weather. Volatile components of the fuel will evaporate. Fuel and diesel used for operation of survey vessels is light and would float on the water surface. There is the potential for a small proportion of the heavier fuel components to adhere to particulate matter in the upper portion of the water column and sink. Given the relative size of the diesel spills evaluated under the accident scenario, coupled with spill response capabilities, the potential for transboundary effects (e.g., transport into waters to the north of Israel) are considered to be extremely small.

D.13 ACCIDENTS OR UPSETS

D.13.1 Background

A large diesel release on any of the project vessels, such as one resulting from a diesel tank rupture, would be an extremely rare event. The probability has not been estimated, but historical data for the Gulf of Mexico include no such incidents between 1981 and 1999 (Anderson and LaBelle, 2000; USDOI, MMS, 2007b). A study conducted in 2000 (USDOI, MMS, 2000) indicates that, historically, most diesel releases have been <1 bbl, and for releases greater than this, the median size is 5 bbl.

D.13.2 Potential Impacts of a Diesel Fuel Release

Previous modeling under comparable conditions provides a point of reference relative to the fate of a hypothetical diesel release in the marine environment. The following discussion applies to a hypothetical diesel release of several hundred barrels. In addition, a hypothetical small diesel release occurring during a fuel transfer was also considered. A 10-bbl diesel fuel release will undergo extensive weathering via evaporation and dispersion. After 8 hours, 35% of the diesel fuel will have evaporated and 54% of the diesel will have dispersed, leaving only 11% of the diesel fuel on the surface of the water.

D.13.2.1 Impacts to Air Quality

A diesel fuel release would affect air quality in the vicinity of the oil slick by introducing VOCs through evaporation. Emissions would not last long due to rapid volatilization of hydrocarbons. Evaporation is greatest within the first 24 hours. The more toxic, light aromatic and aliphatic hydrocarbons are lost rapidly by evaporation and dissolution (NRC, 1985; Payne et al., 1987). Evaporated hydrocarbons are degraded rapidly by sunlight. Biodegradation of diesel fuel on the water surface and in the water column by marine bacteria and fungi initially removes the n-alkanes and subsequently the light aromatics. Other components are biodegraded more slowly. Photo-oxidation attacks mainly the medium and high molecular weight PAHs of a diesel release. The extent and persistence of impacts would depend on meteorological and oceanographic conditions at the time. Little or no impact on air quality in coastal areas would be expected due to the distance of the Tamar SW-1 drillsite from shore and the degree of weathering expected. Overall impact significance is low.

D.13.2.2 Impacts to Water and Sediment Quality

A diesel fuel release would affect marine water quality by increasing hydrocarbon concentrations due to dissolved components and small oil droplets. Natural weathering processes are expected to rapidly remove the diesel fuel from the water column and dilute the constituents to background levels. Diesel releases are unlikely to affect sediment quality unless carried into shallow water, which is not expected given current trajectories and weathering characteristics. Overall impact significance is low.

D.13.2.3 Impacts to Marine Biota

Plankton and Fish and Fishery Resources. A diesel fuel release could affect phytoplankton and zooplankton because they do not have the ability to avoid contact with oil. Planktonic communities drift with water currents and recolonize from adjacent areas. Because of these attributes and their short life cycles, plankton usually recovers relatively rapidly to normal population levels following disturbances.

While adult and juvenile fishes may actively avoid a large diesel release, planktonic fish eggs and larvae would be unable to avoid contact. Eggs and larvae of fishes will die if exposed to certain toxic fractions of diesel fuel. Most fishes inhabiting oceanic waters have planktonic eggs and larvae. However, due to the wide dispersal of early life history stages of fishes, a diesel release would not be expected to have significant impacts at the population level. In the event of a large diesel release, fishing activities near the project area could be temporarily disrupted. The area affected would be relatively small, and the duration would presumably be only a few days. Overall impact significance is low.

Benthic Communities. A diesel fuel release in surface waters would have no impact on benthic communities. Diesel is unlikely to reach the seabed, especially at the water depth of the Tamar SW-1 drillsite. A diesel fuel release occurring nearshore will evaporate very quickly, especially during warm temperatures. Should a small release occur inside a port or harbor, any remaining released fuel would be contained and cleaned up quickly. Overall impact significance is low.

Marine Mammals, Sea Turtles, and Marine and Coastal Birds. Diesel fuel may affect marine mammals through various pathways: direct contact, inhalation of volatile components, ingestion (directly or indirectly through the consumption of fouled prey species), and (for mysticetes) impairment of feeding by fouling of baleen (Geraci and St. Aubin, 1987, 1988, 1990; Loughlin et al., 1996). Cetacean skin is highly impermeable and is not seriously irritated by brief exposure to diesel fuel; direct contact is not likely to produce a significant impact. Whales and dolphins apparently can detect slicks on the sea surface but do not always avoid them; therefore, they may be vulnerable to inhalation of hydrocarbon vapors, particularly those components of diesel fuel that are readily evaporated.

Ingestion of the lighter hydrocarbon fractions found in diesel fuel can be toxic to marine mammals. Ingested diesel fuel can remain within the gastrointestinal tract and be absorbed into the bloodstream and, thus, irritate and/or destroy epithelial cells in the stomach and intestines. Certain constituents of diesel fuel (i.e., aromatic hydrocarbons, PAHs) include some well-known carcinogens. These substances, however, do not show significant biomagnification in food chains and are readily metabolized by many organisms. Released diesel fuel may also foul the baleen fibers of mysticete whales, thereby impairing food-gathering efficiency or result in the ingestion of diesel fuel or diesel fuel-contaminated prey.

Diesel fuel in the marine environment may affect sea turtles through various pathways: direct contact, inhalation of diesel fuel and its volatile components, ingestion of diesel fuel (directly or indirectly through the consumption of fouled prey species), and ingestion of floating tar (Geraci and St. Aubin, 1987). Several aspects of sea turtle biology and behavior place them at risk, including lack of avoidance behavior, indiscriminate feeding in convergence zones, and inhalation of large volumes of air before dives (Milton et al., 2003). Studies have shown that direct exposure of sensitive tissues (e.g., eyes, nares, other mucous membranes) to diesel fuel or volatile hydrocarbons may produce irritation and inflammation. Diesel fuel can adhere to turtle skin or shells. Turtles surfacing within or near a diesel release would be expected to inhale petroleum vapors. Ingested diesel fuel, particularly the lighter fractions, can be toxic to sea turtles. Hatchling and juvenile turtles feed opportunistically at or near the surface in oceanic waters and are especially sensitive to released hydrocarbons (including diesel fuel).

Direct contact of marine birds with diesel fuel may result in the fouling or matting of feathers with subsequent limitation or loss of flight capability or insulating or water-repellent capabilities; irritation or inflammation of skin or sensitive tissues, such as eyes and other mucous membranes; or toxic effects from ingested diesel fuel or the inhalation of diesel and its volatile components.

A diesel fuel release is expected to have a minor to moderate impact to marine mammals, sea turtles, or marine birds due to the expected low density of these resources, relatively short period of release presence on the sea surface, and low areal coverage. Overall impact significance is low to medium.

D.13.2.4 Impacts to Protected Marine Species and Habitats, Marine Habitats of Interest and Areas of Special Concern

Diesel fuel spills could occur as a result of vessel collision or leaks (e.g., during fuel transfer). A small or large diesel spill at the Tamar SW-1 drillsite is expected to dissipate rapidly, and would only likely affect organisms in the immediate location of the accident. Fuel and diesel used for operation of support vessels is light and would float on the water surface. Diesel fuel spilled at the sea surface will disperse and weather, with volatile components evaporating.

The potential for impacts from a diesel fuel spill would depend greatly on the size and location of a spill, the meteorological conditions at the time of the accidental release, and the speed with which cleanup equipment could be employed. Due to the location of the Tamar SW-1 drillsite approximately 98 km offshore, it is extremely unlikely that a diesel fuel spill will reach shore and any sensitive coastal habitats (e.g., protected marine habitats, marine habitats of interest, or areas of special concern, including nature reserves, marine nature reserves, and national parks) in sufficient concentrations to produce impacts. Diesel will disperse rapidly, with the volatile, toxic components quickly evaporating.

Sensitive species include select species of invertebrates, sharks, fish, marine mammals, turtles, and marine and coastal birds. Because diesel floats, with only a small percentage potentially adhering to water-borne particulates and sinking, water column, pelagic, and benthic species would be at minimal risk of exposure when present. Accident impacts to marine mammals, sea turtles, and marine and coastal birds from diesel fuel exposure, outlined previously, were expected to be low to moderate. While

individual birds may be oiled during a diesel spill, such impacts will be unlikely to affect marine and coastal birds at a population level. Overall impact significance of a diesel spill to protected marine species and habitats, marine habitats of interest and areas of special concern is low, with the possible exception of sea turtles and marine and coastal birds, where impacts are expected to range from low to moderate.

D.13.2.5 Impacts to Fishing and Shipping and Maritime Industry

A large diesel release from the Tamar SW-1 drillsite would not be expected to affect socioeconomic or cultural conditions onshore Israel. For diesel fuel, natural weathering processes would remove the released hydrocarbons from the water column and dilute the constituents to background levels relatively quickly. The impacts would be limited to offshore waters near the release site and would persist from a few hours to a few days. Except for exclusion from the area, impacts on fishing from an offshore diesel release at the Tamar SW-1 drillsite are unlikely because of the distance from shore and the likelihood that any fishers would be warned away from a release site. Similarly, impacts on shipping from a diesel release offshore are unlikely. Overall impact significance is low.

D.13.2.6 Impacts to Recreation and Aesthetics/Tourism

Impacts from a diesel fuel spill will depend on the size and location of a spill, the meteorological conditions at the time of the accidental release, and the speed with which cleanup equipment could be employed. Due to the location of the Tamar SW-1 drillsite approximately 98 km offshore, it is extremely unlikely that a diesel fuel spill will reach coastal waters where recreation and tourism activities are located. Diesel will disperse rapidly, with the volatile, toxic components quickly evaporating. As a result, it is very unlikely that diesel will reach coastal waters in sufficient amounts to adversely affect the aesthetics of the coastal zone and beaches. Cleanup operations will be localized to the Tamar SW-1 drillsite area, therefore no impacts to recreation and aesthetics/tourism are expected from vessel and equipment operations associated with a spill. However, increased vessel activity would be expected in support of cleanup operations. Overall impact significance to recreation and aesthetics/tourism is low.

D.13.2.7 Impacts to Archaeological Resources

A small or large diesel spill at the Tamar SW-1 drillsite is expected to dissipate rapidly, and would only likely affect resources in the immediate vicinity of the accident. Because diesel floats, with only a small percentage potentially adhering to water-borne particulates and sinking, water column, pelagic, and benthic resources would be at minimal risk of exposure when present. Only a small percentage of diesel fuel spilled adheres to particulate material, which moves and disperses with subsurface currents. Affected particulates reach the seafloor in extremely low concentrations. Submerged archaeological resources are unlikely to be affected by surface spilled diesel fuel. Overall impact significance of a diesel spill to archaeological resources is negligible.

CHAPTER E: MITIGATION AND MONITORING

E.1 OVERVIEW

The Tamar SW-1 exploratory drilling effort can be divided into four sequential phases, including 1) drilling vessel mobilization to the Tamar SW-1 drillsite; 2) drilling of the Tamar SW-1 well, including drilling, setting casing, and cementing operations; 3) well testing; and 4) drilling vessel demobilization from the Tamar SW-1 drillsite.

The identification and application of mitigation measures is intended, to the extent possible, to 1) reduce the severity or magnitude of identified impacts, 2) reduce their longevity, and/or 3) reduce their probability of occurrence. Individual mitigation measures for select resources and specific issues are described below.

Monitoring provides the mechanisms necessary to characterize the environment using routine, standardized methods and to assess the effectiveness of mitigation measures implemented to reduce or eliminate impact.

E.2 RESOURCE-SPECIFIC MITIGATION

E.2.1 Marine Mammals and Sea Turtles

As appropriate, to reduce, to the extent possible, potential impacts to protected marine species (marine mammals, sea turtles):

- Ensure that personnel on board support vessels that are in transit (to and from the drilling rig) maintain a vigilant lookout for large whales and sea turtles on the surface to avoid vessel strike; and
- Ensure helicopters attain operational altitude as soon as possible after take-off to minimize physical presence and noise-related effects.

E.2.2 Marine and Coastal Birds

As appropriate, to reduce, to the extent possible, potential impacts to marine and coastal birds:

- Ensure that support vessels and helicopters follow the most direct route possible between the Tamar SW-1 drillsite and the marine and air transportation hubs (Haifa, Tel Aviv), avoiding sensitive areas, wildlife areas, and bird colonies, weather conditions permitting;
- Ensure helicopters attain operational altitude as soon as possible after take-off to minimize physical presence and noise-related effects; and
- When feasible and when vessel navigational safety is not compromised, shield lights (i.e., orient downward) to maximize work areas and minimize lighting of the sea surface.

E.2.3 Fishing and Shipping and Maritime Industry

No fishing is expected in the vicinity of the well due to water depth; consequently, no mitigation measures are suggested.

E.3 ISSUE-SPECIFIC MITIGATION

E.3.1 Air Quality Mitigation

Noble Energy and its contractors (i.e., drilling contractor, support vessel contractors), will maintain routine maintenance procedures to reduce excess emissions and reduce potential impacts to air quality.

E.3.2 Noise Mitigation

Internal combustion engines and electrical equipment (e.g., draw works) will undergo routine maintenance and monitoring to ensure that all equipment is working within manufacturer's specifications. Proper operation will ensure that noise emissions are within acceptable bounds.

E.3.3 Drilling Muds and Cuttings Mitigation

The discharge plan will establish effluent limitations, monitoring and reporting requirements and other conditions on discharges specific to drilling operations offshore Israel.

E.3.4 Accidents or Upsets Mitigation

As appropriate, to reduce, to the extent possible, the impact of a diesel spill:

- Noble Energy will maintain its OSRP.

E.3.5 Applicability of Mitigation Measures to Project Phases

Table 24 outlines the applicability of the resource- and issue-specific mitigation measures previously described. With the exception of drilling muds and cuttings mitigation, identified mitigation measures are applicable to all four phases of activity expected at the Tamar SW-1 drillsite.

E.4 MONITORING

Noble Energy has developed an environmental plan for Tamar SW-1 that includes seafloor surveys before and after drilling to document seafloor conditions and potential spatial and temporal changes. During drilling, chemical and toxicity testing will be conducted to assess the relative toxicity of the drilling mud.

E.5 COMPLIANCE WITH MEWR GUIDELINES

Table 25 outlines the compliance measures to be implemented to comply with MEWR guidelines during the Tamar SW-1 drilling effort. The table includes cross references to EA chapters, including text, tables, and appendices, which provide detail regarding vessel operations, drilling, and discharge procedures.

Table 24. Summary of resource- and issue-specific mitigation measures by activity phase, Tamar SW-1 drillsite.

Mitigation Measure	Relevant Resource or Issue	Phase of Activity			
		Mobilization and Anchoring	Drilling, Casing, Cementing	Well Testing	De-mobilization
Resource-Specific					
Support vessel lookout(s) during transit to avoid vessel strike	Marine Mammals and Sea Turtles	●	●	●	●
Helicopters attain operational altitude as soon as possible to minimize disturbance	Marine Mammals and Sea Turtles	●	●	●	●
Direct vessel and helicopter routing and avoidance of sensitive areas	Marine and Coastal Birds	●	●	●	●
Helicopters attain operational altitude as soon as possible to minimize disturbance	Marine and Coastal Birds	●	●	●	●
Light shielding	Marine and Coastal Birds	●	●	●	●
Issue-Specific					
Routine maintenance of internal combustion engines	Emissions/Air Quality	●	●	●	●
Routine maintenance and monitoring of noise sources	Noise/Nature and Ecology	●	●	●	●
Drilling muds and cuttings discharge plan, effluent limits, monitoring, reporting	Effluents/Water Quality, Nature and Ecology		●		
Oil Spill Contingency Plan	Accidents/Water Quality, Nature and Ecology	●	●	●	●

Table 25. Summary of Ministry of Enegry and Water Resources (MEWR) guidelines and Noble Energy or subcontractor compliance measures. Relevant EA chapters are noted parenthetically in bold face type.

Guideline	Guidelines Chapter	Summary of Compliance Measures (EA Chapter)
Performance of drilling and production tests	5.6.1	Industry best practice; installation, maintenance and testing of BOP; well monitoring during drilling; ENSCO well control standards; safe drilling practices (**Chapter C.2.3**); concretization (**Chapter C.2.4**); proper well closure/abandonment (**Chapter C.10**); adherence to ENSCO's well control standards
Handling of hazardous materials	5.6.2	Identification of hazardous materials (**Chapter C.7**); proper storage and handling; recognition of, and compliance with handling requirements and exposure limits specified in, MSDS (**Chapter D.10**; **Appendix E**)
Reduction and prevention of harm to land and to seawater and the coastline, and including harm to the marine ecology	5.6.3	**Discharges:** Identification of effluents (**Chapters C.2.2.1, C.8**), discharge flow (**Chapter C.8.2**); discharge treatment (**Chapter C.8.3**); discharge timing and flow characteristics (**Chapter C.8.4; Figure 26**); discharge method and orientation (**Chapter C.8.5**); discharge quality and effluent limitations (**Chapter C.8.6**); discharge quantity (**Chapter C.8.7**); chemical and toxicity testing (**Chapter C.8.8; Table 10**) **Waste:** Identification of solid wastes and waste management priorities and procedures (**Chapter C.9**) **Accidents:** Development of an OSRP, compliance with the Noble Energy-ENSCO management interface requirements, and compliance with ENSCO's Emergency Response Manual (**Chapter D.3; Appendix G**)
Preservation of fauna and flora in the area	5.6.4	**Discharges:** Identification of effluents (**Chapters C.2.2.1, C.8**), discharge flow (**Chapter C.8.2**); discharge treatment (**Chapter C.8.3**); discharge timing and flow characteristics (**Chapter C.8.4; Figure 26**); discharge method and orientation (**Chapter C.8.5**); discharge quality and effluent limitations (**Chapter C.8.6**); discharge quantity (**Chapter C.8.7**); chemical and toxicity testing (**Chapter C.8.8; Table 10**) **Waste:** Identification of solid wastes and waste management priorities and procedures (**Chapter C.9**) **Accidents:** Development of an OSRP, compliance with the Noble Energy-ENSCO management interface requirements, and compliance with ENSCO's Emergency Response Manual (**Chapter D.3; Appendix G**)
Collection of data for the purpose of monitoring and tracking the quality of seawater, sediment, fauna and flora in the environs of the bore	5.6.5	Chemical and toxicity testing of drilling mud (**Chapter C.8.8; 10**); pre-drilling (**Chapters A.2.1.3, A.2.2.4, A.2.3**) and post-drilling surveys (**Chapter D.11**) of the drillsite environs
Construction of various monitoring systems (air, water, mud and cutting discharge, etc.), to operate during construction and operation	5.6.6	Industry best practice; well monitoring during drilling (ENSCO's well control standards); maintenance and monitoring of drilling muds and cuttings treatment and processing equipment (**Appendix F**)
Measures for preventing/reducing light hazards	5.6.7	Lighting mitigation (**Chapter E.2**)
Measures for reducing air pollution hazards	5.6.8	Identification of sources (**Chapter C.6**); emission/air quality mitigation (**Chapter E.3**)

Table 25. (Continued).

Guideline	Guidelines Chapter	Summary of Compliance Measures (EA Chapter)
Measures for preventing or reducing noise	5.6.9	Identification of sources (**Chapter C.5**); noise mitigation and monitoring (**Chapter E.3**)
Measures for treatment and removal of cutting discharge and drilling mud	5.6.10	Treatment of drilling muds and cuttings (**Appendix F**)
Measures for treatment of various sources of discharge including cooling water, sanitary waste, kitchen waste, concentrate water	5.6.11	Identification of effluents (**Chapters C.2.2.1, C.8**), discharge flow (**Chapter C.8.2**); discharge treatment (**Chapter C.8.3**); discharge timing and flow characteristics (**Chapter C.8.4; Figure 26**); discharge method and orientation (**Chapter C.8.5**); discharge quality and effluent limitations (**Chapter C.8.6**); discharge quantity (**Chapter C.8.7**)
Guidelines and instructions for the preparation of emergency procedures for the case of faults or accidents including leaks or spills of contaminants into the marine environment, or fires	5.6.12	Development of an OSRP, compliance with the Noble Energy-ENSCO management interface requirements, and compliance with ENSCO's Emergency Response Manual (**Chapter D.3; Appendix G**)
Actions to be taken when closing and rehabilitating the drilling site	5.6.13	Proper well closure/abandonment (**Chapter C.10**); adherence to ENSCO's well control standards
Guidelines for periodic reporting of faults to the Commissioner for Oil	5.6.14	A daily drilling report will be made available to the MEWR. In case of fault, notifications will be made as soon as possible

APPENDICES

APPENDIX A

Framework for Guidelines for Environmental Document Accompanying License for Exploration

State of Israel

Ministry of Energy and Water
Natural Resources Administration

Ministry for Environmental Protection
Marine and Coastal Division

July 2012

Appendix A

Framework for Guidelines for Environmental Document Accompanying License for Exploration Purposes – (Trial) Drilling and Maritime Pumping Tests

Environmental document accompanying Application for Exploration Drilling (hereinafter: the "Application"), for the performance of trial drilling and maritime production tests (hereinafter: the "Document").

The document template was prepared with the collaboration of the Ministry for Environmental Protection, the Nature and Parks Authority, and its preparation will be conducted in accordance with the following:

General Requirements

A. The document will be performed under the responsibility of the developers of the Application, and will include the name of the person responsible for its performance and the names of the professional service providers that participated in its preparation and performance.

B. The document will be prepared and performed by a company with experience and expertise in evaluation of environmental impact and marine research. The company selected by the developers of the Application to prepare the document must prove a minimum of 10 years experience in the related area.

C. The company that is chosen to prepare and perform the document, if a foreign company, will be accompanied by a team of Israeli experts with a proven experience in the field of Israeli maritime environmental research. The Israeli team will include content experts in the fields of: marine ecology, marine biology, a maritime biologist specializing in deep sea systems, marine chemistry, hydrodynamics, sedimentology, geology and marine geophysics. The team will be introduced at the time of submitting the application for approval of methodology for the approval of the Commissioner.

D. For the purpose of preparation of this document, it shall be possible to rely on relevant information collected during the past decade.

E. The document shall contain the name of the person responsible for drafting it, and the names of the professional service providers who participated in preparation of it and in the evaluation of the various environmental impacts. The qualifications of the professional staff working for the monitoring company are set out in Appendix A1.

F. The author of the document and the professional consultants shall fill in and sign the appropriate affidavits (Form 1, 2) under section 14(c) of the Planning and Building (Environmental Impact Studies) Regulations, 5763-2003.

G. The document will be set out in Hebrew and in English and will include a comprehensive summary at its start, which shall contain the principal findings, conclusions and recommendations for implementation of the Application. Likewise, a full bibliography and the sources of the data used by the authors of the document, separately for each of the environmental aspects, shall also be included in the document.

H. The document shall be submitted in digital format as well, in a PDF or DOCX file. The drawings in the document shall also be submitted in DWG and SHP files. Ground and aerial photographs (including orthophotos – georectified imagery) used for the document shall be submitted in JPEG, TIFF and GeoTIFF or ECW or MrSID format, in accordance with the kind of result or other format approved in advance and in writing.

I. The maps and aerial photographs that are submitted on digital media shall be at the highest possible resolution employed in the process of preparation thereof. On the other hand, the maps and aerial photographs that are attached to the hardcopy of the document shall be adjusted, in terms of scale, to the guidelines set out in the relevant section of the document. The maps shall include the date of preparation and the name/company of the preparer.

J. The document shall refer to all components of the Application.

K. The document should follow the outline as presented in the guidelines (i.e., chapters A through E). A document that is submitted in an incomplete form shall be returned without being checked.

L. If a particular section is submitted in a format that is different from the requested format, the change as compared with the guidelines must be identified and explained.

M. The proposed plan (instructions + sketch) must be attached to the document that is to be submitted. (information to be provided by the operator)

N. The present Guidelines shall constitute part of the document, and shall be included as an appendix.

O. The document will contain an assessment of the environmental impacts that the proposed Application will have.

P. The environmental document will focus on the region of the Application and on the area of drilling.

Q. Any privileged information constituting a commercial secret must be noted in order to enable publication of the environmental document without disclosing such information.

R. The document must be submitted to the Commissioner for Oil, in five copies, and he shall be assisted by the relevant entities, as a drafted, continuous and complete paper document, and in digital form as well.

Chapter A Description of the current Maritime Environment to which the Application Relates

1.1. General

1.1.1. The subjects set out in this Chapter shall be used for the examination and description of the environmental impacts expected to develop due to performance of the Application.

1.1.2. The Application shall be presented in text with maps and graphic descriptions.

1.1.3. The current conditions of the deep sea area in the exploration sites, as well as biological, ecological, chemical, sedimentological, geological and hydrodynamic aspects of the scientific data, comprise the basis for forecasting the environmental impact that may arise due to the gas and oil exploration and production operations to the surrounding area.

1.2. The Boundaries of the Application

1.2.1. The detailed area of the Application (blue line): shall include the maritime area within a radius of up to 1 km around each of the gas and oil exploration sites, offshore Israel. The maritime area will include the water column, seabed and sub-seabed, and the maritime infrastructure and facilities situated at this site.

1.2.2. In the event that the drilling site is situated less than 1 km from the coastline, the area of the plan shall also include the area of the "coast" as defined in the Preservation of Coastal Environment Law and along a 1 km strip parallel to the drilling site.

1.2.3. The expanded area of the Application (green line): shall include the entire marine and coastal area that might be environmentally affected as a result of operations / faults in each of the exploration sites, including acoustic impacts. Similar to the above, this maritime area will also include the water column, seabed and sub-seabed and maritime infrastructure and facilities.

1.3. Maps and Orthophoto

1.3.1. An orthophoto (geo-rectified aerial photograph) will be required where the distance of the exploration drillings is less than 1,000 m from the coastline.

1.3.2. Set out a general depth map at a scale of 1:250,000 of the deep sea off the coast of Israel, and mark on it the location of the sites, the existing and proposed maritime boundaries and areas and shipping routes.

1.3.3. Set out a series of regional depth maps at a scale of 1:20,000 around each of the sites, and mark on them the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand) and above- and underwater infrastructures and facilities found in each region. The differences between the depth contours on the maps shall be 5 meters and the mapping data shall be updated to the last decade.

1.3.4. Set out detailed depth maps of the detailed area of the plan (blue line) at a scale of 1:5,000 around each of the sites, and mark on them the exposed rocky areas, the seabed, the type of ground (for instance: clay, silt, sand) and above- and underwater infrastructures and facilities found in each region. The differences between the depth contours on the maps shall be 1 meters and the mapping data shall be updated to the last decade. Likewise, the sedimentological characteristics of the seabed shall be based on a granulometric and mineral survey correctly representing the sediment in the detailed area of the plan.

1.3.5. In the event of exploratory drilling at a distance of less than 1 km from the coast, the land zoning and usages within the area of the relevant coastline must be marked (see section 1.2.2) and the physical data including the type of coverage (rock or sand, cliff) antiquities areas, etc.

1.4. Geological, Seismic and Sedimentological Characteristics

An exhaustive and detailed geo-hydrological description of the site, including:

1.4.1. Describe, in words, the general geographical location of the exploration drilling sites, their proximity to seismically active areas and the rock foundations upon which they will be constructed.

1.4.2. Set out a general geological / geomorphological map at a scale of 1:200,000 of the sea off the coast of Israel, and mark thereupon the location of the exploration drilling sites. On this map, mark geological fractures, with an emphasis on fractures that are active or that are suspected of being active. Fractures described as being "suspected of being active" by the Israel Geological Institute or similar entities shall be deemed to be active unless it is proven that they are not active using the usual methods (conduct of research and geophysical cross-sections, and paleoseismological analysis). Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides and other geological and morphological phenomena which are notable.

1.4.3. Set out a series of regional geological / geomorphological maps at a scale of 1:20,000, around all of the sites, and mark geological fractures on them, with an emphasis on active (young) fractures or fractures suspected of being active. Likewise, mark locations of historical earthquakes of a magnitude of more than 2.5, areas liable to landslides, active landslides, rocky infrastructure exposed above the ordinary seabed, and other geological and morphological phenomena which are notable.

1.4.4. If the drilling mud and cutting discharge are to be dispersed at sea, generally describelineate the area of dispersal of the mud and other cutting discharge on a geophysical survey conducted via side-scan sonar and underwater information, physical changes in the seabed due to the effects of anchoring and excavation, the build-up of waste, etc.

1.4.5. Describe in detail the rock infrastructure at each of the exploration drilling sites. Provide detailed information that might clarify the characteristics of the land (for instance: the speed of shear stress waves, the depth to the bedrock, characteristics that affect non-linear conduct, etc.).

1.4.6. Address the possibility of the existence of active geological fractures in the area of the Application and the near environment.

1.5. Hydrodynamic Regime

1.5.1. Describe the characteristic wave regime within the area of the Application. This description shall be based on wave characteristics measured in the southeastern Mediterranean in general, and off the coast of Israel over the last 20 years in particular.

1.5.2. Set out the statistical breakdown of wave characteristics within the timeframe of one year (significant and maximum height, direction, cycle time at the top of the spectrum, and average cycle time), and within a longer timeframe of 5, 10, 20, 50 and 100 years, statistics of storm durations for various maritime conditions.

1.5.3. Refer to the affect of waves in extreme storms and the possibility of the development of killer waves, including due to a seismic source, on the stability of the marine structures within the area of the Application.

1.5.4. Describe the regime of the currents in the area of the Application, created due to the winds, and other oceanic variables (for instance: astronomic tides, Coriolis force, jet streams along the edge of the continental shelf, seasonal changes of seawater mass, temperature, salinity, etc.). This description shall be based on meteorological-oceanographic information collected since the mid-20th Century, in the Eastern Mediterranean in general and along the coast of Israel in particular.

1.5.5. Set out the statistical division of the wind regime in the Eastern Mediterranean, including the annual frequency of wind directions, wind magnitude (including gusts), seasonal effects, and extreme winds. The minimum resolution shall be 22.5° for wind direction and 2 m/s for speed.

1.6. Nature and Ecology

1.6.1. Describe the natural phenomena (micro and macro algae, seaweeds, cold springs, sponge gardens, deep coral reefs and sedentary, mobile, bottom and pelagic fauna), and limniological natural phenomena, as the case may be, situated in the area of the Application. The information regarding natural phenomena will be in reliance upon a detailed biological survey (see Appendix A1) which will be conducted within the area of the Application and on information, if such exists in this area, from prior surveys. The information included shall be set out in tables, maps, graphs, pictures, video, and shall be accompanied by a detailed verbal description of the findings and with lists of inventory, including scientific names based on taxonomic classification. Note the presence of rare, unique or delicate organisms. Photographs and video clips will include details of the sampling site on the picture / clip itself: date, depth, precise coordinates.

1.6.2. Give details of the various habitats within the body of water, and in the various seabed environments. A detailed description must be provided of fauna assemblagess in each of these habitats, including coverage percentages, taxonomic information regarding the identity of species in the region. A map of the various habitats in the area must be included, noting the species found in each habitat.

1.6.3. Pursuant to the above sections, a detailed analysis must be conducted of the information including on the basis of the following issues:

1.6.3.1. Identification of the creatures to a species level or to the most detailed taxonomical level possible.

1.6.3.2. Biomass evaluation.

1.6.3.3. Density of individuals.

1.6.3.4. Richness of species (in the various taxonomic groups).

1.6.3.5. Variety, the appropriate index must be chosen from the acceptable variety indexes such as: Simpson, Shanon-Wiener, Magurran, (2004), with details being given for the choice.

1.6.3.6. Fixed and mobile species.

1.6.3.7. "Target species": key species, species of commercial value, most common species (breeding season, egg-laying season, area in which drilling operations will be tolerable, heavy metals and organic contaminants in target species).

1.6.3.8. Classification of species based on origin: Atlantic-Mediterranean, cosmopolitan species (of broad geographical distribution), invasive species (Lessepsian migrants from the Red Sea or otherwise).

1.6.4. Describe fishing areas within the green line. Set out trawler fishing routes, fishing (note the kind of fishing), rod fishing, etc., and show the data on a map at a scale of 1:20,000 and on a GIS layer, and the quantities of fish collected over a monthly and annual cross-section.

1.6.5. Describe the magnitude of the sub-marine noise at a number of representative points at each of the above sites.

1.7. Sea Water and Sediment Quality

1.7.1. Describe the characteristics of the sea water and sediment quality within the area of the Application, around each of the sites. The information regarding the quality of seawater and sediments shall rely on a detailed seawater and sediment quality survey (see Appendix A1) which shall be conducted within the expanded area of the plan (the green line) and other relevant information if any for this area, from existing monitoring plans and surveys. The information included shall be set out in maps, graphs and shall be accompanied by a detailed verbal description of the findings.

1.7.2. Describe the quantity of suspended material in the water column, in a variety of marine climatic conditions (winds, waves, currents). The data shall be set out based on sediment samples in various places in the expanded examination area. The level of turbidity of the water shall be measured at the surface, in the center of the water column and near to the seabed at each of the sites. Likewise, set out the climatic conditions at the time of taking the samples.

1.7.3. Set out the levels of chlorophyll in the water column, within the area of the plan. Likewise, an assessment of the dispersion of chlorophyll must be conducted over the entire area of the expanded plan (green line), using remote sensing methods.

1.7.4. Describe, in detail, the chemical characteristics of the water column (dissolved oxygen, pH, salinity, temperature, nutrients), within the area of the plan, around each of the sites.

1.7.5. Describe, in detail, the chemical characteristics of the sediment within the above area of the plan. The description shall focus on toxic substances, on chemical derivatives of heavy metals, TOC, PAH, SBF and their derivatives (including the results of decomposition), oxygen concentration in sediments. The sediment sampling system (the number of stations and their location) will be approved prior to performance.

1.7.6. Likewise, describe the characteristics as set out in section 1.7.5 of the fauna on the hard bed (if any) and of the fauna on the soft bed and of the fauna within the bed (in filtering animal tissue such as clams, snails, worms, polychaetes and crabs and fishes). The scope of this sampling will be approved in advance.

1.8. Archeology

Set out, on a map at a scale of 1:20,000, the archeological sites in the area of the plan, and in the close environs thereof. The sites known to the Antiquities Authority (both declared and as yet

undeclared sites) and other sites containing information about archeological findings or sunken ships from before 1912 must be included.

1.9. Air quality

Describe the climatic conditions in the area of the plan. Set out the current state of air quality.

1.10. Marine Transportation System and Infrastructure

Show the marine transportation system and infrastructure in the area of the alternative being examined on a maritime map at a scale of 1:20,000. Set out the current operations of the system: Traffic volumes, entry and exit directions of vessels in accordance with the various classes of vessel, fuel containers, military vessels, fishing vessels, yachts, tugboats and small operations vessels, etc.

- Infrastructure and electrical, communications lines and energy facilities.
- Corridors, pipelines and terminals for various infrastructures (gas, fuel, hazmat, etc.).

Chapter B Reasons for Preference of the Location of the Proposed Plan and Possible Alternatives

2.1. General

This Chapter must contain all of the considerations for choosing the proposed site on the plan for exploratory drilling. In addition to the geological and seismic considerations, set out the environmental considerations, the planning considerations and the engineering and economic considerations, and the above regarding aspects of location, proximity to existing and planned infrastructure, exploitation of additional natural resources, impact on air quality, noise, etc.

2.2. Give details of and explain the various considerations that led to the determination of the proposed site of the plan. Set out the various alternatives examined, the preferred alternative and the reasons that gave rise to the choice of it.

2.3. Address the determination of the location of the exploratory drilling in the context of issues of analysis of the structure and the location of the target strata, habitats of species in danger of extinction, areas defined as special areas such as canyons or deep coral reefs, sponges, clams or other sedentary organisms, shipping routes, infrastructure and energy lines, current regimens, fish spawning times, the type of rig, mud and drilling liquids.

2.4. If possible, address the deployment of infrastructure in the future production plan.

Chapter C Description of the Operations Stemming from Performance of the Proposed Plan

3.1. General

This Chapter shall set out a drilling plan including the drilling rig, various sea vessels and helicopters, and the plans for them, and the activities that they will perform. The description of the plan shall include reference to all of the works that will be done, including all matters relating to trial drillings, drilling phases, abandonment or announcement of a discovery and transition to production. This Chapter shall also refer to the various stages of construction and operation.

Describe all of the details of the plan as will be examined in Chapter D.

3.2. Description of the Plan

3.2.1. General

Set out a description of the rig and the sea vessels involved in the exploration plan including the type of rig, the name of the rig, ownership, previous area of activity, and the principal parameters thereof (fleet specifications).

3.2.2. Description of drilling process

3.2.2.1. - Drilling mud and cutting discharge

Describe the drilling process from an environmental point of view, including an assessment of the quantity of cutting discharge expected to be generated, and the volume thereof.

Give details of the quantity of cutting discharge and the volume thereof for the stage when the drilling is done without recycling, when the cutting discharge is poured near to the bore

onto the seabed and for the stage of the drilling done with recycling when the cutting discharge is brought up onto the rig with the drilling mud.

Describe the area of dispersal of mud and other cuttings, physical changes in the seabed due to the effect of anchoring and excavation, the accumulation of waste, etc.

Give an estimate of quantities of each material used and at what stage, as a function of the depth of the drilling. Ensure use of water-based drilling liquids. If use is made of mineral drilling liquids, set out the criteria and limitations for use of one kind as opposed to another. Use of synthetic substances in those liquids that are not water-based should be preferred provided that such are friendly to the marine environment.

Describe the way in which the various substances are added to the water and to other drilling liquids (creating the drilling mud).

Describe the method and frequency of chemical tests conducted in mud and drilling liquids injected, including materials pumped into the drilling mud preparation system and the standards under which the tests are conducted.

Provide a plan for the treatment and removal of cutting discharge – describe the method of treatment and removal of cutting discharge. If the disposal destination for the cutting discharge is at sea, describe the piling up of the drilling mud on the seabed, the tests, actions and frequency thereof, in order to prevent harm to the marine environment.

Provide information for pumping originating in drilling mud will include the chemical composition of the water, including: extended survey for metals (ICP, mercury in AA); GCMS survey of organic materials with reasonableness percentages, half-quantity concentrations and summary; detailed survey of VOCs (head space) with reasonableness percentages, including half-quantity concentrations and summary; PAH; TPH; TSS; DOC; TOC; BOD; turbidity; phenol; cresol; pH; AOX; DOX; mineral oil (FTIR); species of nitrogen (nitrate - N, nitrite - N, ammoiacal nitrogen - N, Kjeldahl nitrogen, TKN, general nitrogen - calculated); phosphate - P; sulphide; TDS; chlorides; the information shall be presented as concentration (ML) and load (mass per unit of time). This information shall be based on tests on drilling mud from existing facilities and similar processes, subject to details of the source of the information.

3.2.2.2. Prevention of Oil Blowout

Describe the blowout preventer (BOP) that has proven efficacy and that is designed to prevent oil, gas and/or liquids under the surface such as produced water, saline water from blowing out of the bore into the marine environment. Explain and describe the continuous pressure controls. Set out the standard for periodic testing of all of the means of prevention of blowout or fault.

3.2.3. Pipeline and Concretization

In accordance with the drilling plan, describe the protective pipeline from the seabed to the target strata.

Describe the concretization of the casement pipelines in the drilling, in order to prevent possible leaks and the transition of liquids from the bore into the seawater.

Describe the method of construction and concretizing of the bore with reference to the timeframes of the principal stages in drilling the bore.

Describe the composition of bore concretization materials.

Describe the manner in which the quality of concretization is ensured during drilling, the method of testing such and the standard used for the test.

3.2.4. Testing of drilling pipelines

Describe the references required for ensuring that drilling and protection pipelines are in order and the method of testing such, with all of the components thereof.

3.3. Drilling phases

Describe, in brief, all of the drilling processes and phases including the actions and materials relating all drilling activities. Set out a Gantt Chart setting out the drilling activities done in series and in parallel.

3.4. Production Tests

3.4.1. Describe the planned production test method, the phases thereof, the order of activities and the possible methods thereof, and set out the reasons for such. Set out the various indexes that will be examined such as maximum production of all production components (gas, oil, water, condensate), pressure, description of oil and/or gas including sulfur, nitrogen, CO_2, etc.

3.4.2. In cases where use is planned to be made of chemical substances in a production test, details must be given, as far as possible, of the substances that will be used in the production tests, the names of the substances, the quantities of the substances, the chemical composition of them and their function, including chemical formula, MSDS (Material Safety Data Sheet) number and CAS (Chemical Abstract System) number.

3.5. Noise Hazards

Set out details of the mechanical equipment and the noise levels from the dominant sources characteristic of each form of technology. Set out details of the duration of the drilling, the hours of work each day, the number of sea vessels that will operate at the same time, throughout the hours of the day, and the helicopters involved in the work. Set out details of the frequency and magnitude of the noise that will be generated during the course of work at increasing distances from the source.

3.6. Air Quality

Describe the potential sources of air pollution from all of the licensee's operations, including ships and marine installations, the daily and annual operations regime, the rate of emission of contaminants.

Describe the technology for reducing contaminant emissions, the location of clean sampling, etc.

3.7. Hazardous Materials

Describe and set out details of the type and quantity of the planned hazardous substances, note the chemical composition of such, their identification number, and the purpose of use thereof, including drilling liquids, and pumping tests.

3.8. Sources of Discharge into the Sea

3.8.1. Describe all of the emissions into the sea, and describe, for each source, the processes that give rise to the discharge and a flowchart of the process. The flows that must be presented include: water from the drilling mud treatment and recycling facility, cooling

water, RO concentrate water, organic kitchen waste, sanitary waste, wash from the oil separation facility.

3.8.2. Describe the processes that create the flow together with a drawing of the processes.

3.8.3. Describe the processes for treatment if any, including physical data regarding collection units, engineering data and operational data for every facility, treatment (the area of the facility, the volume of each unit, capacity, waiting time, etc.). Provide the means of monitoring and control for every process/treatment. List of additives in every production and treatment process, the quantity of each additive, the function of such and the manner in which it is added. Attach information sheets (MSDS) for each additive, with an emphasis on ecological information for the marine environment. Attach a schematic chart for each treatment facility.

3.8.4. Describe the flow times including whether the flow is continuous or interrupted, fixed or variable (hourly/daily/other), and what the conditions and/or processes are that determine the quantity and/or times of flow.

3.8.5. Describe the method of discharge into the sea of each and every source and whether the discharge is affected separately/separate source or together with other discharges. In describing the source, set out the physical characteristics of the source/source pipe and the depth of the source with respect to the surface of the water/the seabed.

3.8.6. Quantities: Set out the quantities of each source in accordance with the capacity data of each and every source, set out the information based on a maximum hourly, maximum daily, maximum monthly and maximum yearly calculation. Set out the method of controlling quantities/amounts pumped into the sea (wharf based capacity meters, water meters, other). Quantity data shall be presented in cubic meters.

3.8.7. Quality: Describe the composition of each source. Set out the information on the basis of data from similar facilities, including the conduct of laboratory tests. This information shall include contaminant concentration data, and the contaminant load discharged into the sea (tons / year). Note, for each source of pumping, the source of the information regarding the composition of it.

3.8.8. Biological toxicity test (LC50) – set out the tests conducted for testing biological toxicity in drilling mud / surpluses from the treatment facility pumped into the sea and set out where such tests are performed and the source of the data; examine and present the extent to which the existing toxicity tests accord with the deep sea conditions in the Eastern Deep Sea Basin. Attach an expert opinion regarding the extent to which the tests comply, and his recommendations regarding the conducting of compatibility tests for the deep sea conditions in our region.

3.8.9. Give details as to whether there are land-based alternatives for each pumping source. If not, give reasons and details regarding the way in which this subject was checked.

3.8.10. The information for pumping from the wash treatment facility will include the chemical composition of the water, including: extended survey for metals (ICP; mercury in AA); GCMS survey of organic materials with reasonableness percentages, half-quantity concentrations and summary; detailed survey of VOCs (head space) with reasonableness percentages, including half-quantity concentrations and summary; TSS; DOC; TOC; BOD; turbidity; phenol; cresol; pH; AOX; DOX; mineral oil (FTIR); species of nitrogen (nitrate - N, nitrite - N, ammoiacal nitrogen - N, Kjeldahl nitrogen, TKN, general nitrogen - calculated); phosphate - P; sulphide; TDS; chlorides; the information shall be presented as concentration (ML) and load (mass per unit of time).

3.8.11. The information for pumping from the sanitary effluent treatment facility will include the chemical composition of the water, including: BOD; TSS; TOC; turbidity, free chlorine, oils and lipids (FTIR), mineral oil (FTIR), species of nitrogen; sulphide; detergents (MBAS); pH; fecal coli per 100 mL, streptacocus per 100 mL, extended survey of metals (ICP), TDS; the information shall be presented as concentrate (ML) and load (mass per unit of time – mass / month or mass / year).

3.8.12. Describe the efforts to separate upper drainage water, in the event of rain, the tests and treatment thereof before such is returned to the sea.

3.9. Waste

Describe the quantity of the waste expected to be created, including kitchen waste, dry waste, other waste created as a result of the drilling process, except for waste set out in the section of discharge into the sea as set out in section 3.9 above.

3.10. Closure of Drilling Site

Describe the details of the actions required for closure of the drilling site and the order of performance thereof, including abandonment or turning the bore into a production bore. Describe the measures for closing the wellhead, the target strata, and other conducting strata for two alternatives, abandonment and restoration of the previous condition; declaration of a discovery and transition to production. In the event of closure of the wellhead, the standard under which the closure means are installed must be set out.

Chapter D Evaluation of the Environmental Impacts expected to develop due to Performance of the Plan and the Measures to be taken to Prevent/Minimize such

This Chapter shall set out the various issues where environmental impacts are expected in the area and close and distant regions of the Application and its environs verbally and graphically. The description of the environmental impacts and the sources of these shall be both qualitative and quantitative. The variety of activities expected to take place at the drilling site must be set out. With respect to each subject, an explanation shall be given as to whether it is necessary to prevent or reduce the negative environmental impacts and what means must be employed in order to prevent or reduce such, if any. In the event that during the course of preparation of the Application, influences or other findings are found that are not mentioned in this document, these must be addressed and means must be proposed for reducing the impact in the document.

4.1. Assessment of Potential Impact on Sea Water

Assess the maximum scope of the impact of the drilling rig on the seawater, the seabed, and the coast, as the case may be, and set out the basis for the information and the method of effecting the assessment.

Assess the maximum scope of the impact of the drilling liquids at the time of affecting the production tests on the seawater in the area of the Application.

4.1. Production Tests

Describe all of the means for ensuring that under no circumstances will there be any connection (transfer of liquids or gases) from the area where the production tests are taking place and the water-carrying strata and expansion of the fuel composition (liquid and gas) underground or in the marine environment.

4.2. Preparation for handling events of sea pollution by hydrocarbons

Set out a plan for the implementation of treatment of outflow leaks or hydrocarbon blowouts. The plan must include reference to all of the components of the site, including drainage of operational areas – drilling, production tests. The plan will be designed in accordance with Appendix D (Emergency Factory Plan for the Treatment of Incidents of Sea Pollution by Oil for Oil and Gas Exploration and Production Activities)

4.3. Light Hazards

The effect of lighting and the planned production tests required for performance of the Application on the environment must be examined and measures proposed for reducing expected light hazards.

4.4. Noise

Assess the expected impact of noise on animals in the environs of the drilling. Provide information on local species that might be harmed by such noises (with an emphasis on pelagic animals such as fish, marine mammals, turtles), and measures for reducing damage.

4.5. Nature and Ecology

4.5.1. Assess the level of sensitivity of the animals and the possible impacts of construction of the rig on habitats as described on the habitat map in **section 1.6.2**.

4.5.2. Describe rehabilitation at the end of drilling work and abandonment or commencement of the operational period. - Examine different approaches according to depths, for instance: require rehabilitation and full cleaning up to a depth of 150 m, and allow partial rehabilitation at greater depths. Check whether there is a similar requirement in the USA or Britain?

4.6. Archeology

Check the impact of performance of the plan on declared sites and on sites that may be discovered and exposed during the performance of the plan.

4.7. Air Quality

4.7.1. Show the state of air quality expected during the various stages of drilling and production, using an AERMOD model or another model approved by the Ministry for Environmental Protection. Coordinate the data in the meteorological file used for the forecast and the various scenarios for which the model will be run.

4.7.2. According to the results of the model, examine the impacts on air quality and the minimization of such, if negative impacts are found.

4.8. Waste

Describe the methods of treatment and removal of waste, as set out in **section 3.9** above.

4.9. Hazardous Substances

In accordance with **section 3.7**, describe the method of usage for all hazardous substances, their location on the rig, the method of treatment thereof, and the removal thereof. Describe cases and incidents that describe faults, and the methods of handling such.

4.10. Preparations for Earthquakes

Prepare emergency procedures or a chapter of existing emergency procedures for the handling of earthquakes. These procedures must address all exceptional situations, including: failure of communications and contact, inability to reach emergency forces, partial emergency team, etc.

4.11. Monitoring and Control Program

4.11.1. Describe the monitoring and control methods for each source discharged into the sea. Note what tests are done continuously, which are done visually and which are done in laboratories, and at what frequency. The measures are to be adjusted for the guideline set out in the Permits for Discharge into the Sea.

4.11.2. Describe the method of taking samples in order to obtain representative samples, for continuous/visual/laboratory sampling.

4.11.3. Describe the calibration and maintenance actions on monitoring and control instruments.

4.11.4. Set out the plan for monitoring the marine environment in accordance with Appendix A1.

4.12. Closure of Drilling Site

The impact of closure of the drilling site on the environment and the means required to prevent such impacts, including the removal of materials, equipment and waste, must be examined.

Chapter E Proposal for Application Guidelines

General:

5.1. This Chapter shall set out all of the proposals for setting the guidelines of the Application, at the level set out as being required for detailing the possible impacts set out in the chapters of this document, and the measures that are to be taken in order to prevent or reduce such.

5.2. The guidelines shall refer to the actions that must be taken or not taken in the entire area of the Plan, during the course of drilling and throughout the various phases of performance thereof, and following completion thereof.

5.3. The guidelines shall be for the grant of a drilling permit.

5.4. The guidelines shall relate to the installation and operation of systems to track and monitor the effects that flow or that may flow from this Application.

5.5. The guidelines shall relate to the actions that must be done throughout the area of the Application, upon the making of a decision to close the drilling site within the area of the Plan.

5.6. The guidelines shall include the following topics, inter alia:

5.6.1. Guidelines for the phases of performance of drilling and production tests.

5.6.2. Guideline for the handling of hazardous materials.

5.6.3. Guidelines for the reduction and prevention of harm to land and to seawater and the coastline, and including harm to the marine ecology.

5.6.4. Guidelines for the preservation of fauna and flora in the area of the Application.

5.6.5. Collection of data for the purpose of monitoring and tracking the quality of seawater, sediment, fauna and flora in the environs of the bore.

5.6.6. Setting of guidelines for the construction of various monitoring systems (air, water, mud and cutting discharge, etc.), to operate during the construction and operation of the Application.

5.6.7. Measures for preventing/reducing light hazards.

5.6.8. Measures for reducing air pollution hazards.

5.6.9. Measures for preventing or reducing noise.

5.6.10. Measures for treatment and removal of cutting discharge and drilling mud.

5.6.11. Measures for treatment of various sources of discharge including cooling water, sanitary waste, kitchen waste, concentrate water.

5.6.12. Guidelines and instructions for the preparation of emergency procedures for the case of faults or accidents including leaks or spills of contaminants into the marine environment, or fires.

5.6.13. Actions to be taken when closing and rehabilitating the drilling site.

5.6.14. Guidelines for periodic reporting of faults to the Commissioner for Oil.

APPENDIX B

List of Preparers and Qualifications

Name	Position, Affiliation	Qualifications	Responsibilities
Brian J. Balcom	Senior Scientist, CSA Ocean Sciences Inc.	Experience: • 33 years Education: • B.S., Biological Sciences, University of Southern California, 1975 • M.S., Biology/Marine Biology, University of Southern California, 1980 • Post-graduate studies – environmental law, environmental impact assessment, 1985, University of California, Santa Barbara; environmental engineering, USC, 1980-1981	Author, Chapters C-E Reviewer, Chapters A-B
Bruce D. Graham	Marine Specialist, CSA Ocean Sciences Inc.	Experience: • 31 years Education: • B.S., Biological Sciences, University of New Hampshire, 1979 • M.S., Biological Sciences, Florida Institute of Technology, 1983 • Exchange program, California State University, Chico, 1977-1978	Author, Chapters A-B Reviewer, Chapter C-E
Stephen T. Viada	Senior Scientist, CSA Ocean Sciences Inc.	Experience: • 33 years Education: • B.S., Zoology, Texas A&M University, 1978 • M.S., Biological Oceanography, Texas A&M University, 1980	Contributing author, Chapters B, C, D, and E
Melody B. Powell	Senior Technical Editor, CSA Ocean Sciences Inc.	Experience: • 23 years Education: • B.S. Zoology, University of Florida, 1988	Technical editor
Brent R. Gore	GIS Technician, CSA Ocean Sciences Inc.	Experience: • 3 years Education: • Master of Arts in Geography, East Carolina University, in process • B.A., Geography, University of North Carolina, 2009	GIS and graphic imagery
Karen I. Stokesbury	Support Services Mgr., CSA Ocean Sciences Inc.	Experience: • 15 years	Document production
Lynanne Rockhill	Word Processor, CSA Ocean Sciences Inc.	Experience: • 15 years	Document formatting

APPENDIX C

List of References and Data Sources

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APPENDIX D

Project Vessel and Aircraft Specifications

Ensco Europe & Africa
Badentoy Avenue
Portlethen
Aberdeen, U. K. AB12 4YB
Phone: + 44 1224 780400
Fax: + 44 1224 783483
E-mail: marketing.eu@enscoplc.com
www.enscoplc.com

ENSCO 5006

GENERAL INFORMATION

Flag Vanuatu
Previous Name(s) Pride North America
Year Built 1998/1999
Builder Friede & Golldman, Pascagoula, USA
Design Bingo 8000, modified by the addition of 22.96 ft pontoon extensions Fore & Aft.
Classification DNV, Maltese Cross 1A1 Column Stabilized Drilling Unit

MAIN DIMENSIONS

Deck Area 252.60 x 213.3 ft

MACHINERY

Main Power (4) Caterpillar 3608-TA diesel engines, 3,055HP; (1) Baylor AC generator, 600V 60Hz 3,571 kVA each.
Power Distribution 6 SCR's: M&I ; 2,200 amp 750V dc output each SCR units for drilling and mooring
Emergency Power (1) Caterpillar 3512-DITA diesel engine 1,281 HP, (1) Caterpillar SR-4 AC generator, 480 V 60 Hz 1,137 kVA

OPERATING PARAMETERS

Water Depth Maximum design value: 7,500 ft, Outfitted for 7,000 ft
Maximum Drilling Depth 25,000 ft
Transit Speed 5 knots
Survival Conditions Wind: 100 knots; Waves: 105 ft at 15 sec; Current: 1.5 knots

DRILLING EQUIPMENT

Derrick Loadmaster 172 x 44 x 40 ft, rated at 1,600,000 lb SHL capacity with 14 lines
Drawworks National 1625 UBDE, input 3,000hp;7838 Elmagco brake
Rotary National 60-1/2 in powered by GE 752 electric motor
Top Drive Varco TDS-4S, 2 speeds, rated 750 ton, 45,500ft.lb @ 130 rpm, 7,500psi WP
Mud Pumps (3) National 14P220, 2,200HP each, 7,500 psi WP

HOISTING EQUIPMENT

Cranage (1) AmClyde Kingpost crane, rated 80 mt at 31.5 m with 48.76 m boom
(1) Liebherr Kingpost crane MTC-1900-60D Litronic, rated 60 mt at 8.9 m with 45.72 m boom

CAPACITIES

Liquid Mud 5,100 bbls (Deck Box), 4,800 bbls Reserve Mud (Minor columns)
Bulk Mud/Cement 20,600 ft3
Sacks 6,000 sacks
Drillwater 12,320 bbls
Potable Water 4,620 bbls
Fuel Oil 16,650 bbls

WELL CONTROL SYSTEMS

BOP VetcoHD-H4 well head connector 18-3/4 in 15,000psi WP; 2 x Cameron 18-3/4 in type TL double 15,000psi WP H2S trimmed preventers; 1 x Hydril 18-3/4 in dual annuflex annular 10,000psi WP H2S trimmed; LMRP: Cameron connector model HC, 18-3/4 in 15,000psi WP; Oil State 5,000 psi flex joint.
BOP Handling (1) BOP carrier, 272 mt; (1) X-mas Tree Carrier, 272 mt; (2) 72.5 mt BOP overhead crane
Control System Cameron Multiplex system, 5,000psi
Diverter Hydril FS-21-500, 21-1/4 in for a 60 1/2 in rotary, 500psi WP, 2 x 14 in vent line and 1 x 18 in flow line outlets
Choke and Kill Cameron 15,000psi, 4 in, H2S service manifold

MOORING

Winches (4) Skagit double drum traction winches
Wire 10,600 ft x 3-3/4 in wire and 2,500 ft x 3-1/4 in R3S chain
Anchors (8) Vryhof Stevpris MK-5 anchors, 15 mt each

HELIDECK Sikorsky S-61N, 84 x 84 ft
ACCOMMODATION 120 persons

ADDITIONAL DATA

(4) Norsafe 60-man totally enclosed life boats; 5 x 25 man life rafts

TYPE: VS 486		**John P Laborde**			
GENERAL		PROPULSION		EQUIPMENT	
Length OA	85.34 m	Engines	4 x EMDs	Workdrum pull	600 t
Breadth	21.0 m	BHP	24000	Capacity 1	5800m x 83mm
DWT		kW	17650	Capacity 2	
Deck area		For'd Thruster		Towdrum pull	600 t
Fuel	1527 m3	Az Thruster		Capacity 1	
Pot water	437 m3	Aft Thrusters		Capacity 2	
Mud		Bollard pull	200 t	Sharks Jaw	
Brine		DP		Cranes	
Dry bulk		Joystick		Tank cleaning	
Year built/due	2004			Shipyard	Yantai Raffles

TYPE: VS 486		**Richard M Currence**			
GENERAL		PROPULSION		EQUIPMENT	
Length OA	85.34 m	Engines	4 x EMD 16-265H	Workdrum pull	600 t
Breadth	21.0 m	BHP	24000	Capacity 1	5800m x 83mm
DWT		kW	17650	Capacity 2	
Deck area		For'd Thruster		Towdrum pull	600 t
Fuel	1527 m3	Az Thruster		Capacity 1	
Pot water	437 m3	Aft Thrusters		Capacity 2	
Mud		Bollard pull	200 t	Sharks Jaw	
Brine		DP		Cranes	
Dry bulk		Joystick		Tank cleaning	
Year built/due	2003			Shipyard	Yantai Raffles

M/V "EAS" – DP I AHTS – 9500 IHP

GENERAL INFORMATION

Owner	Sea Whale Shipping Ltd
Operators	EDT Shipmanagement Ltd
Built	1975 by Husumer Shipyard, Husum, Germany
Flag	Cyprus
Refit	1998 upgraded with extra thrusters and DP-I
	1999 upgraded accommodation with survey room and cabins for 34 persons
Call Sign	P3ZM4
Classification	GL +100 A5 Offshore Tug-Supply Vessel
IMO Number	7403146
MMSI Number	209005000
GL Registration Number	101777
Operation	World Wide
Endurance	40 Days
Speed Maximum	13.5 Knots

DIMENSIONS

Gross Tonnage	1191
Net Tonnage	357
Deadweight	1,268 M/T
Length Oveall	61.75m
Breadth Moulded	13.00 m
Depth to Main Deck	6.35 m
Draft	5.437 m
Displacement	2,688 M/T

TANK CAPACITIES

Marine Diesel	470 MTS
Fresh Water	310 MTS

DP SYSTEM

DP System	Alstom Cegelec DPS 900 Simplex Dynamic Position System
GL Notation	GL Notation "Dynpos Aut" (Class I).
Differential GPS Reference systems	2 x DGPS
	1 x Veripos LD3-G1 Single frequency receiver
	1 x Dual frequency C-Nav 2050 (high accuracy cpable <30cm) Receiver
	Sonardyne Hydro Acoustic
Gyros	2 x Anschütz Standard 20
Accoustic Systems	Sonardyne USBL

DECK EQUIPMENT

Deck Area	254 m2 Clear Deck (25.46 x 10.02)
Deck Load	500 Tons
Deck Cargo Capacity	385 tons

DECK CRANES & A-FRAME

Deck Crane	HIAB 360 Knuckle Boom, 2.25 Tons

TOWING EQUIPMENT

Towing Winch	Brattvaag Water Fall - 200 Tons Line Pull, Triple Drum
Main Drum Capacity	1,128 m x 62 mm wire (wire length 1,050 m x 62 mm)
Bollard Pull	94 Tons
Stern Roller	250 T SWL (3 m x 1.5 m)

PROPULSION/MACHINERY

Main Engines	2 x MaK 12 M453 AK Total 7,760 BHP / 9,500 IHP
Auxiliary Generators	1 x 405 BHP Deutz BF 12 M716, 340 kVA 440 V 60 HZ
	1 x Volvo 162C, 340 kVA, 440 V 60 HZ
	2 x 800 kW Cummins KTA 38
Main Propulsion	2 x Pitch Propellers in Kortnozzles
Bow Thrusters	1 x Kamewa Tunnel Thruster 1650 H-CP
	1 x Ulstein Tunnel Thruster
Stern Thrusters	1 x Kamewa Tunnel Thruster 1650 H-CP

ACCOMMODATION

Total Accommodation	35 Persons
Other Facilities	Survey Room 18m²(4 x 4.5m)
	Laundry Room : - 2 x Wesco Navy Washing Machines
	- 2 x Wesco Tumble Driers
	SAT TV
	Permanent Internet Connection
	The Vessel is fully air conditioned.

NAVIGATION EQUIPMENT

Radars	1 x SAM Eletronics CHARTRADAR 1100
	1 x Decca Bridge Master E
ECDIS	1 x SAM Electronics CHARTPILOT 1100
GPS	1 x Leica MX 420
LRIT	2 x JRC JUE-85 INMARSAT-C
AIS	JHS - 182
Gyro Compass	2 x Anschütz Standard 20
	1 x Anschütz
Auto Pilot	1 x Robertson
Navtex	Racal Lo-kata
Echo Sounder	Furuno FE-700

COMMUNICATIONS

Radio Transeivers	Sailor
DSC Decoders	1 x Sailor for HF SSB
	2 x Sailor for VHF
VHF	1 x Redifon Sealand
	2 x Sailor
	1 x Icom
Inmarsat C	Telex
V-Sat	Voice, Data
Broadband Sat Com	Voice, Fax and Data

GMDSS installation in accordance with IMO regulations for vessels operating within Sea Area A3.

The specifications listed on this data sheet are subject to change without notice and cannot be used for contractual purposes.
Up-to-date specifications will be supplied on request.
All details without guarantee.
(30.11.2011)

M/V "EDT LEON" – Fast Crew / Supply Boat (DP I)

GENERAL INFORMATION	
Owner	Mahita Sea Shipping Ltd.
Managers	EDT Shipmanagement Ltd
Built	2009, Damen Shipyards, Danang
Flag	Cyprus
Call Sign	5 BFB 3
Classification	GL,107666 ✠ Hull 100 A5 Supply Vessel Unrestricted Navigation, Dynapos AM
IMO Number	9575400
MMSI Number	209343000
Operation	Worldwide
Maximum Speed	20 – 30 knots (trials)

DIMENSIONS	
Gross Tonnage	427 T
Net Tonnage	128 T
Deadweight	350 T
Length Overall	51.25 m
Breadth	10.1 m
Draft	3.2 m
Deck Length	29 m

TANK CAPACITIES	
MGO (cargo + auton.)	165 m^3
Fresh Water (cargo)	190 m^3
Deck Space / Cargo Capacity	225 m^2 / 250 tonnes

PROPULSION/MACHINERY	
Main Engines	4 x Caterpillar / 3512B TA, Total Power 4472 bkW / 6000 BHP
Generators	3 x Caterpillar C4.4 TA, 99 kW
Bow Thrusters	2 x 75 kWTwin 950mm
ACCOMMODATION	
Crew Accommodation	8 bunks
Offshore Passengers	80 pax
Other	Air Conditioning in wheelhouse and accommodation
NAVIGATION EQUIPMENT	
Radars	2 x Furuno FR 1944 C
Magnetic Compass	Ritchie, HB 71
Electronic Compass	Fluxgate Heading Sensor
COMMUNICATION	
VHF	1 x Sailor RT5022 1 x Sailor RT2048
VHF's Handheld	2 x Jotron
GPS	Furuno 320 GPS
Chart Plotter	C-Map Chart Plot
Navtex	Furuno FX 900
Epirb	Jotron Tron 40S
AIS	Furuno, FA150
Autopilot	Raytheon Anschutz, NP60
Broadband Sat Com	Voice and Data

The specifications listed on this data sheet are subject to change without notice and cannot be used for contractual purposes.
Up-to-date configurations and specifications will be supplied on request.
All details without guarantee.
(30.11.2011)

1.2 Helicopter #1 – BELL 412SP, N142PH, S/N 33150

PROPOSED PRIMARY AIRCRAFT

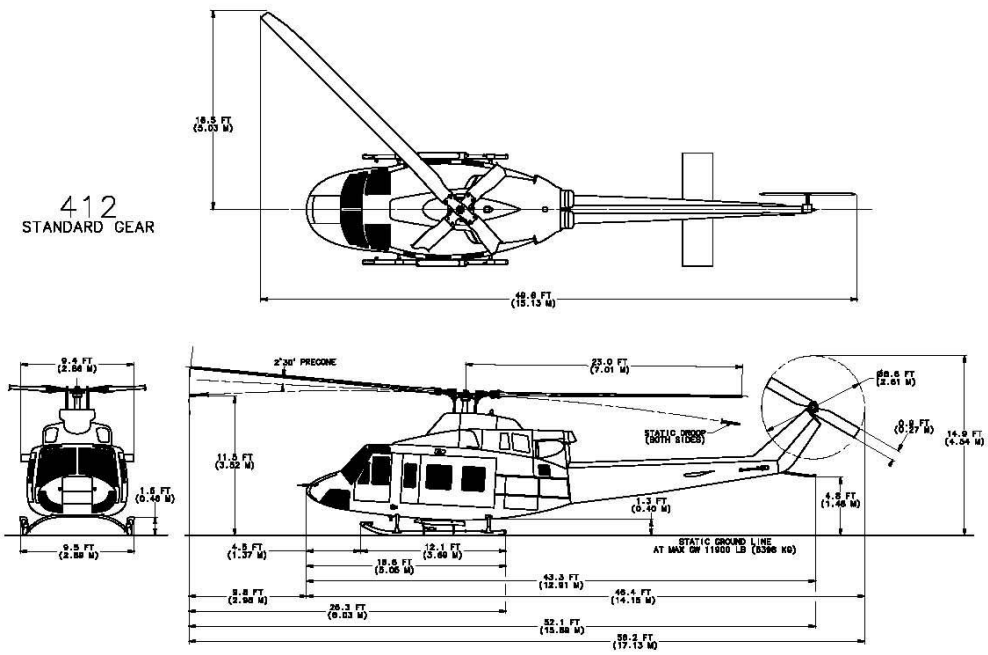
BELL 412SP, N142PH, S/N 33150

INSTRUMENT PANEL – Actual photo

INTERIOR – Actual photos

Bell 412
Heliport Design Data and Dimensions

Bell Helicopter
A Textron Company



LANDING GEAR LOADING AT MAXIMUM GROSS WEIGHT (11,900-POUNDS),
BASED ON 1G STATIC CONDITIONS AT AFT-MOST STRUCTURAL CG LIMIT

Gear Type	Loading (lb)		Contact Area (in^2)		Contract Pressure (lb/in^2)	
	Forward	Aft	Forward	Aft	Forward	Aft
Standard Skid	2356	9544	24.0 x 2.0	24.0 x 2.0	49	199
High Skid	2386	9514	24.0 x 2.0	24.0 x 2.0	50	199
Emergency Floats	2486	9514	24.0 x 2.0	24.0 x 2.0	50	199

February 13, 2008

1	**GENERAL**	AIRCRAFT # 1
	Precise type of AIRCRAFT	412SP
	Manufacturer	Bell Helicopter
	Year of manufacture	1987
	Total flight time of AIRCRAFT	12,101
	Number of flying hours before next major overhaul: (800 minimum)	No major overhaul within 800 hrs
	Registration marks and serial number	**N142PH / SN: 33150**
	Ownership and nationality	PHI, Inc. / USA
	Mortgage and possible preferential rights on the AIRCRAFT	None
	For each engine:	
	Time Since New (TSN)	Left: 10,642 Right: 10,623
	Time Since Overhaul (TSO)	Left: 2,717 Right: 4,834
	Time Remaining before next overhaul*	Left: 4,532 Right: 2,415
	***(Note: PHI authorized TBO ext.to 7250 hrs)**	
	Availability date	August 2010
2	**CERTIFICATION AND OPERATION**	
	Certification	
	Authority of certification	US FAA
	Airworthiness certificate number	FAA H4SW
	Limit of validity of certificate	Indefinite
	Category of certificate and/or restriction/limitations	FAR 29
	Operations	
	Air Operator Certificate (AOC) reference nº.issued by (Authority)	HEEA617E / US FAA
	Contents and conditions of the AOC	On Demand, Title 14 Section 119.25(b)
	Name and location (main place of business) of the operator	PHI, Inc, Lafayette Regional Aiirport, Lafayette, LA..
	Date of issue and period of validity	1/2/2010 / Indefinite
	Description of the type of operations authorised	VFR/IFR; Day/Night
	Authorised areas of operation	See attached OPNS Specifications
	Special limitations and special authorisations / approvals	See attached OPNS Specifications
	Does the aircraft carry an Operations Manual?	Yes
	Operations Manual approved by which Authority?	US FAA
3	**TECHNICAL DATA**	

3.1 *Operational Envelope*	
Altitude	Max op alt - 20,000 ft; Max DA: 14,000 ft
In flight envelope	
Flight envelope for take-off and landing	40 kts single engine flyaway safety speed
Flight envelope for re-starting engine(s)	Cruise / pilot discretion
Temperature	
In flight (max and minimum)	-2 C lapse rate per 1000 ft (-) limitatons below
At take-off (maximum and minimum)	51.7 C Max / - 40 C Min
Wind limitations	
For starting the rotor	60 Kts / pilot discretion
For take off and landing (on ground and on offshore platform)	60 Kts / pilot discretion
Rear wind	35 kts
Side wind	35 kts
Maximum slope gradients for landing/take-off	10 degrees side and 4 degrees nose/tail
For starting and stopping the rotor	Same as above
For landing/take-off with rotor turning	Same as above
In relation to the rig's movements (offshore operations)	
Pitch/roll/heave limitations (platform landing)	5 degrees roll and 5 degrees pitch
3.1 *Weight*	
Maximum take-off weight: ISA & ISA +20	11,900 lbs
Maximum weight with external load (if different)	Same as above
Helicopter empty weight (offshore equipped)	7925 lbs approx
Fuel	2237 lbs max fuel
Type	Jet A, A-1, B, JP4, 5
Supplier	Laufer Aviation / Haifa
Tank capacity	330 US gl
Average fuel consumption (MTOW, ISA and ISA+20, ZP 2000ft)	115 gl/hr
At cruise speed of 120 knots/hr	110 gl/hr
3.2 *Commercial Capacity*	
Passengers	
Maximum number of passenger seats	13
Maximum number of stretchers	2
Luggage	
Maximum weight	400 lbs / 28 cu ft
Cargo	
Maximum capacity (kg or lbs)	2200 lbs / internal
Maximum dimensions	4 ft x 8 ft (internal cabin) - 220 cu ft
Structural resistance of floor (kg/m² or lbs/ft²)	100 lbs/sq/ft
Under a sling maximum capacity (kg or lbs)	4500 ;bs
3.3 *Cruising Range (Km or Nautical Miles)*	
Maximum cruising range (average conditions) - 30 min resereve	265 nm

3.4 Crew	
Number of pilots required	
for VFR flights	2
for IFR flights	2
Number of crew members in addition to the pilots if applicable	n/a
(for hoist, sling, etc.)	
3.5 Type of Landing Gear	
Skid type, wheels type, retractable gear type, etc.	Skid (note: heliport netting not allowed)
3.7 Equipment and Instrumentation	See attached Equipment List
Weather radar (With minimum scale of 2.5 nm. with a beacon mode)	
GPS	
Fixed ELT (Emergency Locator Transmitter) on the airframe	
Removeable ELT	
Cospas-Sarsat 406 MHz ELT	
ULB (Underwater Locator Beacon)	
CVR (Cockpit Voice Recorder)	
Public Address for passengers)	
Push out windows	
HEEL (Helicopter Emergency Exit Lighting)	
Passenger Life-Jacket type	
Do passengers systematically wear life-jackets during flight (not stored in a pouch)	
FDR (Flight Data Recorder)	
AVAD (Voice Alarm on radio altimeter)	
HUMS (Health and Usage Monitoring System) or equivalent	
(please provide details)	
3.8 Radio-Communications	See attached Equipment List
Full list of radio-communication equipment installed	
Full list of radio-navigation equipment installed	
3.9 Dimensions	
Overall length (rotor turning)	56 ft 2 inches
Overall height	15 ft 1 inch
Main rotor diameter	46 ft
4.0 **SAFETY AND LIFE-SAVING -** Please Asnwer YES or NO	
Written safety instructions available for the use of the passengers	Yes
YES (written in which language ?) - NO	English

Safety video briefing available for the concerned type of helicopter	Yes
YES (available in which language ?) - NO	English
Number of first aid kits on board	2
Life-rafts (type, number)	2 / Apical External
Life-jackets (type, number)	Switlik HV-35 P bladders
Fireman's axe (number, location)	0
Hand fire-extinguishers for use on board (type, number)	2
Heavy fire-extinguishers	0
Flares	4 (crew lifevest, life rafts)
Other	2 offshore survival kits
´5.0 **MAINTENANCE - Please Asnwer YES or NO**	
Is the operator responsible for the maintenance of AIRCRAFT he hires?	Yes
If not, who is responsible (address and telephone number)?	n/a
Maintenance agreement certificate reference (JAR 145 or equivalent)	HEEA617E / US FAA
What are the different types of checks included in the maintenance programme?	PHI ContinuousAirworthiness Maintenance Program (CAMP) Zones 1-4, 50 hr a/f insp
Average time required to carry out each type of check	24 man hours
Date when last check of each type was carried out & hours flown since then	All Zone inspections to be completed prior to delivery to customer in Haifa, Israel
Do the maintenance checks conform with the manufacturer's recommendations? (YES – NO)	Yes
If not, main differences	n/a
Approximate date of next major overhaul	4000 hr/5 YR - August 2014
´6.0 **OPTIONAL EQUIPMENT ON BOARD**	
Winch (YES – NO)	No
Maximum load (lbs)	n/a
Necessary crew	n/a
Slings (YES – NO)	Not required
Maximum load (lbs)	n/a
Length of slings (m or yard)	n/a
Antisand filter (YES – NO)	No
Other equipment (please provide a list)	See attached Equipment List

APPENDIX E

Material Safety Data Sheets

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **AQUAGEL® GOLD SEAL**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: AQUAGEL® GOLD SEAL
Synonyms: None
Chemical Family: Mineral
Application: Viscosifier

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	0.1 mg/m^3	Not applicable	0,075 mg/m^3	Not applicable
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Bentonite	1302-78-9	60 - 100%	215-108-5	10 mg/m^3	Not applicable	Not applicable	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 24 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Tan
Odor:	Mild earthy
pH:	8-10
Specific Gravity @ 20 C (Water=1):	2.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARA-DEFOAM® W300**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARA-DEFOAM® W300
Synonyms: None
Chemical Family: Blend
Application: Defoamer

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

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Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed. Combustible.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrotreated light petroleum distillate	64742-47-8	30 - 60%	265-149-8	5 mg/m^3	Not applicable	Not applicable	Xn; R65

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases. Runoff to sewer may cause fire or explosion hazard.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 6 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear amber
Odor:	Mineral oil
pH:	5 - 8.5
Specific Gravity @ 20 C (Water=1):	0.872
Density @ 20 C (kg/l):	0.88
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	< -17.8
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	>77
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.6
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	5.0
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide. Hydrocarbons.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin defatting with prolonged exposure. May cause skin irritation.
Eye Contact	May cause eye irritation.

Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xn - Harmful.
R65 Harmful: may cause lung damage if swallowed.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARACARB**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARACARB
Synonyms: None
Chemical Family: Mineral
Application: Bridging Agent

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

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Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye, skin, and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, quartz	14808-60-7	0 - 1%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Limestone	1317-65-3	60 - 100%	215-279-6	10 mg/m^3	Not applicable	10 mg/m^3	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Store away from acids. Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to tan
Odor:	Odorless
pH:	8-9
Specific Gravity @ 20 C (Water=1):	2.7
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide. Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Safety Phrases S22 Do not breathe dust.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARACOR™ 95**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARACOR™ 95
Synonyms: None
Chemical Family: Amine
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R34 Causes burns.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.

Hazard Overview
May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed. Repeated overexposure may cause liver and kidney effects.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Monoethanolamine	141-43-5	60 - 100%	205-483-3	3 ppm	2 ppm	1 ppm	Xn; C; R20/21/22-34

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases. Do not allow runoff to enter waterways.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from acids. Store away from oxidizers. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	In high concentrations, supplied air respirator or a self-contained breathing apparatus.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron. Rubber boots.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Colorless
Odor:	Amine
pH:	12
Specific Gravity @ 20 C (Water=1):	1.02
Density @ 20 C (kg/l):	1.02
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	130
Freezing Point/Range (C):	-13
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	96
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	0.2
Vapor Density (Air=1):	2.1
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	0.1
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	23
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	-1.9 (OECD117)
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Carbon monoxide and carbon dioxide. Hydrocarbons.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause Central Nervous System effects.
Skin Contact	Causes severe skin irritation. May cause skin burns.
Eye Contact	Causes severe eye irritation May cause eye burns.

Ingestion	May be harmful if swallowed. Causes burns of the mouth, throat and stomach. May cause stomach discomfort. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions. May cause liver and kidney damage.
Aggravated Medical Conditions	Skin disorders. Lung disorders. Liver and kidney disorders.
Chronic Effects/Carcinogenicity	Prolonged or repeated exposure may cause central nervous system and brain effects. Prolonged or repeated exposure may cause liver, kidney and lung effects.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 1720 mg/kg (Rat)
Dermal Toxicity:	LD50: 2000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 57% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	EC50: 1247 mg/l (Corophium volutator)
Acute Crustaceans Toxicity:	TLM48: 163.2 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 60.5 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
UN2491,Ethanolamine Solution, 8, III

Air Transportation

ICAO/IATA
UN2491,Ethanolamine Solution, 8, III

Sea Transportation

IMDG
UN2491,Ethanolamine Solution, 8, III
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification
Xn - Harmful.
C - Corrosive.

Risk Phrases
R34 Causes burns.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.

Safety Phrases
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification
C - Corrosive.
Xn - Harmful.
R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R34 Causes burns.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BARAZAN® D**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BARAZAN® D
Synonyms: None
Chemical Family: Polysaccharide
Application: Viscosifier

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Xanthan gum	11138-66-2	60 - 100%	234-394-2	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Slippery when wet. Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 6 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	White to yellow
Odor:	Slight
pH:	5.5-8.5

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	510
Flash Point Method:	Not Determined
Autoignition Temperature (C):	204
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	1,000,000
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May impede respiration.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(5 Day): 200 mg/g COD: 1600 mg/g
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 320-560 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	TLM96: > 75000 ppm (Mysidopsis bahia)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

BARITE

Revision Date: 27-Mar-2012 **Revision Number:** 17

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name BARITE

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Weight Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Carcinogenicity - (H350)	Category 1A
Specific Target Organ Toxicity - (Repeated Exposure) - (H372)	Category 1

2. HAZARDS IDENTIFICATION

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H350i - May cause cancer by inhalation
H372 - Causes damage to organs through prolonged or repeated exposure

Contains

Substances	CAS Number
Barium sulfate	7727-43-7
Crystalline silica, quartz	14808-60-7

Precautionary Statements - EU (§28, 1272/2008)
P201 - Obtain special instructions before use
P308 + P313 - IF exposed or concerned: Get medical advice/attention

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Barium sulfate	231-784-4	7727-43-7	60 - 100%	Not applicable	Not applicable	No data available
Crystalline silica, quartz	238-878-4	14808-60-7	1 - 5%	Not applicable	Carc. 1A (H350i) STOT RE 1 (H372)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

4. FIRST AID MEASURES

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin	Wash with soap and water. Get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

Specific End Use(s)

Exposure Scenario	No information available
Other Guidelines	No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Barium sulfate	Not applicable	10 mg/m^3	4 mg/m^3	Not applicable	8 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Barium sulfate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Personal protective equipment
Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.
Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State: Solid **Color:** Pink to tan to gray
Odor: Odorless **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	4.23
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
Molecular Weight 233.4
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity

10. STABILITY AND REACTIVITY

Not applicable

Chemical Stability

Stable

Possibility of Hazardous Reactions

Will Not Occur

Conditions to Avoid

None anticipated

Incompatible Materials

None known.

Hazardous Decomposition Products

Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects

Acute Toxicity

Inhalation

Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Eye Contact May cause mild eye irritation.

Skin Contact None known.

Ingestion May produce nervous system effects such as feeling of weakness, unsteady walk, and dilation of blood vessels. May affect the heart and cardiovascular system.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Prolonged inhalation of fine barium sulfate dusts form harmless nodular granules in lung, an affliction called baritosis. Baritosis produces no symptoms of bronchitis or emphysema, and lung functioning is not affected although dyspnea, upon exertion, may occur. The nodulation disappears if exposure is stopped.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation

11. TOXICOLOGICAL INFORMATION

Barium sulfate	No data available	No data available	No data available
Crystalline silica, quartz	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Barium sulfate	No information available	TLM96: 7500 ppm (Oncorhynchus mykiss)	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)
Crystalline silica, quartz	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

14. TRANSPORT INFORMATION

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	27-Mar-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE®**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE®
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9 (1%)
Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions None known.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Biodegradable

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity: TLM48: 1875 mg/l (Daphnia magna)
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE® COARSE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE® COARSE
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9
Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions None known.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Biodegradable

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity: TLM48: 1875 mg/l (Daphnia magna)
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BAROFIBRE® SUPERFINE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BAROFIBRE® SUPERFINE
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Nut hulls		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Safety glasses.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	Tan
Odor:	Odorless
pH:	4.9

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.3
Density @ 20 C (kg/l):	1.1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	190
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	193
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	0.29
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	290
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 445 mg/l (Cyprinus carpio)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BDF-467**

Revision Date: 30-Aug-2007

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BDF-467
Synonyms: None
Chemical Family: Anionic Polymer
Application: Flocculent

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Do NOT spread spilled product with water. Scoop up and remove. Flush area with water.

7. HANDLING AND STORAGE

Handling Precautions Slippery when wet. Avoid creating or inhaling dust.

Storage Information Store away from oxidizers. Store in a dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Store at temperatures between 40 and 90 F (5 and 35 C). Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Rubber gloves.

Skin Protection Rubber apron.

Eye Protection Wear safety glasses or goggles to protect against exposure. Do NOT wear contact lenses.

Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	Off white
Odor:	Odorless
pH:	4-9 (5g/l)
Specific Gravity @ 20 C (Water=1):	Not Determined
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	Prolonged or repeated contact may cause slight skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: LD50: > 5000 mg/kg (Rat)

Dermal Toxicity: LD50: > 10000 mg/kg (Rabbit)

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not readily biodegradable.

Bio-accumulation Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity: LC50:(96 hour) >100 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity: EC50: (48 hour) >100 mg/l (Daphnia magna)

Acute Algae Toxicity: IC50 (72 hour): > 100 mg/l (Clorella vulgaris)

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **BENTONITE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: BENTONITE
Synonyms: None
Chemical Family: Mineral
Application: Weight Additive

Company Undertaking Identification

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Bentonite	1302-78-9	60 - 100%	215-108-5	10 mg/m^3	Not applicable	Not applicable	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	0.1 mg/m^3	Not applicable	0,075 mg/m^3	Not applicable
Crystalline silica, quartz	14808-60-7	< 3	238-878-4	0.3 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable

Restrictive exposure limits **More restrictive exposure limits may be enforced by some states, agencies, or other authorities.**

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Various
Odor:	Odorless
pH:	9.9
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated

Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.
Chronic Effects/Carcinogenicity	Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis. Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2). There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.
Other Information	For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

CALCIUM CHLORIDE (52620)

Revision Date: 04-Jan-2011 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name CALCIUM CHLORIDE (52620)

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Reagent
Uses Advised Against No information available

Details of the supplier of the safety data sheet

FANN Instruments Company
Halliburton House, Howe Moss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Acute Oral Toxicity	Category 4

- H302

Serious Eye Damage / Eye Irritation	Category 2

- (H319)

2. HAZARDS IDENTIFICATION

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Label Elements

Signal Word **Warning**

Hazard Statements
H319 - Causes serious eye irritation
H302 - Harmful if swallowed

Precautionary Statements - EU (§28, 1272/2008)
P264 - Wash face, hands and any exposed skin thoroughly after handling
P270 - Do not eat, drink or smoke when using this product
P280 - Wear eye protection/face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P301+ P312 - IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
P330 - Rinse mouth

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Calcium chloride	Listed	Proprietary	60 - 100%	Xi; R36	Eye Irrit. 2 (H319) Acute Tox. 4 (H302)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists. Remove contaminated clothing and launder before reuse.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

4. FIRST AID MEASURES

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Calcium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Calcium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.

Predicted No Effect Concentration (PNEC)	No information available.

Exposure controls

Engineering Controls	Use in a well ventilated area.
Personal protective equipment	
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls	No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical State:	Solid	**Color:**	White
Odor:	Odorless		

Property Remarks/ Method	Values
pH:	10
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.83
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	147.02
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation.

11. TOXICOLOGICAL INFORMATION

Eye Contact May cause severe eye irritation. May cause corneal injury.
Skin Contact Causes severe skin irritation. May cause skin burns on prolonged contact.
Ingestion Causes burns of the mouth, throat and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Calcium chloride	1000 mg/kg	LD50: > 5000 mg/kg	No data available

Test species: Rat

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Calcium chloride	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted

14. TRANSPORT INFORMATION

Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory This product, and all its components, complies with EINECS
US TSCA Inventory All components listed on inventory or are exempt.
Canadian DSL Inventory All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
R36 Irritating to eyes.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 04-Jan-2011
Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CAUSTIC SODA**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CAUSTIC SODA
Synonyms: None
Chemical Family: Hydroxide
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R35 Causes severe burns.

Hazard Overview May cause eye, skin, and respiratory burns. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium hydroxide	1310-73-2	60 - 100%	215-185-5	2 mg/m^3	2 mg/m^3	Not applicable	C; R35

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse. Destroy or properly dispose of contaminated shoes.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	May form explosive mixtures with strong acids. Reaction with steel and certain other metals generates flammable hydrogen gas.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Neutralize to pH of 6-8. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Localized ventilation should be used to control dust levels.
Respiratory Protection	HEPA Respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Full protective chemical resistant clothing. Rubber boots.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	14

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	2.13
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	1390
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Soluble in alcohols
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	40
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Contact with acids. Peroxides. Halogenated compounds. Prolonged contact with aluminum, lead, or zinc may liberate flammable hydrogen.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Causes severe respiratory burns. May cause chemical pneumonia.
Skin Contact	Causes severe burns.
Eye Contact	May cause eye burns.
Ingestion	Causes burns of the mouth, throat and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure may cause erosion of the teeth.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 140-340 mg/kg (Rat)
Dermal Toxicity:	LD50: 1350 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 730 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	This bag may contain residue of a hazardous material. Some authorities may regulate such containers as hazardous waste. Dispose of container according to national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
UN1823,Sodium Hydroxide, Solid, 8, II

Air Transportation

ICAO/IATA
UN1823,Sodium Hydroxide, Solid, 8, II

Sea Transportation

IMDG
UN1823,Sodium Hydroxide, Solid, 8, II
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification C - Corrosive.

Risk Phrases R35 Causes severe burns.

Safety Phrases S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S1/2 Keep locked up and out of reach of children.
S37/39 Wear suitable gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification C - Corrosive.
R35 Causes severe burns.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

CEMENT - CLASS G

Revision Date: 08-May-2012 **Revision Number:** 13

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name CEMENT - CLASS G

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Cement
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com
For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Skin Corrosion / irritation - (H315)	Category 2
Serious Eye Damage / Eye Irritation - (H318)	Category 1
Skin Sensitization - (H317)	Category 1
Carcinogenicity	Category 1A

2. HAZARDS IDENTIFICATION

- (H350)	
Specific Target Organ Toxicity - (Single Exposure)	Category 3
- (H335)	
Specific Target Organ Toxicity - (Repeated Exposure)	Category 1
- (H372)	

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xi - Irritant.

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H318 - Causes serious eye damage
H315 - Causes skin irritation
H317 - May cause an allergic skin reaction
H335 - May cause respiratory irritation
H372 - Causes damage to organs through prolonged or repeated exposure
H350i - May cause cancer by inhalation

Contains

Substances	**CAS Number**
Portland cement	65997-15-1
Crystalline silica, quartz	14808-60-7

Precautionary Statements - EU (§28, 1272/2008)
P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting
P201 - Obtain special instructions before use
P280 - Wear eye protection/face protection
P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P310 - Immediately call a POISON CENTER or doctor/physician
P308 + P313 - IF exposed or concerned: Get medical advice/attention

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Portland cement	266-043-4	65997-15-1	60 - 100%	Xi; R37/38-41 R43	Eye Dam. 1 (H318) Skin Irrit. 2 (H315) Skin Sens. 1 (H317) STOT SE 3 (H335)	No data available
Crystalline silica, quartz	238-878-4	14808-60-7	<3	Not applicable	Carc. 1A (H350i) STOT RE 1 (H372)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed

May cause eye and skin irritation.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó

Suitable Extinguishing Media

None - does not burn.

Extinguishing media which must not be used for safety reasons

None known.

Special hazards arising from the substance of mixture

Special Exposure Hazards

Not applicable.

Advice for firefighters

Special Protective Equipment for Fire-Fighters

Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions

None known.

Methods and material for containment and cleaning up

Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

Reference to other sections

See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Product has a shelf life of 24 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Portland cement	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	5 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Portland cement	Not applicable	6.0 mg/m^3	10 mg/m^3	10.0 mg/m^3	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Personal protective equipment
Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.
Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Gray
Odor: Odorless **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	12.4
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Density	No data available
Specific Gravity	3.15
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
Keep away from any contact with water.
Incompatible Materials
Hydrofluoric acid.

Hazardous Decomposition Products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Eye Contact	May cause severe eye irritation.
Skin Contact	Can dry skin. May cause an allergic skin reaction. May cause alkali burns with confined contact.
Ingestion	None known

11. TOXICOLOGICAL INFORMATION

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Portland cement	No data available	No data available	No data available
Crystalline silica, quartz	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Portland cement	No information available	No information available	No information available	No information available
Crystalline silica, quartz	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
Does not bioaccumulate

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.

16. OTHER INFORMATION

R37/38 Irritating to respiratory system and skin.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	08-May-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CITRIC ACID (BAROID)**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CITRIC ACID (BAROID)
Synonyms: None
Chemical Family: Organic acid
Application: Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Citric acid	77-92-9	60 - 100%	201-069-1	10 mg/m^3	Not applicable	Not applicable	Xi: R36

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water.

Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Get immediate medical attention.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	2.2
Specific Gravity @ 20 C (Water=1):	1.66
Density @ 20 C (kg/l):	1.66
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	1000
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	8
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	65
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	192.12
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases

S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **Clay Sync II**

Revision Date: 05-Jan-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: Clay Sync II
Synonyms: None
Chemical Family: Polymer
Application: Shale stabilizer

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 0, Reactivity 0
HMIS Ratings: Health 1, Flammability 0, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Wash hands after use. Slippery when wet.

Storage Information Store away from oxidizers. Store in a dry location. Store between 40.5 F (4.7 C) and 120.5 F (49 C). Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Granules
Color:	Off white
Odor:	Odorless
pH:	6.5-7.5 (1%)
Specific Gravity @ 20 C (Water=1):	1.04
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	50
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	500,000-750,000

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 10000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: >1000 mg/l (Pimephales promelas)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	EC50: > 500 mg/l (Selenastrum capricornutum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **CLAYSEAL PLUS**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: CLAYSEAL PLUS
Synonyms: None
Chemical Family: Ethoxylated polyamine
Application: Shale stabilizer

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrochloric acid	7647-01-0	1 - 5%	231-595-7	1 ppm	8 mg/m^3	5 ppm	C; R34-37
Propylene glycol	57-55-6	10 - 30%	200-338-0	150 ppm	10 mg/m^3	Not applicable	Not applicable
Polyalkeneamine		10 - 30%	Not Listed	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

4. FIRST AID MEASURES

Inhalation	If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store in a cool well ventilated area. Keep container closed when not in use. Store away from oxidizers. Store away from alkalis. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Organic vapor/acid gas respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear light yellow
Odor:	Amine
pH:	6-8
Specific Gravity @ 20 C (Water=1):	1.04-1.07
Density @ 20 C (kg/l):	1.04-1.07
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	-9
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 93**Min:** > 93
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	2-15
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers. Strong alkalis.
Hazardous Decomposition Products	Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause severe skin irritation.

Eye Contact	May cause severe eye irritation.
Ingestion	May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.
Aggravated Medical Conditions	Skin disorders. Eye ailments.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases

S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/39 Wear suitable protective clothing and eye/face protection.

EINECS Inventory This product does not comply with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

C - Corrosive.
R34 Causes burns.
R37 Irritating to respiratory system.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

D-AIR 3000L

Revision Date: 09-Jun-2011 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name D-AIR 3000L

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Defoamer

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

Risk Phrases None

2. HAZARDS IDENTIFICATION

Label Elements
Not classified

Signal Word **Not Hazardous**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Alkenes	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available
Silica, amorphous precipitated	Not applicable	67762-90-7	10 - 30%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation. May cause lung damage if swallowed.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep container closed when not in use. Product has a shelf life of 24 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Alkenes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Silica, amorphous precipitated	Not applicable	6 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Alkenes	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Silica, amorphous precipitated	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Impervious rubber gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid **Color:** Opaque
Odor: Hydrocarbon

Property Remarks/ Method	Values
pH:	5.5-7.9
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.92
Water Solubility	Insoluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.

Eye Contact May cause mild eye irritation.
Skin Contact May cause mild skin irritation.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea. Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation

11. TOXICOLOGICAL INFORMATION

Alkenes	No data available	No data available	No data available
Silica, amorphous precipitated	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Alkenes	No information available	No information available	No information available	No information available
Silica, amorphous precipitated	No information available	No information available	No information available	No information available

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

14. TRANSPORT INFORMATION

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) Not determined.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	09-Jun-2011
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

DEXTRID® E

Revision Date: 18-Nov-2010 **Revision Number:** 7

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name DEXTRID® E

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
Dust can form an explosive mixture in air

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Complex carbohydrate	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential. Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

6. ACCIDENTAL RELEASE MEASURES

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust. Avoid dust accumulations.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Complex carbohydrate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Complex carbohydrate	Not applicable	Not applicable	Not applicable	4.0 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Powder **Color:** White to Off white

Odor: Starch

Property Remarks/ Method	Values
pH:	7.1
Melting Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.5
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
Keep away from heat, sparks and flame.
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause allergic respiratory reaction.
Eye Contact	None known.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Complex carbohydrate	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

12. ECOLOGICAL INFORMATION

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Complex carbohydrate	No information available	No information available	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

15. REGULATORY INFORMATION

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	18-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

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End of Safety Data Sheet

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **DIAMOND SEAL**

Revision Date: 04-Jan-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: DIAMOND SEAL
Synonyms: None
Chemical Family: Polymer
Application: Additive

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Contains no hazardous substances	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Carbon Dioxide, Dry Chemicals, Foam.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 1, Flammability 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust. Slippery when wet.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Wash hands after use. Slippery when wet.

Storage Information Store away from oxidizers. Store in a dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	4-11
Specific Gravity @ 20 C (Water=1):	0.65- 0.85
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	40-50
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of nitrogen. Ammonia. Hydrocarbons. Carbon monoxide and carbon dioxide. In the event of oxygen depletion, hydrocyanic acid can be formed.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 5000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 2000 mg/kg (Rabbit)
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not readily biodegradable.
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **DRILTREAT®**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: DRILTREAT®
Synonyms: None
Chemical Family: Lipid
Application: Oil-wetting Agent

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Contains no hazardous substances	Mixture	60 - 100%		Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Wash with soap and water.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing.
Storage Information	Store away from oxidizers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally necessary.
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Amber
Odor:	Bean
pH:	6.4-7
Specific Gravity @ 20 C (Water=1):	1.03
Density @ 20 C (kg/l):	1.03
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	0

9. PHYSICAL AND CHEMICAL PROPERTIES

Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	204
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	0
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Disperses
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	None known.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined

Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: 497,500 ppm (Mysidopsis bahia) SPP @ 12 ppb
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **ECONOLITE LIQUID**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: ECONOLITE LIQUID
Synonyms: None
Chemical Family: Silicate
Application: Light Weight Cement Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Sodium silicate	1344-09-8	35-49	215-687-4	Xi; R36/37/38

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Neutralize to pH of 6-8. Scoop up and remove. Do NOT spread spilled product with water.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

Storage Information Store away from acids. Store in a cool well ventilated area. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Respiratory Protection Dust/mist respirator. (95%)

Hand Protection Impervious rubber gloves.

Skin Protection Full protective chemical resistant clothing.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Sodium silicate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Sodium silicate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear to hazy
Odor:	Slightly soapy
pH:	11.2
Specific Gravity @ 20 C (Water=1):	1.4
Density @ 20 C (kg/l):	1.4
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	101
Freezing Point/Range (C):	-1
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.
Hazardous Decomposition Products	Toxic fumes.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Causes severe respiratory irritation.

Skin Contact	May cause skin burns.
Eye Contact	May cause eye burns.
Ingestion	Causes burns of the mouth, throat and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 2000-3000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases
R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36 Wear suitable protective clothing.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xi - Irritant.
R36/37/38 Irritating to eyes, respiratory system and skin.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **ELASTICEM CEMENT BLEND**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: ELASTICEM CEMENT BLEND
Synonyms: None
Chemical Family: Cement
Application: Cement

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

2. HAZARDS IDENTIFICATION

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye, skin, and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Aluminum oxide	1344-28-1	5 - 10%	215-691-6	Not applicable
Crystalline silica, quartz	14808-60-7	<3	238-878-4	Not applicable
Portland cement	65997-15-1	30 - 60%	266-043-4	Xi; R37/38-41

Restrictive exposure limits

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation

If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin

Wash with soap and water. Get medical attention if irritation persists.

Eyes

In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion

Under normal conditions, first aid procedures are not required.

Notes to Physician

Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media

None - does not burn.

Extinguishing media which must not be used for safety reasons

None known.

Special Exposure Hazards

Not applicable.

Special Protective Equipment for Fire-Fighters

Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures

Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures

None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Store in a cool, dry location. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Product has a shelf life of 24 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Aluminum oxide	Not applicable	10 mg/m^3	10 mg/m^3	10 mg/m^3	6 mg/m^3
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3
Portland cement	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	5 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Aluminum oxide	Not applicable	2.5 mg/m^3	6 mg/m^3	0.1 mg/m^3	Not applicable
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable
Portland cement	Not applicable	6.0 mg/m^3	10 mg/m^3	10.0 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Solid
Color: Gray
Odor: Odorless
pH: 12.4
Specific Gravity @ 20 C (Water=1): 2.58
Density @ 20 C (kg/l): Not Determined
Bulk Density @ 20 C (kg/m^3): Not Determined
Boiling Point/Range (C): Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	0
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Not Determined
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from any contact with water.
Incompatibility (Materials to Avoid)	Hydrofluoric acid.
Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	Can dry skin. May cause an allergic skin reaction. May cause alkali burns with confined contact.
Eye Contact	May cause severe eye irritation.
Ingestion	None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not applicable

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases
R41 Risk of serious damage to eyes.
R43 May cause sensitization by skin contact.
R37/38 Irritating to respiratory system and skin.

Safety Phrases
S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S37 Wear suitable gloves.
S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

Xi - Irritant.
R37/38 Irritating to respiratory system and skin.
R41 Risk of serious damage to eyes.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **EZ SPOT®**

Revision Date: 02-Jul-2009

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: EZ SPOT®
Synonyms: None
Chemical Family: Blend
Application: Pipe Release Agent

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Hydrotreated light petroleum distillate	64742-47-8	30 - 60%	200 mg/m^3	Not applicable
Isobutanol	78-83-1	10 - 30%	50 ppm	100 ppm

3. HAZARDS IDENTIFICATION

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed. Flammable.

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin
In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Eyes
In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion
Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Notes to Physician
Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	92
Flash Point/Range (C):	33
Flash Point Method:	PMCC
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards May be ignited by heat, sparks or flames. Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 2, Flammability 2, Reactivity 0
HMIS Ratings: Health 2, Flammability 2, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Remove ignition sources and work with non-sparking tools. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.

Storage Information Store away from oxidizers. Keep from heat, sparks, and open flames. Keep container closed when not in use. Product separates with storage and requires mixing before use. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Respiratory Protection Organic vapor respirator with a dust/mist filter. In high concentrations, supplied air respirator or a self-contained breathing apparatus.

Hand Protection Impervious rubber gloves.

Skin Protection Rubber apron.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Semi-Solid
Color:	Brown Green
Odor:	Alcohol
pH:	5-8
Specific Gravity @ 20 C (Water=1):	0.977
Density @ 20 C (lbs./gallon):	8.2
Bulk Density @ 20 C (lbs/ft3):	61
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	14
Freezing Point/Range (C):	-10
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Slightly soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.

Aggravated Medical Conditions Lung disorders.

Chronic Effects/Carcinogenicity Repeated overexposure may cause liver and kidney effects.

Other Information None known.

Toxicity Tests

Oral Toxicity: LD50: > 2000 mg/kg (Rat)

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: TLM96: > 100 mg/l (Golden orfe)
Acute Crustaceans Toxicity: LC50: 8.77 mg/l (Daphnia magna)
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Disposal should be made in accordance with federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT

UN1212,Isobutanol Solution, 3, III, (33.3 C)
NAERG 129

Canadian TDG
Isobutanol Solution, 3, UN1212, III, (33.3 C)

ADR

UN1212,Isobutanol Solution, 3, III

Air Transportation

ICAO/IATA

UN1212,Isobutanol Solution, 3, III

Sea Transportation

IMDG

UN1212,Isobutanol Solution, 3, III, (33.3 C)
EmS F-E, S-D

Other Shipping Information

Labels:	Flammable Liquid

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health Hazard Fire Hazard
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does meet the criteria of a hazardous waste as defined by the US EPA, because of: Ignitability D001
California Proposition 65	The California Proposition 65 regulations apply to this product.
MA Right-to-Know Law	One or more components listed.
NJ Right-to-Know Law	One or more components listed.
PA Right-to-Know Law	One or more components listed.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.

WHMIS Hazard Class B2 Flammable Liquids
D2B Toxic Materials

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **EZ-MUD®**

Revision Date: 01-Apr-2009

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: EZ-MUD®
Synonyms: None
Chemical Family: Blend
Application: Shale Inhibitor

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Hydrotreated light petroleum distillate	64742-47-8	10 - 30%	265-149-8	5 mg/m^3	Not applicable	Not applicable	Xn; R65

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated shoes and discard.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Use water spray to cool fire exposed surfaces.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Organic vapor respirator with a dust/mist filter. In high concentrations, supplied air respirator or a self-contained breathing apparatus.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	White to gray
Odor:	Mild hydrocarbon
pH:	6-8
Specific Gravity @ 20 C (Water=1):	1.0
Density @ 20 C (kg/l):	1
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	175
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	PMCC
Autoignition Temperature (C):	> 200
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	0.002
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	70
Evaporation Rate (Butyl Acetate=1):	< 1
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Ammonia. Oxides of nitrogen. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.

Ingestion	Aspiration into the lungs may cause chemical pneumonitis including coughing, difficulty breathing, wheezing, coughing up blood and pneumonia, which can be fatal. May cause central nervous system depression including headache, dizziness, drowsiness, muscular weakness, incoordination, slowed reaction time, fatigue blurred vision, slurred speech, giddiness, tremors and convulsions.
Aggravated Medical Conditions	Lung disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 40% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: >1000 mg/l (Pimephales promelas)
Acute Crustaceans Toxicity:	TLM48: 98 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 16.70 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases
S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 2: Hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification Xn - Harmful.
R65 Harmful: may cause lung damage if swallowed.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

SAFETY DATA SHEET
Fluorodye UC

1 IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

PRODUCT NAME	Fluorodye UC
APPLICATION	INDUSTRIAL DYE
SUPPLIER	Champion Technologies Minto Avenue Altens Industrial Estate Aberdeen, AB12 3JZ 00 44 1224 879022 00 44 1224 876022 eh.productstewardship@champ-tech. com
EMERGENCY TELEPHONE	[24Hr] 00 44 (0)1224 879022 OUT OF OFFICE HOURS ASK FOR HEALTH AND SAFETY

2 HAZARDS IDENTIFICATION

CLASSIFICATION (1999/45) Xi;R36/38.

CLASSIFICATION (EC 1272/2008)

Physical	Not classified.
Health	Skin Irrit. 2 - H315;Eye Irrit. 2 - H319
Environmental	Not classified.

LABEL IN ACCORDANCE WITH (EC) NO. 1272/2008

SIGNAL WORD Warning

HAZARD STATEMENTS

H315	Causes skin irritation.
H319	Causes serious eye irritation.

PRECAUTIONARY STATEMENTS

P280	Wear protective gloves/protective clothing/eye protection/face protection.
P305/351/338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P313	Get medical advice/attention.

3 COMPOSITION/INFORMATION ON INGREDIENTS

ETHANEDIOL **10-30%**

CAS-No.: 107-21-1 **EC No.: 203-473-3**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Acute Tox. 4 - H302	Xn;R22

ACETIC ACID **10-30%**

CAS-No.: 64-19-7 **EC No.: 200-580-7**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Flam. Liq. 3 - H226	R10
Skin Corr. 1A - H314	C;R35

9-(2-carboxyphenyl)-3,6-bis(diethylamino)xanthylium chloride **10-30%**

CAS-No.: 81-88-9 **EC No.: 201-383-9**

CLASSIFICATION (EC 1272/2008)	CLASSIFICATION (67/548)
Eye Irrit. 2 - H319	Xi;R36.

The Full Text for all R-Phrases and Hazard Statements are Displayed in Section 16

4 FIRST-AID MEASURES

INHALATION

Provide rest, warmth and fresh air. Get medical attention if any discomfort continues.

INGESTION

Immediately rinse mouth and drink plenty of water (200-300 ml).

SKIN CONTACT

Wash skin thoroughly with soap and water. Immediately remove contaminated clothing. Get medical attention if irritation persists after washing.

EYE CONTACT

Make sure to remove any contact lenses from the eyes before rinsing. Promptly wash eyes with plenty of water while lifting the eye lids. To hospital or eye specialist.

5 FIRE-FIGHTING MEASURES

EXTINGUISHING MEDIA

Use fire-extinguishing media appropriate for surrounding materials.

SPECIAL FIRE FIGHTING PROCEDURES

Cool containers exposed to flames with water until well after the fire is out. If risk of water pollution occurs, notify appropriate authorities.

UNUSUAL FIRE & EXPLOSION HAZARDS

No unusual fire or explosion hazards noted.

SPECIFIC HAZARDS

Oxides of: Carbon. Nitrogen. Sulphur.

PROTECTIVE MEASURES IN FIRE

Use air-supplied respirator during fire fighting. Wear full protective clothing.

6 ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS

Wear protective clothing as described in Section 8 of this safety data sheet. Avoid contact with skin and eyes.

ENVIRONMENTAL PRECAUTIONS

Do not discharge into drains, water courses or onto the ground. Contain spillages with sand, earth or any suitable adsorbent material.

SPILL CLEAN UP METHODS

Stop leak if possible without risk. Provide ventilation and confine spill. Do not allow runoff to sewer. Absorb in vermiculite, dry sand or earth and place into containers. Containers with collected spillage must be properly labelled with correct contents and hazard symbol.

7 HANDLING AND STORAGE

USAGE PRECAUTIONS

Avoid spilling, skin and eye contact. Provide good ventilation. Observe good chemical hygiene practices.

STORAGE PRECAUTIONS

Store in tightly closed original container in a dry, cool and well-ventilated place. Store above freezing.

8 EXPOSURE CONTROLS/PERSONAL PROTECTION

Name	Std	TWA - 8 hrs		STEL - 15 min		Notes
ETHANEDIOL	WEL		10 mg/m3		104 mg/m3	Sk

WEL = Workplace Exposure Limit.
Sk = Can be absorbed through skin.

INGREDIENT COMMENTS

WEL = Workplace Exposure Limits

PROTECTIVE EQUIPMENT

ENGINEERING MEASURES

Provide adequate general and local exhaust ventilation.

RESPIRATORY EQUIPMENT

Respiratory protection not required.

HAND PROTECTION

Rubber or plastic. The most suitable glove must be chosen in consultation with the gloves supplier, who can inform about the breakthrough time of the glove material. Be aware that the liquid may penetrate the gloves. Frequent change is advisable.

EYE PROTECTION

Use approved safety goggles or face shield.

OTHER PROTECTION

Wear appropriate clothing to prevent any possibility of skin contact.

HYGIENE MEASURES

When using do not eat, drink or smoke. DO NOT SMOKE IN WORK AREA! Wash at the end of each work shift and before eating, smoking and using the toilet.

9 PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE	Liquid		
COLOUR	Dark Purple		
ODOUR	Acrid. Acetic acid		
SOLUBILITY	Miscible with water		
BOILING POINT (°C)	~ 100	**RELATIVE DENSITY**	1.052-1.082 @ 20C
VAPOUR PRESSURE	~ 15.7 mbar @ 20C	**pH-VALUE, DILUTED SOLUTION**	2.18-4.18
DECOMPOSITION TEMPERATURE (°C)	>200		

10 STABILITY AND REACTIVITY

STABILITY

Stable under normal temperature conditions and recommended use.

CONDITIONS TO AVOID

Avoid heat.

MATERIALS TO AVOID

Strong oxidising substances. Strong alkalis.

HAZARDOUS DECOMPOSITION PRODUCTS

Oxides of: Carbon. Nitrogen. Sulphur.

11 TOXICOLOGICAL INFORMATION

GENERAL INFORMATION

Prolonged and repeated contact with solvents over a long period may lead to permanent health problems.

INHALATION

Not relevant at normal room temperatures. When heated, toxic vapours may be formed.

INGESTION

May cause discomfort if swallowed.

SKIN CONTACT

Liquid may irritate skin.

EYE CONTACT

Spray and vapour in the eyes may cause irritation and smarting.

12 ECOLOGICAL INFORMATION

ECOTOXICITY

The product is not expected to be hazardous to the environment.

MOBILITY

The product is miscible with water. May spread in water systems.

BIOACCUMULATION

The product does not contain any substances expected to be bioaccumulating.

DEGRADABILITY

The product is biodegradable.

ACUTE FISH TOXICITY

Not considered toxic to fish.

13 DISPOSAL CONSIDERATIONS

GENERAL INFORMATION

Recover and reclaim or recycle, if practical.

DISPOSAL METHODS

Absorb in vermiculite or dry sand and dispose of at a licenced hazardous waste collection point. Dispose of waste and residues in accordance with local authority requirements.

WASTE CLASS

For this product, in accordance with the European Waste Catalogue (EWC), a catalogue number cannot be given because the customer has to lay down the purpose first. The catalogue number has to be given according to the local waste removal processes.

14 TRANSPORT INFORMATION

GENERAL	The product is not covered by international regulation on the transport of dangerous goods (IMDG, IATA, ADR/RID).

15 REGULATORY INFORMATION

UK REGULATORY REFERENCES

Approved Supply List.

EU DIRECTIVES

Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 with amendments.

STATUTORY INSTRUMENTS

The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009 (S.I 2009 No. 716).

APPROVED CODE OF PRACTICE

Safety Data Sheets for Substances and Preparations.

GUIDANCE NOTES

Classification and Labelling of Substances and Preparations Dangerous for Supply.

16 OTHER INFORMATION

REVISION COMMENTS

NOTE: Lines within the margin indicate significant changes from the previous revision.

ISSUED BY

CES

REVISION DATE	22/11/2010
REV. NO./REPL. SDS GENERATED	8

RISK PHRASES IN FULL

R35	Causes severe burns.
R10	Flammable.
R22	Harmful if swallowed.
R36	Irritating to eyes.

HAZARD STATEMENTS IN FULL

H226	Flammable liquid and vapour.
H302	Harmful if swallowed.
H314	Causes severe skin burns and eye damage.
H319	Causes serious eye irritation.

DISCLAIMER

The information provided in this SDS is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal, and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process unless specified in the text.

Material Safety Data Sheet

FUSABOND® C250 RESIN

Version 2.3

Revision Date 08/12/2011 Ref. 130000021081

This SDS adheres to the standards and regulatory requirements of the United States and may not meet the regulatory requirements in other countries.

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	FUSABOND® C250 RESIN
MSDS Number	:	130000021081
Manufacturer	:	DuPont 1007 Market Street Wilmington, DE 19898
Product Information	:	1-800-441-7515 (outside the U.S. 1-302-774-1000)
Medical Emergency	:	1-800-441-3637 (outside the U.S. 1-302-774-1139)
Transport Emergency	:	CHEMTREC: 1-800-424-9300 (outside the U.S. 1-703-527-3887)

SECTION 2. HAZARDS IDENTIFICATION

Potential Health Effects

Skin

Vinyl acetate : May cause skin irritation.
May cause: Discomfort, itching, redness, or swelling.

Eyes : Resin particles, like other inert materials, are mechanically irritating to eyes.

Inhalation

Vinyl acetate : May cause respiratory tract irritation.

Ingestion : Is not considered a potential route of exposure.

Target Organs

Vinyl acetate : Respiratory Tract

Carcinogenicity

Material	IARC	NTP	OSHA
Vinyl acetate	2B		

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS-No.	Concentration
ETHYLENE COPOLYMER		>99%
Vinyl acetate	108-05-4	<0.3 %

SECTION 4. FIRST AID MEASURES

Skin contact : In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash contaminated clothing before reuse. The material is not likely to be hazardous by skin contact, but cleansing the skin after use is advisable. Cool skin rapidly with cold water after contact with molten material. Do not attempt to remove material from the skin. Obtain medical treatment for thermal burn.

Eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Inhalation : If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion : Not a probable route of exposure. However, in case of accidental ingestion, call a physician.

SECTION 5. FIREFIGHTING MEASURES

Flammable Properties

Flash point : no data available

Autoignition temperature : 260 °C (500 °F)

Fire and Explosion Hazard	:	Material in pellet form may accumulate static charge when poured from one container to another.
Suitable extinguishing media	:	Water, Foam, Dry chemical, Carbon dioxide (CO2)
Firefighting Instructions	:	Wear self-contained breathing apparatus (SCBA). The solid polymer can only be burned with difficulty. Evacuate personnel and keep upwind of fire. Grounding and elimination of the static charge is recommended.

SECTION 6. ACCIDENTAL RELEASE MEASURES

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Spill Cleanup	:	Shovel or sweep up.
Accidental Release Measures	:	Do not discharge to streams, ponds, lakes or sewers.

SECTION 7. HANDLING AND STORAGE

Handling (Personnel)	:	Before using, read the product bulletin.
Handling (Physical Aspects)	:	When opening containers, avoid breathing vapours that may be emanating.
Storage	:	Keep containers dry and tightly closed to avoid moisture absorption and contamination. Store in a cool, dry place.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls	:	See Bulletin "Proper Use of Local Exhaust Ventilation During Processing of Plastics".
Personal protective equipment Respiratory protection	:	A respiratory protection program that meets country requirements must be

followed whenever workplace conditions warrant respirator use. Consult the respirator manufacturer to determine the appropriate type of equipment for a given application. Observe respirator use limitations specified by the manufacturer.
Consult the OSHA respiratory protection information located at 29CFR 1910.134.

Hand protection : Additional protection: Protective gloves

Eye protection : Wear safety glasses with side shields. Wear tightly fitting chemical splash goggles and face shield when possibility exists for eye and face contact due to spattering or splashing of molten material.

Skin and body protection : Where there is potential for skin contact, have available and wear as appropriate, impervious gloves, apron, pants, jacket, hood and boots.
If there is a potential for contact with hot/molten material wear heat resistant clothing and footwear.

Exposure Guidelines

Exposure Limit Values

Maleic anhydride

PEL:	(OSHA)	0.25 ppm	1 mg/m3	8 hr. TWA
PEL:	(OSHA)	0.25 ppm	1 mg/m3	8 hr. TWA
TLV	(ACGIH)	0.1 ppm	TWA	
TLV	(ACGIH)	0.01 mg/m3	TWA	
AEL *	(DUPONT)	0.1 ppm	8 & 12 hr. TWA	

Dust (inhalable and respirable fraction)

PEL:	(OSHA)	5 mg/m3	8 hr. TWA	Respirable fraction.
		Remarks		All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3.
PEL:	(OSHA)	15 mg/m3	8 hr. TWA	Total dust.

TLV	(ACGIH)	10 mg/m3	TWA	Inhalable particles.
TLV	(ACGIH)	3 mg/m3	TWA	Respirable particles.

Vinyl acetate

TLV	(ACGIH)	10 ppm	TWA
TLV	(ACGIH)	15 ppm	STEL
AEL *	(DUPONT)	10 ppm	8 & 12 hr. TWA

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Form	:	solid
Color	:	white, to, light yellow
Odor	:	irritating
Melting point/range	:	ca. 35 - 100 °C (95 - 212 °F)
% Volatile	:	0.3 %
Specific gravity	:	< 1
Water solubility	:	insoluble

SECTION 10. STABILITY AND REACTIVITY

Stability	:	Stable at normal temperatures and storage conditions.
Conditions to avoid	:	Temperature > 230 °C (> 446 °F) Decomposes on heating. short residence times Temperature > 204 °C (> 399 °F) long residence times
Incompatibility	:	Incompatible with strong acids and oxidizing agents.

Hazardous decomposition products	:	Decomposition is a function of both processing temperature and time at that temperature. Decomposition can occur below the recommended processing temperature limit. At temperatures above the "conditions to avoid" temperature, thermal decomposition of the resin becomes rapid. Hazardous decomposition products: Aldehydes, Carbon monoxide, Hydrocarbons, Smoke , Vinyl acetate , Acetic acid, Acrolein Decomposition products may vary in nature depending upon actual conditions, eg. availability of oxygen, temperature and presence of other materials.
Hazardous reactions	:	Polymerization will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

FUSABOND® C250 RESIN

Further information	:	No data is available on the product itself.

Vinyl acetate

Dermal LD50	:	7,440 mg/kg , rabbit
Oral LD50	:	3,500 mg/kg , rat
Inhalation 4 h LC50	:	15.8 mg/l , rat Target Organs: Respiratory Tract Respiratory tract irritation
Skin irritation	:	slight irritation, rabbit
Eye irritation	:	slight irritation, rabbit
Skin sensitization	:	Did not cause sensitization on laboratory animals., mouse
Repeated dose toxicity	:	Inhalation multiple species Pathologic changes, Respiratory Tract, Respiratory tract irritation
Carcinogenicity	:	An increased incidence of tumours was observed in laboratory animals.
Mutagenicity	:	Overall weight of evidence indicates that the substance is not

mutagenic.
Genetic damage in animals was observed in some laboratory tests but not in others.
Genetic damage in cultured mammalian cells was observed in some laboratory tests but not in others.
Did not cause genetic damage in cultured bacterial cells.

Reproductive toxicity : Animal testing showed no reproductive toxicity.

Teratogenicity : Animal testing showed effects on embryo-fetal development at levels equal to or above those causing maternal toxicity.

SECTION 12. ECOLOGICAL INFORMATION

Aquatic Toxicity

Vinyl acetate

96 h LC50 : Fathead minnow 24 mg/l

72 h ErC50 : Pseudokirchneriella subcapitata (green algae) 12.7 mg/l

48 h EC50 : Daphnia 12.6 mg/l

Environmental Fate

Vinyl acetate

Bioaccumulation : 3.16
Bioaccumulation is unlikely.

Additional ecological information : No data is available on the product itself. Toxicity is expected to be low based on insolubility in water.

SECTION 13. DISPOSAL CONSIDERATIONS

Waste Disposal : Preferred options for disposal are recycling, incineration with energy recovery, and landfill. The high fuel value of this product makes incineration very desirable for material that cannot be recycled. Treatment, storage, transportation, and disposal must be in accordance with applicable federal, state/provincial, and local regulations.

SECTION 14. TRANSPORT INFORMATION

Not classified as dangerous in the meaning of transport regulations.

SECTION 15. REGULATORY INFORMATION

TSCA Status	:	In compliance with TSCA Inventory requirements for commercial purposes.
SARA 313 Regulated Chemical(s)	:	Vinyl acetate
CERCLA Reportable Quantity	:	333,333 lbs Based on the percentage composition of this chemical in the product.: 2-Methylpropan-2-ol
California Prop. 65	:	This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.
PA Right to Know Regulated Chemical(s)	:	Substances on the Pennsylvania Hazardous Substances List present at a concentration of 1% or more (0.01% for Special Hazardous Substances): None known.
NJ Right to Know Regulated Chemical(s)	:	Substances on the New Jersey Workplace Hazardous Substance List present at a concentration of 1% or more (0.1% for substances identified as carcinogens, mutagens or teratogens): None known.

SECTION 16. OTHER INFORMATION

Restrictions for use	:	Do not use DuPont materials in medical applications involving implantation in the human body or contact with internal body fluids or tissues unless the material has been provided from DuPont under a written contract that is consistent with DuPont policy regarding medical applications and

expressly acknowledges the contemplated use. For further information, please contact your DuPont representative. You may also request a copy of the DuPont POLICY Regarding Medical Applications H-50103-3 and DuPont CAUTION Regarding Medical Applications H-50102-3.

FUSABOND® is a registered trademark of DuPont.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Significant change from previous version is denoted with a double bar.

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **GEM GP**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: GEM GP
Synonyms: None
Chemical Family: Glycol Ether
Application: Shale stabilizer

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R36 Irritating to eyes.

Hazard Overview
May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Polyalkylene glycol		60 - 100%	Not Listed	Not applicable	Not applicable	Not applicable	Xi; R36

4. FIRST AID MEASURES

Inhalation
If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Storage Information	Store away from oxidizers. Store away from acids. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Yellow to brown

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Mild
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.012
Density @ 20 C (kg/l):	1.012
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	126
Freezing Point/Range (C):	< -12**Max.** < -12
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	166
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	7.3
Partition Coefficient/n-Octanol/Water:	0.436
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Keep away from heat, sparks and flame.
Incompatibility (Materials to Avoid)	Strong oxidizers. Mineral acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Skin Contact	May cause skin irritation.
Eye Contact	May cause severe eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

Aggravated Medical Conditions	Lung disorders. Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: > 2000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(28 Day): 66% of COD
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	EC50: 475 ppm (Abra alba)
Acute Crustaceans Toxicity:	TLM48: 310 mg/l (Acartia tonsa)
Acute Algae Toxicity:	EC50: 391 mg/l (Skeletonema costatum)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases R36 Irritating to eyes.

Safety Phrases
S2 Keep out of reach of children.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S46 If swallowed, seek medical advice immediately and show this container or label.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information
For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification
Xi - Irritant.
R36 Irritating to eyes.

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **GUAR GUM**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: GUAR GUM
Synonyms: None
Chemical Family: Polysaccharide
Application: Fluid Loss Additive

Company Undertaking Identification

Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

May cause eye and respiratory irritation. May cause allergic respiratory reaction. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Guar gum	9000-30-0	60 - 100%		10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation

If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Off white
Odor:	Bean
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.3

9. PHYSICAL AND CHEMICAL PROPERTIES

Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	510**Min:** > 93
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause allergic respiratory reaction. May cause respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 9400 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HALAD® 322 CEMENT ADDITIVE**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: HALAD® 322 CEMENT ADDITIVE
Synonyms: None
Chemical Family: Blend
Application: Cement Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Sodium formate	141-53-7	1 - 5%	205-488-0	Not applicable
Cellulose derivative		10 - 30%	Not Listed	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust.

Storage Information Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Sodium formate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable
Cellulose derivative	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Sodium formate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Cellulose derivative	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Red
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.28
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Partially soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	>600
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.

Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

HALAD® 413 CEMENT ADDITIVE

Revision Date: 17-Nov-2010 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name HALAD® 413 CEMENT ADDITIVE

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Fluid Loss Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Acrylic resin	Not applicable	Mixture	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

6. ACCIDENTAL RELEASE MEASURES

Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Acrylic resin	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Acrylic resin	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
- **Respiratory Protection** Dust/mist respirator. (95%)
- **Hand Protection** Normal work gloves.
- **Skin Protection** Normal work coveralls.
- **Eye Protection** Wear safety glasses or goggles to protect against exposure.
- **Other Precautions** None known.

Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Brown-black
Odor: Sweet

Property	Values
Remarks/ Method	
pH:	7.5
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.48
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Oxides of nitrogen. Oxides of sulfur. Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	None known.
Eye Contact	May cause eye irritation.
Skin Contact	May cause skin irritation.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Acrylic resin	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Acrylic resin	No information available	No information available	No information available	No information available

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	Product contains one or more components not listed on the inventory.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 2: Hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	17-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HR-4**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: HR-4
Synonyms: None
Chemical Family: Lignosulfonate
Application: Cement Retarder

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Modified lignosulfonate		30 - 60%	Not Listed	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.

Storage Information Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modified lignosulfonate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modified lignosulfonate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Brown
Odor:	Odorless
pH:	9 - 10.3
Specific Gravity @ 20 C (Water=1):	1.20 - 1.30
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: > 1000 ppm (Crangon crangon)
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **HR-4L**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: HR-4L
Synonyms: None
Chemical Family: Lignosulfonate
Application: Cement Retarder

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Modified lignosulfonate		30 - 60%	Not Listed	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.

Storage Information Store away from oxidizers. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modified lignosulfonate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modified lignosulfonate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Dark brown
Odor:	Slight
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.18 - 1.21
Density @ 20 C (kg/l):	1.18 - 1.21
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	100
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	7.5
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	None known.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.

Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

HR-5

Revision Date: 22-Aug-2011 **Revision Number:** 12

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier
Product Name HR-5

Relevant identified uses of the substance or mixture and uses advised against
Recommended Use Cement Retarder
Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com
For further information, please contact
E-Mail address: fdunexchem@halliburton.com
Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture
REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16
Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Modifed lignosulfonate	Not Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
May cause eye irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.

6. ACCIDENTAL RELEASE MEASURES

See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Modifed lignosulfonate	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Modifed lignosulfonate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)
Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** Black
Odor: Molasses

Property Remarks/ Method	Values
pH:	9.5-10.3
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.41
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Oxides of sulfur.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause mild respiratory irritation.
Eye Contact	May cause mechanical irritation to eye.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Modifed lignosulfonate	> 5000 mg/kg	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)

12. ECOLOGICAL INFORMATION

Modifed lignosulfonate	E(B)C50: 1.6 mg/l (Skeletonema costatum) E(R)C50: 2.4 mg/l (Skeletonema costatum)	TLM24: 160-320 mg/l (Oncorhynchus mykiss); LC50: 9650 mg/l (Cyprinus carpio)	No information available	EC50: 38225 mg/l (Daphnia magna); TLM96: > 1000 ppm (Crangon crangon)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO
UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

15. REGULATORY INFORMATION

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	22-Aug-2011
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Baroid Fluid Services

HYDRO-PLUG®

Lost Circulation Material — Product Data Sheet

Product Description

HYDRO-PLUG lost circulation material hydrates to plug vugular and cavernous formations.

Applications / Functions

- HYDRO-PLUG material will work with all types of water-based and oil-based drilling fluids but must be mixed in fresh water. HYDRO-PLUG material is ideal for use in deep water operations where synthetic base drilling fluids are in use.

Advantages

- Mix and pump without costly trips
- Quick-acting sealant for vugular, fractured formations and severe loss zones
- Rapid mixing through standard hopper
- One-sack product provides compact storage; each pallet of HYDRO-PLUG makes a 25-bbl pill
- No special equipment is required to place the pill, just the rig pump

Typical Properties

Appearance	Mixture of dark gray to black granules and flakes
Specific gravity	2

Recommended Treatment

For normal treatment, add 45 bbls of freshwater (freshwater only) to a clean pit. Add 80 50-lb bags of HYDRO-PLUG material. Do not add CAUSTIC or LIME. Spot the mixture across the loss zone and perform a gentle squeeze (if possible). Do not add directly to active system.
Note: A 90 to 120 minute window is required to mix, pump and squeeze. No special equipment is required to pump the pill. Just use the rig pump.

Packaging

HYDRO-PLUG material is packaged in 50-lb (22.7-kg) bags

HALLIBURTON | Fluid Systems

Baroid Fluid Services • P.O. Box 1675 • Houston TX 77251 • 281-871-5516

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

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HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **LATEX 3000**

Revision Date: 19-Feb-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: LATEX 3000
Synonyms: None
Chemical Family: Polymer
Application: Additive

Company Undertaking Identification
Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview No significant hazards expected.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Contains no hazardous substances	Mixture	60 - 100%		Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.
Notes to Physician	Treatment should be directed at preventing absorption, administering to symptoms as they occur, and providing supportive therapy.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Extinguishing media which must not be used for safety reasons	None known.
Special Exposure Hazards	Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Avoid breathing mist. Material is slippery underfoot.
Storage Information	Store in a cool well ventilated area. Keep container closed when not in use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Trace amounts of monomers may be released during use of this material. Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally necessary.
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Contains no hazardous substances	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Milky white
Odor:	Mild
pH:	4.5
Specific Gravity @ 20 C (Water=1):	1.03
Density @ 20 C (kg/l):	1.05
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	100
Freezing Point/Range (C):	0
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	17
Vapor Density (Air=1):	< 1
Percent Volatiles:	46-48
Evaporation Rate (Butyl Acetate=1):	< 1
Solubility in Water (g/100ml):	Miscible
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	>600
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data: Stable

Hazardous Polymerization: Will Not Occur

Conditions to Avoid None anticipated

Incompatibility (Materials to Avoid) Strong oxidizers.

Hazardous Decomposition Products 1,3-Butadiene. Styrene.

Additional Guidelines Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye and skin contact.

Inhalation Not a likely route of exposure.

Skin Contact Prolonged or repeated contact may cause slight skin irritation.

Eye Contact May cause eye irritation.

Ingestion No adverse health effects are expected from swallowing.

Aggravated Medical Conditions None known.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: LC50: (96 hour) 97811 mg/l (fish) estimated
Acute Crustaceans Toxicity: EC50(48 Hour): 16552 mg/l (Daphnia magna) estimated
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Disposal should be made in accordance with federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

END OF MSDS

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **LIME**

Revision Date: 18-Jul-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: LIME
Synonyms: None
Chemical Family: Inorganic
Application: pH Control

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Calcium hydroxide	1305-62-0	60 - 100%	215-137-3	5 mg/m^3	5 mg/m^3	5 mg/m^3	Xi; R-36/37/38

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not Determined

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Impervious rubber gloves.
Skin Protection	Rubber apron.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	12.2
Specific Gravity @ 20 C (Water=1):	2.24
Density @ 20 C (kg/l):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	0.2
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	74.1
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	Causes severe skin irritation. May cause skin burns on prolonged contact.
Eye Contact	Causes severe eye irritation May cause eye burns.
Ingestion	Irritation of the mouth, throat, and stomach.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 7340 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 100-500 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	TLM96: 478,520 ppm (Mysidopsis bahia) SPP @ 8 ppb
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Empty container completely. Transport with all closures in place. Return for reuse or dispose in a sanitary landfill according to national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Xi - Irritant.

Risk Phrases

R36/37/38 Irritating to eyes, respiratory system and skin.

Safety Phrases

S22 Do not breathe dust.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S39 Wear eye and face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

Xi - Irritant.
R36/37/38 Irritating to eyes, respiratory system and skin.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **MICA**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: MICA
Synonyms: None
Chemical Family: Mineral
Application: Fluid Loss Additive

Company Undertaking Identification

Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	0.1 mg/m^3	0,15 mg/m^3	0,075 mg/m^3	Not applicable
Mica	12001-26-2	60 - 100%		10 mg/m^3	Not applicable	5 mg/m^3	Not applicable

More restrictive exposure limits may be enforced by some states, agencies, or other authorities.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Unsuitable Extinguishing Media None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.
Respiratory Protection	Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.
Hand Protection	Normal work gloves.
Skin Protection	Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Silver
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	2.9
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Hydrofluoric acid.

Hazardous Decomposition Products	Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure Eye or skin contact, inhalation.

Inhalation

Prolonged breathing of mica dust may produce pneumoconiosis. Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A).

Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).

Skin Contact May cause mechanical skin irritation.

Eye Contact May cause eye irritation.

Ingestion None known

Aggravated Medical Conditions Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

MUSOL SOLVENT

Revision Date: 11-Apr-2012 **Revision Number:** 12

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name MUSOL SOLVENT

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Solvent

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Acute Oral Toxicity - (H302)	Category 4
Acute Toxicity - Dermal - (H311)	Category 4
Acute Inhalation Toxicity - Dusts and Mists - (H332)	Category 4
Skin Corrosion / irritation	Category 2

2. HAZARDS IDENTIFICATION

- (H315)

Serious Eye Damage / Eye Irritation	Category 2

- (H319)

Classification according to EU Directives 67/548/EEC or 1999/45/EC
For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Xn - Harmful.

Risk Phrases

R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R36/38 Irritating to eyes and skin.

Label Elements

Hazard Pictograms

Signal Word **Danger**

Hazard Statements
H302 - Harmful if swallowed
H311 - Toxic in contact with skin
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H332 - Harmful if inhaled

Contains

Substances	**CAS Number**
Ethylene glycol monobutyl ether	111-76-2

Precautionary Statements - EU (§28, 1272/2008)
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P312 - Call a POISON CENTER or doctor/physician if you feel unwell
P302 + P350 - IF ON SKIN: Gently wash with plenty of soap and water

Other Hazards

None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Ethylene glycol monobutyl ether	203-905-0	111-76-2	60 - 100%	Xn; R20/21/22 Xi; R36/38	Acute Tox. 4 (H302) Acute Tox. 4 (H312) Acute Tox. 4 (H332) Skin Irrit. 2 (H315) Eye Irrit. 2 (H319)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed

May cause eye, skin, and respiratory irritation. May cause headache, dizziness, and other central nervous system effects.

Indication of any immediate medical attention and special treatment needed

Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

Special hazards arising from the substance of mixture

Special Exposure Hazards

May be ignited by heat, sparks or flames. Use water spray to cool fire exposed surfaces. Closed containers may explode in fire. Decomposition in fire may produce toxic gases.

Advice for firefighters

Special Protective Equipment for Fire-Fighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment. Wear self-contained breathing apparatus in enclosed areas.
See Section 12 for additional information

Environmental precautions

Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections

See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep from heat, sparks, and open flames. Keep container closed when not in use. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Ethylene glycol monobutyl ether	Not applicable	25 ppm	100 mg/m^3	2 ppm	20 ppm

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Ethylene glycol monobutyl ether	20 ppm	98 mg/m^3	98 mg/m^3	100 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment
Respiratory Protection Organic vapor respirator.

Hand Protection Impervious rubber gloves.
Skin Protection Rubber apron.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Liquid **Color:** Colorless
Odor: Mild **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	-70°C
Boiling Point/Range	171°C
Flash Point PMCC	67°C
upper flammability limit	10.6
lower flammability limit	1.1
Evaporation rate	0.06
Vapor Pressure	0.76 mmHg
Vapor Density	4.1

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity	0.9
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	0.8
Autoignition Temperature	230°C
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	118.2
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers. Peroxides. Amphoteric metals such as aluminum, magnesium, lead, tin, or zinc.
Hazardous Decomposition Products
Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation. May cause central nervous system depression including headache, dizziness, drowsiness, incoordination, slowed reaction time, slurred speech, giddiness and unconsciousness.
Eye Contact	May cause eye irritation.
Skin Contact	May be absorbed through the skin and contribute to the symptoms listed under ingestion. May cause skin irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. May produce nervous system effects such as feeling of weakness, unsteady walk, and dilation of blood vessels.

Chronic Effects/Carcinogenicity Prolonged or repeated exposure may cause fetal damage and testicular effects.

LD50 Oral:	470 mg/kg (rat)
LD50 Dermal:	2270 mg/kg (rat)
LC50 Inhalation:	450 ppm (rat) (4-hr)

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Ethylene glycol monobutyl ether	470 mg/kg	2270 mg/kg	450 ppm

12. ECOLOGICAL INFORMATION

Toxicity

12. ECOLOGICAL INFORMATION

Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Ethylene glycol monobutyl ether	EC50: 839.56 mg/l (Skeletonema costatum)	LC50: > 1000 mg/l (Scophthalmus maximus juvenile)	No information available	EC50: >1000 mg/L (Daphnia magna)

Persistence and degradability
Readily biodegradable

Bioaccumulative potential
Does not bioaccumulate

Substances	Log Pow
Ethylene glycol monobutyl ether	0.9

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None

14. TRANSPORT INFORMATION

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3

R20/21/22 Harmful by inhalation, by contact with skin and if swallowed.
R36/38 Irritating to eyes and skin.

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date: 11-Apr-2012
Revision Note Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET

NF-6

Revision Date: 22-Feb-2012 **Revision Number:** 13

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name NF-6

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Defoamer

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Hazard Pictograms

Signal Word **Not Hazardous**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Vegetable oil	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available
Aluminum stearate	211-279-5	637-12-7	1 - 5%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Get medical attention! If vomiting occurs, keep head lower than hips to prevent aspiration.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
Carbon dioxide, dry chemical, foam.
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Use water spray to cool fire exposed surfaces. Decomposition in fire may produce toxic gases.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store away from oxidizers. Keep container closed when not in use.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Vegetable oil	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Aluminum stearate	Not applicable	2 mg/m^3	2 mg/m^3	Not applicable	2 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Vegetable oil	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Aluminum stearate	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal protective equipment
Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Organic vapor respirator with a dust/mist filter.
Hand Protection Polyvinylchloride gloves.
Skin Protection Normal work coveralls.
Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions Eyewash fountains and safety showers must be easily accessible.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid **Color:** Yellow
Odor: Mild **Odor Threshold:** No information available

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	No data available
Boiling Point/Range	182°C
Flash Point	> 170°C
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.93
Water Solubility	Dispersable
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	385°C
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information
VOC Content (%) No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
Strong oxidizers.
Hazardous Decomposition Products
Hydrocarbons. Carbon monoxide and carbon dioxide.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation None known.
Eye Contact May cause eye irritation.
Skin Contact May cause skin irritation. May cause an allergic skin reaction.
Ingestion May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Vegetable oil	No data available	No data available	No data available
Aluminum stearate	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Vegetable oil	EC50: > 3200 mg/L (Skeletonema costatum)	LC50: > 5600 mg/L (Scophthalmus maximus)	No information available	LC50: > 10000 mg/L (Acartia tonsa)
Aluminum stearate	No information available	TLM96: 1100 mg/l (Oncorhynchus mykiss)	No information available	TLM96: 836400 ppm (Mysidopsis bahia)

Persistence and degradability
Readily biodegradable

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None

14. TRANSPORT INFORMATION

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	Product contains one or more components not listed on the inventory.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	22-Feb-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **NUT SHELL**

Revision Date: 03-Jan-2012

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: NUT SHELL
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Walnut hulls	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Rinse mouth with water many times.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	380
Flash Point/Range (C):	193
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 0, Flammability 1, Reactivity 0
HMIS Ratings: Health 0, Flammability 1, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust.

Storage Information Store away from oxidizers. Store in a dry location. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional.

Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Dust proof goggles.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Crumbles
Color:	Brown
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.1
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye contact. Inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause slight eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory or are exempt.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information	For additional information on the use of this product, contact your local Halliburton representative. For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

SAFETY DATA SHEET
NUTPLUG (All Grades)

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

PRODUCT NAME: NUTPLUG (All Grades)

APPLICATIONS: Lost circulation material.

SUPPLIER:
M-I Drilling Fluids UK Ltd,
Pocra Quay,
Footdee,
Aberdeen. AB11 5DQ
Tel: 44 (0)1224 - 584336
Fax: 44 (0)1224 - 576119

EMERGENCY TELEPHONES: 001 281 561 1600 (USA)

2. COMPOSITION/INFORMATION ON INGREDIENTS

GROSS FORMULA: Cellulose - Nutshells

CAS No.: 9004-34-6

COMPOSITION COMMENTS: This product is classified as containing no hazardous ingredients according to the EC Directives.

3. HAZARDS IDENTIFICATION

Not regarded as a health hazard under current legislation.

4. FIRST AID MEASURES

INHALATION: Move the exposed person to fresh air at once. Get medical attention if any discomfort continues.

INGESTION: First aid is not normally required. Rinse mouth thoroughly. Drink plenty of water.

SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.

EYES: Promptly wash eyes with plenty of water while lifting the eye lids. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA: Carbon dioxide (CO_2). Dry chemicals. Foam. Water spray, fog or mist.

SPECIAL FIRE FIGHTING PROCEDURES: Use pressurized air mask if substance is involved in a fire.

UNUSUAL FIRE & EXPLOSION HAZARDS: High concentrations of dust may form explosive mixture with air.

HAZARDOUS COMBUSTION PRODUCTS: Asphyxiating gases/vapors/fumes of: Carbon dioxide (CO_2). Carbon monoxide (CO).

6. ACCIDENTAL RELEASE MEASURES

SPILL CLEANUP METHODS: Shovel into dry containers. Cover and move the containers. Flush the area with water. Wear necessary protective equipment.

7. HANDLING AND STORAGE

USAGE PRECAUTIONS: Avoid handling which leads to dust formation. Provide good ventilation.

STORAGE PRECAUTIONS: Store at moderate temperatures in dry, well ventilated area.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

INGREDIENT COMMENTS: This material is considered a nuisance dust, OES TWA 4mg/m3 Respirable Dust, 10 mg/m3 Total Dust.

PROTECTIVE EQUIPMENT:

VENTILATION: Provide adequate general and local exhaust ventilation.

RESPIRATORS: Respiratory protection must be used if air concentration exceeds acceptable level. Dust filter P2 (for fine dust).

PROTECTIVE GLOVES: No specific hand protection noted, but gloves may still be advisable. For prolonged or repeated skin contact use suitable protective gloves. Rubber or plastic.

EYE PROTECTION: Wear dust resistant safety goggles where there is danger of eye contact.

OTHER PROTECTION: Wear appropriate clothing to prevent repeated or prolonged skin contact. Provide eyewash station.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE:	Powder, dust.		
COLOUR:	Brown.		
ODOUR/TASTE:	Odourless or no characteristic odour.		
DENSITY/SPECIFIC GRAVITY (g/ml):	~ 1.35 - 1.35	**Temperature (°C):**	20
BULK DENSITY:	577 - 641 kg/m3		
SOLUBILITY DESCRIPTION:	Insoluble in water.		
FLAMMABILITY LIMIT - LOWER(%):	May form explosive dust clouds in air.		

10. STABILITY AND REACTIVITY

STABILITY:	Normally stable.
CONDITIONS TO AVOID:	Avoid heat, flames and other sources of ignition.
MATERIALS TO AVOID:	Strong oxidizing agents.
HAZARDOUS DECOMP. PRODUCTS:	Fire or high temperatures create: Asphyxiating gases/vapours/fumes of: Carbon dioxide (CO_2). Carbon monoxide (CO).

11. TOXICOLOGICAL INFORMATION

INHALATION:	Dust may irritate respiratory system or lungs. Inhalation may cause bronchial asthma in some personnel.
INGESTION:	May cause discomfort if swallowed.
SKIN:	Powder may irritate skin.
EYES:	Particles in the eyes may cause irritation and smarting.

12. ECOLOGICAL INFORMATION

ECOLOGICAL INFORMATION:	Not regarded as dangerous for the environment.

13. DISPOSAL CONSIDERATIONS

DISPOSAL METHODS: Recover and reclaim or recycle, if practical. Dispose of on site landfill area. Dispose of in accordance with Local Authority requirements.

14. TRANSPORT INFORMATION

ROAD TRANSPORT NOTES: Not Classified

RAIL TRANSPORT NOTES: Not Classified.

SEA TRANSPORT NOTES: Not Classified.

AIR TRANSPORT NOTES: Not Classified.

15. REGULATORY INFORMATION

RISK PHRASES: Not classified.

SAFETY PHRASES: Not classified.

UK REGULATORY REFERENCES: Chemicals (Hazard Information & Packaging) Regulations 1993. The Control of Substances Hazardous to Health Regulations 1988.

STATUTORY INSTRUMENTS: Control of Substances Hazardous to Health.

GUIDANCE NOTES: Occupational Exposure Limits EH40.

16. OTHER INFORMATION

USER NOTES: HMIS Health - 1 HMIS Flammability - 1 HMIS Physical Hazard - 0 E - Safety glasses, Gloves, Dust Respirator

INFORMATION SOURCES: Material Safety Data Sheet, Misc. manufacturers. Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).

ISSUED BY: Sarah Glover

REVISION DATE: 01-04-03

REV. No./REPL. SDS GENERATED: 1

PRINTING DATE: 2003-04-25

DISCLAIMER: MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

BJ SERVICES MATERIAL SAFETY DATA SHEET

OSCA, Inc., PO Box 80627, Lafayette, Louisiana 70598 (318) 837-6047

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PRODUCT NAME: OS-8

DOT SHIPPING NAME: Not regulated | **DOT ID #: NA**
HAZARD CLASS: NA | **PKG. GROUP: NA**
EFFECTIVE DATE: August 19, 2009 | **DATE PRINTED: June 13, 2012**

1. INGREDIENTS:

Chemical	TLV	PEL	STEL	SEC. 313	% (optional)
Proprietary	NE			No	

The components of this product are listed on the TSCA inventory.

2. PHYSICAL DATA:

pH: 5.5 – 8.0 (10% solution)
SPECIFIC GRAVITY (Water=1): 1.2
VAPOR PRESSURE: N/D
VOLATILITY: ND
SOLUBILITY IN WATER: Soluble
APPEARANCE: White Crystals
ODOR: Odorless

HMIS:
Health- 1
Fire - 0
React. - 0
Other - None
PPE: e

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: None
METHOD USED: N/A

FLAMMABLE LIMITS:

LFL: N/A
UFL: N/A

EXTINGUISHING MEDIA: Use carbon dioxide, dry chemical foam, water fog or water spray.

SPECIAL FIRE FIGHTING PROCEDURES: Product may burn but does not ignite readily. Minimize explosion hazard by controlling dusts. Normal equipment; self-contained breathing apparatus.

4. REACTIVITY DATA:

Stability: Stable under ordinary conditions.

Incompatibility: Strong oxidizers, dust-air mixtures, excessive heat, sparks or open flames.

Hazardous Decomposition Products: Carbon dioxide and carbon monoxide.

Hazardous Polymerization: Will not occur.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

If spilled: Ventilate area of leak or spill. Cleanup personnel may require respiratory protection from dust. Sweep up and containerize for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Disposal Method: Review federal, state and local government requirements prior to disposal. Disposal by controlled incineration or secure landfill may be acceptable.

6. HEALTH HAZARD DATA:

Carcinogen? : NTP?: No IARC?: No OSHA Regulated?: No

EFFECTS OF OVEREXPOSURE

Inhalation: Overexposure may cause minor irritation to the respiratory tract.

Skin Contact: Prolonged or repeated skin contact may cause mild irritation/dermatitis.

Eye Contact: Prolonged or excessive contact with eyes may cause mild irritation.

Ingestion: This product is safe for use in foods.

7. FIRST AID:

Skin Contact: Wash with a large amount of water and non-abrasive soap. If irritation persists, obtain medical attention. Wash contaminated clothing before reuse.

Eye Contact: Wash eyes with a large amount of water for at least fifteen minutes and obtain medical assistance if irritation persists.

If Inhaled: Remove to fresh air. If required, give supportive and symptomatic treatment and get medical attention.

If Ingested: None usually necessary.

8. HANDLING PRECAUTIONS:

Respiratory Protection: NIOSH-approved dust/mist respirator should be worn in dusting conditions or if airborne concentration is high.

Ventilation: Use general mechanical ventilation. Local exhaust is suggested for use, where possible, in enclosed or confined spaces. Explosion-proof exhaust is recommended.

Protective Clothing: Wear protective gloves and clean body-covering clothing. Use chemical safety goggles. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

9. ADDITIONAL INFORMATION:

Store in tightly closed container in cool, dry, ventilated area away from sources of heat or ignition.

****

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act of 1970 and shall not be used for any other purpose. The information supplied is presented in good faith and has been derived from sources believed to be reliable. However, no warranty, expressed or implied is extended regarding its accuracy or the results to be obtained from its use. Since conditions of use are beyond our control, all risks are assumed by the user.

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HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **OXYGON®**

Revision Date: 17-Jun-2008

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: OXYGON®
Synonyms: None
Chemical Family: Organic Salt
Application: Oxygen Scavenger

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases

Hazard Overview May cause eye and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Organic acid salt		60 - 100%	Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin	Wash with soap and water. Get medical attention if irritation persists.
Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid Powder
Color:	White
Odor:	Odorless
pH:	5.5-8 (5%)
Specific Gravity @ 20 C (Water=1):	1.2
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	640
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	15
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known

Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases

Safety Phrases

S24/25 Avoid contact with skin and eyes.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-LE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-LE
Synonyms: None
Chemical Family: Carbohydrate
Application: Fluid Loss Additive

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	750
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Forms gel
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 1260 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: > 500 mg/l (Golden orfe)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **PAC™-RE**

Revision Date: 05-Jan-2009

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: PAC™-RE
Synonyms: None
Chemical Family: Polysaccharide
Application: Fluid Loss Additive

Company Undertaking Identification

Halliburton Manufacturing Services, Ltd.
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Cellulose derivative		60 - 100%	Not Listed	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases. Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Slippery when wet.
Storage Information	Store away from oxidizers. Store in a dry location. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to off white
Odor:	Odorless
pH:	6.5-9 (1%)

9. PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	400-800
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	221
Flash Point Method:	Not Determined
Autoignition Temperature (C):	400
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 16,000 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	BOD(5 Day): 0 mg/g COD: 900 mg/l
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	TLM96: 27000 ppm (Oncorhynchus mykiss)
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

*OEL in Section 2 is for dust.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

MATERIAL SAFETY DATA SHEET
MSDS

Trade Name: Poly Anionic Cellulose (uLV)
Revision date: 19.06.2007
Replaced: 08.05.2007

Poly Anionic Cellulose (uLV)

1. PRODUCT AND COMPANY

TRADE NAME:	Poly Anionic Cellulose (uLV)	APPROVED:	YES
CHEMICAL NAME:		RECEIPT NO:	
FORMULA:		ARTICLE NO:	
SYNONYMS:	PAC ULV	EC-NO:	
INDEX NO:		CAS NO:	
GROUP:		PR.NO:	
SUPPLIER:	Halliburton AS Postboks 200 4065 Stavanger Tlf: 51837000 Fax: 51838383		
TOXIC INFORMATION:	22591300	EMERGENCY PHONE:	51838888
RESPONSIBLE:	Jan Erik Eriksen		
AUTHOR:	Essenticon AS		
APPLICATION:	Fluid Loss aditive with ultra low viscosity		
MORE INFORMATION:			

2. COMPOSITION

EXPLANATION:
CF/CH/CE=Classification fire/-health/-environment, Tx=Very Toxic, T=Toxic, C=Corrosive, Xn=Harmful, Xi=Irritating, IK=No classification required, E=Explosive, O=Oxidizing, Fx=Extremely flammable, F=Highly flammable, N=Danger for environment, M=Genotoxic, A=Sensitisation, K=Carcinogen, R=Causes birth defects.
COMPOSITION COMMENTS:
The product contains several ingredients that either are not classified, or are present i such small amounts that they are not necessary to be stated. HMS Logiconsult has seen and evaluated the whole composition.

3. HAZARDS IDENTIFICATION

MORE INFORMATION:
Not classified as dangerous to health, safety or environment.

4. FIRST AID MEASURES

GENERAL:
No special measures required.

INHALATION:
Fresh air; consult doctor in case of complaints.

SKIN CONTACT:
Rinse with water.

EYE CONTACT:
In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

INGESTION:
No special measures required.

INFORMATION TO HEALTH PERSONEL:

No special measures required.
5. FIRE FIGHTING MEASURES
SUITABLE EXTINGUISH MEDIA:
Water fog, carbon dioxide, foam, dry chemical.

FIRE AND EXPLOSION HAZARDS:
Not flammable.
In case of fire or exposed to strong heat may be formed carbonmonooxide (CO).
Organic dust in the presence of an ignition source can be explosive in high concentrations.

PERSONAL PROTECTION WHEN FIREFIGHTING:
Firefighters shall wear breathing apparatus.

MORE INFORMATION:
Product forms slippery surface when combined with water.
6. ACCIDENTAL RELEASE MEASURES
PERSONAL PRECAUTIONS:
Use personal proctection as necessary. See chap. 8. Avoid formation/inhalation of dust.
Ensure adequate ventilation.

ENVIRONMENTAL PRECAUTIONS:
No special measures required.

CLEANING MEASURES:
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:Warm water
Dispose contaminated material as waste according to Section 13.
The product is not hazardous waste.
7. HANDLING AND STORAGE
SPECIAL PRECAUTIONS:
Prevent formation of dust. Work only in fume cupboard. Product forms slippery surface when combined with water.

HANDLING:
Avoid creating or inhaling dust. Avoid dust accumulations. Ensure adequate ventilation. Use explosion-proof apparatus / fittings and spark-proof tools.

STORAGE:
Store only in the original receptacle. Protect from humidity and water.
Store away from oxidizers.
8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE CONTROL:
A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation. Do not breathe dust.

RESPIRATORY PROTECTION:
In poorly ventilated room use filter P2-filter (dust).

EYE PROTECTION:
Safety goggles which protects against dust.

HAND PROTECTION:
Not required.

SKIN PROTECTION:
Light weight protective clothing

9. PHYSICAL AND CHEMICAL PROPERTIES

FORM:	Powder	ODOUR:	Odourless
COLOUR:	White, light yellow	SOLUBILITY:	
MELTING/FREEZING POINT:		BOILING POINT:	
DENSITY:	1,5 g/cm³	FLASH POINT:	221 °C
EXPLOSION LIMITS LEL-UEL %:	Risk of dust explosion	PH (CONCENTRATE.):	
SOLUBILITY IN WATER:	Soluble	MOL MASS:	
VAPOUR PRESSURE:		VISCOSITY:	Dynamic at 25°C: < 7 mPas (Fann). Water: < 8 %.
SATURATION CONC.:		AUTO IGNITION TEMP:	400 °C
DECOMPOSITION TEMP.:	>150 °C	SMELL LIMIT:	
PH (SOLUTION):	7 - 9 (10 g/l)	REL.VAPOUR DENSITY (AIR=1):	

MORE INFORMATION:
Bulk density at 20°C: 600 - 700 kg/m³

10. STABILITY AND REACTIVITY

STABILITY:
Stable when used at recommended storage and handling conditions.

REACTIVITY:
Strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS:
No dangerous decomposition products known.

OTHER INFORMATION:
Dangerous reactions: Risk of dust explosion.

11. TOXICOLOGICAL INFORMATION

INHALATION:
Inhalation of dust may irritate the respiratory tract.

SKIN CONTACT
No irritant effect.

EYE CONTACT:
No irritant effect.

INGESTION:
No irritant effect.

SENSITIZATION:
No sensitizing effects known.

OTHER TOXOLOGICAL INFORMATION:

When used and handled according to specifications, the product does not have any harmful effects to our experience and the information provided to us.

12. ECOLOGICAL INFORMATION

MOBILITY:
Soluble in water. Low mobility.

BIODEGRADABILITY:
The product is easily biodegradable.

ACCUMULATION:
No bio-accumulation is indicated.

ECOTOXICITY:
The product is classified to be not dangerous for the environment. This excludes not the risk that frequent or small releases may pose a risk for the environment.

MORE INFORMATION:
Water hazard class 1 (German Regulation) (Self-assessment): slightly hazardous for water.

13. DISPOSAL

DECONTAMINATION/DISPOSAL:
Smaller quantities can be disposed of with household waste. Disposal must be made according to official regulations. Not hazardous waste.

MORE INFORMATION:
Recommended cleansing agents: Water, if necessary together with cleansing agents.

14. TRANSPORT INFORMATION

ADR(Road)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
PACKING GROUP:	HAZ. ID NO:	

RID(Railway)

UN NO:	CLASS:	
HAZ. ID NO:	DANG. GOODS:	No
PACKING GROUP:		

IMDG(SEA)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
EMS:	PACKING GROUP:	
MARINE POLL:	SUB.RISK:	

IATA(Airplane)

UN NO:	CLASS:	
LABEL:	DANG. GOODS:	No
SUB.RISK:	PACKING GROUP:	

MORE INFORMATION:
Not hazardous goods (ADR/RID/IMDG/IATA).

15. REGULATORY INFORMATION

REFERENCES:
Revised in compliance with national regulations for health, fire and environment labelling. (The Working Environment Act, Pollution Control Act, Act relating to Prevention of Fire, Explosion and Accidents involving Hazardous Substances and the Fire Services) Norwegian Databases: List of Dangerous Substances, The Observation List, List of Priority Substances. Authorities: Norwegian Labour Inspection Authority, Directorate for Civil Protection and Emergency Planning, Norwegian Petroleum Directorate, Petroleum Safety Authority Norway. Transport legislation: The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment (ADR/RID),The International Maritime Dangerous Goods (IMDG), International Air Transport Association Dangerous Goods (IATA) EU-directives : 67/548/EEC, 1999/45/EC, 2001/58/EC, 2004/73/EF (29. ATP), 2006/8/EC with later amendments.
16. OTHER INFORMATION
Replace date:: 08.05.2007

MORE INFORMATION:
Essenticon AS has no legal responsibility for mistakes or faulty information which is given from the producer. The producer given in chapter 1 is responsible for this MSDS and is legally responsible for the content.
Approved and revised in compliance to 29. ATP.

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Signature: R. E. Lunde

Revision 19.06.2007: replaces MSDS of 08.05.2007. Chenhed name form "PAC ULV" to "Poly Anionic Cellulose (uLV)". Else no amendments.

This document was generated by Logichem 2002, a web based library for hazardous chemicals.
http://www.hmslogiconsult.com/

Product data sheet

DPI INDUSTRIER

Product	**Poly Anionic Cellulose (u)LV** **PAC Lovis pure, Equivalent**	
Product information	Description	Anionic carboxymethylated polymer
	Application	Fluid loss additive for KCl based drilling fluids for drilling active shales
Specific properties	Appearance	Off white, free flowing particles
	Compatibility	Resistant to high concentrations of mono-and bivalent cations (Na^+, K^+, Ca^{2+}, Mg^{2+}) Compatible with all drilling fluid additives
	Solubility	Readily soluble in saline drilling fluids
	Suspensibility	Excellent without lumping
	Purity	min. 95 %
	Moisture	max. 8.0 %
	pH (2% sol. at 25ºC)	7.0 – 10.0
	Rate of addition	5 – 15 kg/m^3 (2 – 5 lbs/bbl)
General properties	Storage	Dry
	Shelf life	24 months
	Packaging	25 kg multiply paper bags with PE liner

Product **Poly Anionic Cellulose (u)LV**
PAC Lovis pure, Equivalent

The above given information is provided with care, but the author(s) cannot be held responsible for discrepancies

Product data sheet

DPI INDUSTRIER

Mud composition

	KCl / NaCl solution	
	(g)	*(lbs/bbl)*
Fresh water	1000	350
KCl	80	28
NaCl	40	14
$NaHCO_3$	3	1
OCMA Clay	60	21
Pac- (u)LV	**...**	**...**

Quality control test

	KCl / NaCl solution	
	Requirements	*Pac - LV 5.7 g/l **
Apparent Viscosity (cP) *	max. 10	8
API fluid loss, after 30 min. (ml)	max. 15	11

* For Apparent viscosity test at 8.6 g/l (3 lbs/bbl)

Performance test

		KCl / NaCl solution	
		Requirements	*Pac - LV 5.7 g/l*
Apparent Viscosity (cP)	65ºC, 16 h hot roll	max. 10	3.5
	120ºC, 16 h hot roll	max. 10	3
API, fluid loss (ml)	65ºC, 16 h hot roll	max. 15	10
	120ºC, 16 h hot roll	max. 15	9

The above given information is provided with care, but the author(s) cannot be held responsible for discrepancies

HALLIBURTON

SAFETY DATA SHEET

POTASSIUM CHLORIDE

Revision Date: 17-Nov-2010 **Revision Number:** 9

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name POTASSIUM CHLORIDE

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Chronic Aquatic Toxicity	Chronic 3

- (H412)

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

Risk Phrases None

2. HAZARDS IDENTIFICATION

Label Elements

Signal Word **None**

Hazard Statements
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements - EU (§28, 1272/2008)
P273 - Avoid release to the environment

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Potassium chloride	231-211-8	7447-40-7	60 - 100%	Not applicable	Aquatic chronic 3 (H412)	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Skin Wash with soap and water. Get medical attention if irritation persists.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause eye and skin irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid creating and breathing dust.
See Section 12 for additional information

Environmental precautions
Prevent from entering sewers, waterways, or low areas.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Avoid breathing vapors.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a cool, dry location. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Potassium chloride	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Potassium chloride	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
- **Respiratory Protection** Dust/mist respirator. (95%)
- **Hand Protection** Normal work gloves.
- **Skin Protection** Normal work coveralls.
- **Eye Protection** Dust proof goggles.
- **Other Precautions** Eyewash fountains and safety showers must be easily accessible.

Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** White to gray
Odor: Odorless

Property Remarks/ Method	Values
pH:	9.2
Melting Point/Range	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	No data available
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	1.99
Water Solubility	Soluble in water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

Molecular Weight	74.55
VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	May cause respiratory irritation.
Eye Contact	May cause severe eye irritation.
Skin Contact	May cause moderate skin irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea. Irritation of the mouth, throat, and stomach.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

LD50 Oral: > 5000 mg/kg (rat)

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Potassium chloride	> 5000 mg/kg	No data available	No data available

Test species: Rat

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Potassium chloride	No information available	No information available	No information available	TLM96: 100-330 ppm (Crangon crangon)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	17-Nov-2010
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **QUIK-FREE**

Revision Date: 03-Jan-2008

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: QUIK-FREE
Synonyms: None
Chemical Family: Blend
Application: Spotting fluid

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Glycerine	56-81-5	30 - 60%		10 mg/m^3	Not applicable	10 mg/m^3	Not applicable
Fatty acid		30 - 60%	Not Listed	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Wash hands after use.
Storage Information	Store away from oxidizers. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Not normally necessary.
Hand Protection	Impervious rubber gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Clear light yellow
Odor:	Fatty acid
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	0.98
Density @ 20 C (kg/l):	0.98
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined**Min:** > 180
Flash Point Method:	PMCC
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Acrolein. Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause mild eye irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	Not determined

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON | Baroid

QUIK-THIN® PLUS

Thinner — Product Data Sheet

Product Description

QUIK-THIN® PLUS thinner is a lignosulfonate based product that can be used in all dispersed water-base systems to effectively control rheological properties of fluids containing large amounts of drill solids. It works effectively to reduce the effects of contaminants at a wide range of pH levels. QUIK-THIN PLUS thinner is effective at temperatures approaching 375°F (190°C). Compared to QUIK-THIN thinner, QUIK-THIN PLUS thinner works better at lower pH and has less caustic demand.

Applications / Functions

- Helps reduce the rheological properties of water-base drilling fluids
- Helps prevent high temperature gelation
- Helps Minimize adverse effects of mud contamination
- Should be used at pH 9.0 or higher

Advantages

- Effective in high calcium environments
- Helps improve filter-cake quality
- Functions in lime, gypsum, salt water and fresh water fluids

Typical Properties

Form	Solid Brown Powder
Bulk density, lb/cu.ft	30
Specific gravity	1.1
pH, (10% aqueous solution)	5 to 7
Solubility	Water soluble

Recommended Treatment

Add 1 – 8 lb/bbl of QUIK-THIN PLUS thinner to the active fluid system

Note: When prehydrated bentonite is added to saltwater systems, add QUIK-THIN PLUS thinner to the slurry to help minimize flocculation

Packaging

QUIK-THIN PLUS thinner is packaged in 50-lb (22.7-kg) bags and in bulk

www.halliburton.com/baroid

Because the conditions of use of this product are beyond the seller's control, the product is sold without warranty either express or implied and upon condition that purchaser make its own test to determine the suitability for purchaser's application. Purchaser assumes all risk of use and handling of this product. This product will be replaced if defective in manufacture or packaging or if damaged. Except for such replacement, seller is not liable for any damages caused by this product or its use. The statements and recommendations made herein are believed to be accurate. No guarantee of their accuracy is made, however.

QUIK-THIN is a registered trademark of Halliburton. © 2010 Halliburton All Rights Reserved

9/29/2010

HALLIBURTON

SAFETY DATA SHEET

SILICALITE LIQUID

Revision Date: 22-Feb-2012 **Revision Number:** 10

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name SILICALITE LIQUID

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Light Weight Cement Additive

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Hazard Pictograms

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Silica, amorphous - fumed	231-545-4	7631-86-9	30 - 60%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Skin Wash with soap and water.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Most Important symptoms and effects, both acute and delayed
May cause mild eye, skin, and respiratory irritation.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing mediaó
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid contact with eyes, skin, or clothing.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Keep container closed when not in use. Product has a shelf life of 24 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Silica, amorphous - fumed	Not applicable	6 mg/m^3	Not applicable	Not applicable	4 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Silica, amorphous - fumed	Not applicable	Not applicable	Not applicable	0.1 mg/m^3	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls Use in a well ventilated area.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Liquid **Color:** Dark gray
Odor: Odorless **Odor Threshold:** No information available

Property Values
Remarks/ Method

9. PHYSICAL AND CHEMICAL PROPERTIES

pH:	6- 8
Melting Point/Range	No data available
Freezing Point/Range (C):	0°C
Boiling Point/Range	100°C
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	22.9 mmHg
Vapor Density	No data available
Specific Gravity	1.37
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	None known.
Eye Contact	May cause mild eye irritation.
Skin Contact	Practically Non-toxic by Skin Contact.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Silica, amorphous - fumed	3160 mg/kg	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity

12. ECOLOGICAL INFORMATION

Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Silica, amorphous - fumed	No information available	No information available	No information available	No information available

Persistence and degradability
The methods for determining biodegradability are not applicable to inorganic substances.

Bioaccumulative potential
Does not bioaccumulate

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods
Disposal Method Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

RID

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

ADR

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

IATA/ICAO

UN Number: Not restricted.
UN Proper Shipping Name: Not restricted
Transport Hazard Class(es): Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	22-Feb-2012
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

MATERIAL SAFETY DATA SHEET

SODA ASH

Drilling Fluids

1. Product and Company Identification

Material name	**SODA ASH**
Chemical name	Sodium carbonate
Applications	Alkalinity Control Agent
Supplier	Baker Hughes Drilling Fluids 2001 Rankin Rd. Houston, TX 77073 Emergency telephone number 713-439-8900

2. Composition / Information on Ingredients

The manufacturer lists no ingredients as hazardous according to OSHA 29 CFR 1910.1200.

3. Hazards Identification

Emergency overview	May cause severe irritation or burns to the eyes, skin, gastrointestinal tract, and respiratory system.
Potential health effects	
Eyes	Contact can cause moderate to severe irritation and possible injury to the eyes. Eye contact may result in corneal injury.
Skin	Contact causes severe skin irritation and possible burns.
Inhalation	Harmful if inhaled. Dusts of this product may cause irritation of the nose, throat, and respiratory tract. Inhalation of dust may cause shortness of breath, tightness of the chest, a sore throat and cough.
Ingestion	Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.
Chronic effects	Prolonged or repeated inhalation may cause nosebleeds, nasal congestion, erosion of the teeth, perforation of the nasal septum, chest pain and bronchitis.

4. First Aid Measures

First aid procedures	
Eye contact	Rinse immediately with plenty of water, also under the eyelids. Get medical attention if irritation develops or persists.
Skin contact	Wash off immediately with plenty of water for at least 15 minutes. Get medical attention if irritation develops or persists. Remove and isolate contaminated clothing and shoes. Launder contaminated clothing before reuse.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Call a physician if symptoms develop or persist.
Ingestion	DO NOT INDUCE VOMITING. Give victim water or milk. Get medical attention immediately.
Notes to physician	Treat symptomatically.
General advice	If you feel unwell, seek medical advice (show the label where possible).

5. Fire Fighting Measures

Extinguishing media	
Suitable extinguishing media	Use extinguishing agent suitable for type of surrounding fire. Dry chemical, CO2, water spray or regular foam.
Protection of firefighters	
Protective equipment for firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Move containers from fire area if you can do it without risk. Cool containers with flooding quantities of water until well after fire is out.

6. Accidental Release Measures

Personal precautions	Wear appropriate protective equipment and clothing during clean-up. For recommended protective clothing and equipment, see section 8 "Exposure Controls and Personal Protection".

Evacuation procedures	Keep unnecessary personnel away.
Environmental precautions	Do not contaminate surface water. Prevent further leakage or spillage if safe to do so.
Methods for containment	Stop the flow of material, if this is without risk.
Methods for cleaning up	Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid the generation of dusts during clean-up. Ventilate the contaminated area.

7. Handling and Storage

Handling	Wash hands after handling and before eating. Do not get this material in your eyes, on your skin, or on your clothing. Remove and wash contaminated clothing before re-use. Do not ingest. Avoid dust formation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure Controls / Personal Protection

Exposure guidelines	NUISANCE DUST: Exposure limit for respirable dust is 4 mg/m3 (8hr TWA) Exposure limit for inhalable dust is 10 mg/m3 (8hr TWA)
Engineering controls	Good general ventilation should be sufficient to control airborne levels.
Personal protective equipment	
Eye / face protection	Wear dust goggles.
Skin protection	Use of protective coveralls and long sleeves is recommended. Rubber or plastic boots.
Hand protection	Protective gloves.
Respiratory protection	In case of insufficient ventilation wear suitable respiratory equipment. Half mask with a particle filter P2 (EN 143).
General hygeine considerations	Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and Chemical Properties

Appearance / Color / Form	Powder. White. Solid.
Odor	None.
Clarity	Not available
Odor threshold	Not available
Physical state	Solid
pH	7 - 9 11.5 , conc:1% (aqueous solution)
Melting point	Not available
Freezing point	Not available
Boiling point	752 °F (400 °C)
Flash point	Not applicable
Evaporation rate	1
Flammability limits in air, lower, % by volume	Not available
Flammability limits in air, upper, % by volume	Not available
Vapor pressure	0 HPa at 20 °C
Vapor density	Not available
Specific gravity	2.8823
Relative density	2.4 g/cm3
Solubility	Soluble in water.
Octanol/H2O coeff	1.7
Auto-ignition temperature	Not available
Decomposition temperature	752 °F (400 °C)
Percent volatile	5 % in water
Molecular weight	105.99 g/mol
Molecular formula	Na2.CO3

10. Chemical Stability and Reativity Information

Chemical stability	Stable at normal conditions.

Incompatible materials	Ammonia + silver nitrate, 2,4-dinitrotoluene, 2,4,6-trinitrotoluene, sulfuric acid, sodium sulfide + water, lithium, phosphorus pentoxide, fluorine, and hydrogen peroxide. Corrosive to steel.
Hazardous decomposition products	At thermal decomposition temperatures, carbon monoxide and carbon dioxide. Sodium oxides.
Possibility of hazardous reactions	Will not occur.

11. Toxicological Information

Carcinogenicity	Did not cause cancer in long-term animal studies.

12. Ecological Information

Ecotoxicity	This material is not expected to be harmful to aquatic life.
Persistence / degradability	Expected to be slow, but will ultimately degrade in the aquatic environment.
Bioaccumulation / accumulation	Not expected to bioaccumulate.
Partition coefficient	1.7
Mobility in environmental media	This product will disperse readily in bodies of water or in wet soil.

13. Disposal Considerations

Disposal instructions	Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

14. Transport Information

Department of Transportation (DOT) Requirements

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

15. Regulatory Information

Occupational Safety and Health Administration (OSHA)

29 CFR 1910.1200 hazardous chemical	No
CERCLA (Superfund) reportable quantity	None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
Section 302 extremely hazardous substance	No
Section 311 hazardous chemical	No
Food and Drug Administration (FDA)	Total food additive GRAS food additive

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (CCS)	Yes
Europe	European Inventory of New and Existing Chemicals (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Japanese Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Korean Inventory of Chemicals (KICS)	Yes
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)

16. Other Information

HMIS ratings
Health: 1
Flammability: 0
Physical hazard: 0
Personal protection: E

NFPA ratings
Health: 0
Flammability: 0
Instability: 0

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release

EU preparer Melanie Thatcher - Tel +44 (0)1224 721597

US preparer Cheryl Hood - (713)625-4888

Issue date 08-19-2005

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **SODIUM BICARBONATE**

Revision Date: 02-Jun-2007

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: SODIUM BICARBONATE
Synonyms: None
Chemical Family: Carbonate
Application: Buffer

Company Undertaking Identification
Halliburton Energy Services
Deveron Facility, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GS
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium bicarbonate	144-55-8	60 - 100%	205-633-8	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store away from acids. Store in a dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	8
Specific Gravity @ 20 C (Water=1):	1.87
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong acids.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 4220 mg/kg (Rat)

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Slowly biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **SODIUM BROMIDE**

Revision Date: 19-Nov-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Statement of Hazardous Nature Non-Hazardous according to the criteria of NOHSC, Non-Dangerous Goods according to the criteria of ADG.

Manufacturer/Supplier

Halliburton Australia Pty. Ltd.
53-55 Bannister Road
Canning Vale
WA 6155
Australia

ACN Number: 009 000 775
Telephone Number: 61 (08) 9455 8300
Fax Number: 61 (08) 9455 5300

Product Emergency Telephone
Australia: 08-64244950
Papua New Guinea: 05 1 281 575 5000
NewZealand: 06-7559274

Fire, Police & Ambulance - Emergency Telephone
Australia: 000
Papua New Guinea: 000
New Zealand: 111

Identification of Substances or Preparation

Product Trade Name: SODIUM BROMIDE
Synonyms: None
Chemical Family: Salt
UN Number: None
Dangerous Goods Class: None
Subsidiary Risk: None
Hazchem Code: None
Poisons Schedule: None
Application: Additive

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	Australia NOHSC	ACGIH TLV-TWA
Sodium bromide	7647-15-6	60 - 100%	Not applicable	Not applicable

Total to 100%

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. May be harmful if swallowed.

Hazard Ratings

Flammability:	0
Toxicty:	1
Body Contact:	1
Reactivity:	0
Chronic:	0

Scale: Min/Nil=0 Low=1 Moderate=2 High=3 Extreme=4

4. FIRST AID MEASURES

Inhalation If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.

Skin In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.

Eyes In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.

Ingestion Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures Prevent from entering sewers, waterways, or low areas.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Wash hands after use. Launder contaminated clothing before reuse.

Storage Information	Store away from oxidizers. Store away from acids. Store in a cool, dry location. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Powder
Color:	White
Odor:	Odorless
pH:	5.5-8.5
Specific Gravity @ 20 C (Water=1):	3.21
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	1390
Freezing Point/Range (C):	755
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	97
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	102.89
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	Moisture
Incompatibility (Materials to Avoid)	Strong acids.

Hazardous Decomposition Products	Hydrogen bromide. Toxic fumes.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	Irritation of the mouth, throat, and stomach. May cause headache, dizziness, nausea, vomiting, gastrointestinal irritation and central nervous system depression.
Aggravated Medical Conditions	Central nervous system disorders.
Chronic Effects/Carcinogenicity	May cause bromism characterized by disturbances of the central nervous system, skin and digestive tract. May cause birth defects.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 3500 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

Chemical Inventories

Australian AICS Inventory All components listed.
US TSCA Inventory All components listed on inventory or are exempt.
EINECS Inventory This product, and all its components, complies with EINECS

Classification Not Classified

Risk Phrases None

Safety Phrases None

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Contact

Australian Poisons Information Centre
24 Hour Service: - 13 11 26
Police or Fire Brigade: - 000 (exchange): - 1100

New Zealand National Poisons Centre
0800 764 766

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **SODIUM CHLORIDE**

Revision Date: 04-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: SODIUM CHLORIDE
Synonyms: None
Chemical Family: Salt
Application: Additive

Company Undertaking Identification

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Sodium chloride	7647-14-5	60 - 100%	231-598-3	10 mg/m^3	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Under normal conditions, first aid procedures are not required.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust.
Storage Information	Store in a cool, dry location.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	Not Determined
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	35.7
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	None known.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 3000 mg/kg (Rat)
Dermal Toxicity:	Not determined

Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not applicable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Not Classified
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **STARCIDE®**

Revision Date: 30-Apr-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STARCIDE®
Synonyms: None
Chemical Family: Oxazolidine
Application: Bactericide

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
R34 Causes burns.
R21/22 Harmful in contact with skin and if swallowed.

Hazard Overview May cause eye and skin burns. May cause respiratory irritation. May be harmful if swallowed.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
N, N' -Methylene bis (5-methyl oxazolidine)	66204-44-2	90 - 100%	266-235-8	Not applicable	Not applicable	Not applicable	C; Xn; R21/22-34

4. FIRST AID MEASURES

Inhalation	If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably mouth-to-mouth. If breathing is difficult give oxygen. Get medical attention.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 15 minutes. Get medical attention. Remove contaminated clothing and launder before reuse.
Eyes	In case of contact, or suspected contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention immediately after flushing.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	Water fog, carbon dioxide, foam, dry chemical.
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Decomposition in fire may produce toxic gases.
Special Protective Equipment for Fire-Fighters	Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	Prevent from entering sewers, waterways, or low areas.
Procedure for Cleaning / Absorption	Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Wash hands after use. Launder contaminated clothing before reuse. Avoid breathing mist.
Storage Information	Store away from oxidizers. Store away from acids. Store in a cool well ventilated area. Keep container closed when not in use. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	Use in a well ventilated area.
Respiratory Protection	If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Not normally needed. But if significant exposures are possible then the following respirator is recommended: Organic vapor respirator.

Hand Protection	Impervious rubber gloves. Butyl rubber gloves. Nitrile gloves.
Skin Protection	Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Liquid
Color:	Light yellow
Odor:	Sweet amine
pH:	10
Specific Gravity @ 20 C (Water=1):	1.05
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	116
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined**Min:** > 100
Flash Point Method:	DIN 51758
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	< 1
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Soluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	1.89
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers. Strong acids. Reducing agents.
Hazardous Decomposition Products	Formaldehyde. Oxides of nitrogen. Oxides of sulfur.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.

Inhalation	May cause respiratory irritation.
Skin Contact	Causes severe skin irritation. May cause skin burns.
Eye Contact	Causes severe eye irritation May cause eye burns.
Ingestion	Harmful if swallowed.
Aggravated Medical Conditions	Skin disorders. Eye ailments.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 900 mg/kg (Rat)
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Readily biodegradable
Bio-accumulation	Will not bio-accumulate.

Ecotoxicological Information

Acute Fish Toxicity:	LC50: 57.7 mg/l (Brachidanio rerio)
Acute Crustaceans Toxicity:	EC50: 37.9 mg/l (Daphnia magna)
Acute Algae Toxicity:	IC50: 5.7 mg/l (Scenedesmus subspicatus)
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Disposal should be made in accordance with federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR

UN3267,Corrosive Liquid, Basic, Organic, N.O.S.(Contains N, N' -Methylenebis[5-methyl oxazolidine]), 8, III

Air Transportation

ICAO/IATA

UN3267,Corrosive Liquid, Basic, Organic, N.O.S., 8, III
(Contains N, N' -Methylenebis[5-methyl oxazolidine] Solution)

Sea Transportation

IMDG

UN3267,Corrosive Liquid, Basic, Organic, N.O.S.(Contains N, N' -Methylenebis[5-methyl oxazolidine]), 8, III
EmS F-A, S-B

Other Shipping Information

Labels: Corrosive

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification C - Corrosive.

Risk Phrases
R34 Causes burns.
R21/22 Harmful in contact with skin and if swallowed.

Safety Phrases
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S28 After contact with skin, wash immediately with plenty of soap and water.
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 1: Low hazard to waters.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Component Classification

C - Corrosive.
Xn - Harmful.
R21/22 Harmful in contact with skin and if swallowed.
R34 Causes burns.

Disclaimer Statement

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*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET (2001/58/EC)

Product Trade Name: **STEELSEAL®**

Revision Date: 05-Jan-2010

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STEELSEAL®
Synonyms: None
Chemical Family: Graphite
Application: Loss Circulation Material

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview
May cause eye and respiratory irritation. May cause delayed injury to lungs. Airborne dust may be explosive.

3. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	EINECS	UK WEL	Germany MAK/TRK	Netherlands MAC	EEC Classification
Calcined petroleum coke	64743-05-1	60 - 100%	265-210-9	Not applicable	Not applicable	Not applicable	Not applicable

4. FIRST AID MEASURES

Inhalation
If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin
Wash with soap and water. Get medical attention if irritation persists.

Eyes	In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Ingestion	Do not induce vomiting. Slowly dilute with 1-2 glasses of water or milk and seek medical attention. Never give anything by mouth to an unconscious person.
Notes to Physician	Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media	All standard fire fighting media
Unsuitable Extinguishing Media	None known.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment. Avoid creating and breathing dust.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid creating or inhaling dust. Avoid dust accumulations. Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and dark procedures for low oxygen levels should be taken to ensure ample oxygen availability.
Storage Information	Store away from oxidizers. Store in a dry location. Keep from heat, sparks, and open flames. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls	A well ventilated area to control dust levels.
Respiratory Protection	Not normally needed. But if significant exposures are possible then the following respirator is recommended: Dust/mist respirator. (95%)
Hand Protection	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Wear safety glasses or goggles to protect against exposure.
Other Precautions	None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	Dark gray

9. PHYSICAL AND CHEMICAL PROPERTIES

Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.75
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	4200
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 356
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	1
Vapor Density (Air=1):	0.4
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause mild gastric distress.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.

Other Information None known.

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Not determined

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not Determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined
Acute Algae Toxicity: Not determined

Chemical Fate Information Not determined

Other Information Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method Bury in a licensed landfill according to federal, state, and local regulations.

Contaminated Packaging Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **STOP-FRAC D**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: STOP-FRAC D
Synonyms: None
Chemical Family: Blend
Application: Sealing and Plugging Agent

Company Undertaking Identification
Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview May cause eye, skin, and respiratory irritation.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Limestone	1317-65-3	10 - 30%	215-279-6	Not applicable
Graphite	7782-42-5	10 - 30%	231-955-3	Not applicable
Carbon	7440-44-0	10 - 30%	231-153-3	Not applicable
Cellulose	9004-34-6	5 - 10%	232-674-9	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion If swallowed, induce vomiting immediately by giving two glasses of water and sticking fingers down throat; never give anything to an unconscious person. Get medical attention.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media All standard fire fighting media

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Not applicable.

Special Protective Equipment for Fire-Fighters Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust. Avoid dust accumulations.

Storage Information Store in a dry location. Keep from heat, sparks, and open flames. Store away from oxidizers. Product has a shelf life of 12 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls A well ventilated area to control dust levels.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Limestone	Not applicable	10 mg/m^3	10 mg/m^3	10 mg/m^3	Not applicable
Graphite	Not applicable	10 mg/m^3	2 mg/m^3	2 mg/m^3	6 mg/m^3
Carbon	Not applicable	10 mg/m^3	10 mg/m^3	Not applicable	10 mg/m^3

Cellulose	Not applicable	10 mg/m^3	2 mg/m^3	10 mg/m^3	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Limestone	Not applicable	Not applicable	10 mg/m^3	10.0 mg/m^3	Not applicable
Graphite	Not applicable	4.0 mg/m^3	Not applicable	2.0 mg/m^3	Not applicable
Carbon	Not applicable	4.0 mg/m^3	Not applicable	Not applicable	Not applicable
Cellulose	Not applicable	Not applicable	Not applicable	6.0 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Pellet
Color:	Black
Odor:	Mild
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.5
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	> 356
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong acids. Strong alkalis.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	May cause mild skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause mild gastric distress.
Aggravated Medical Conditions	Skin disorders.
Chronic Effects/Carcinogenicity	Prolonged, excessive exposure to dust may cause pneumoconiosis, a lung disease caused by inhaling dust particles less than 0.5 micrometers into the lungs.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	Not determined
Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Not determined
Bio-accumulation	Not determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	Not determined
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels: None

15. REGULATORY INFORMATION

EC Supply labeling Requirements This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.

Classification Not Classified

Risk Phrases None

Safety Phrases None

EINECS Inventory This product, and all its components, complies with EINECS

Germany, Water Endangering Classes (WGK) WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

SAFETY DATA SHEET

Product Trade Name: **TUNED SPACER E+**

Revision Date: 04-Jan-2011

1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND OF THE COMPANY/UNDERTAKING

Identification of Substances or Preparation

Product Trade Name: TUNED SPACER E+
Synonyms: None
Chemical Family: Mineral
Application: Cement Spacer

Company Undertaking Identification

Halliburton Energy Services
Halliburton House, Howemoss Place
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

Prepared By

Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. HAZARDS IDENTIFICATION

Risk Phrases
None

Hazard Overview

CAUTION! - ACUTE HEALTH HAZARD
May cause eye and respiratory irritation.

DANGER! - CHRONIC HEALTH HAZARD
Breathing crystalline silica can cause lung disease, including silicosis and lung cancer. Crystalline silica has also been associated with scleroderma and kidney disease.

This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposures below recommended exposure limits. Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product. Review the Material Safety Data Sheet (MSDS) for this product, which has been provided to your employer.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	CAS Number	PERCENT	EINECS	EEC Classification
Crystalline silica, quartz	14808-60-7	1 - 5%	238-878-4	Not applicable
Bentonite	1302-78-9	60 - 100%	215-108-5	Not applicable
Crystalline silica, tridymite	15468-32-3	0 - 1%	239-487-1	Not applicable
Crystalline silica, cristobalite	14464-46-1	0 - 1%	238-455-4	Not applicable

4. FIRST AID MEASURES

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.

Skin Wash with soap and water. Get medical attention if irritation persists.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Treat symptomatically.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons None known.

Special Exposure Hazards Decomposition in fire may produce toxic gases.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Avoid creating and breathing dust.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Collect using dustless method and hold for appropriate disposal. Consider possible toxic or fire hazards associated with contaminating substances and use appropriate methods for collection, storage and disposal.

7. HANDLING AND STORAGE

Handling Precautions This product contains quartz, cristobalite, and/or tridymite which may become airborne without a visible cloud. Avoid breathing dust. Avoid creating dusty conditions. Use only with adequate ventilation to keep exposure below recommended exposure limits. Wear a NIOSH certified, European Standard En 149, or equivalent respirator when using this product. Material is slippery when wet.

Storage Information Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Do not reuse empty container.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use approved industrial ventilation and local exhaust as required to maintain exposures below applicable exposure limits listed in Section 2.

Respiratory Protection Wear a NIOSH certified, European Standard EN 149, or equivalent respirator when using this product.

Hand Protection Normal work gloves.

Skin Protection Wear clothing appropriate for the work environment. Dusty clothing should be laundered before reuse. Use precautionary measures to avoid creating dust when removing or laundering clothing.

Eye Protection Wear safety glasses or goggles to protect against exposure.

Other Precautions None known.

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Crystalline silica, quartz	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.1 mg/m^3	0,15 mg/m^3
Bentonite	Not applicable	10 mg/m^3	Not applicable	Not applicable	Not applicable
Crystalline silica, tridymite	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.05 mg/m^3	Not applicable
Crystalline silica, cristobalite	Not applicable	0.1 mg/m^3	0,075 mg/m^3	0.05 mg/m^3	0,15 mg/m^3

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Crystalline silica, quartz	Not applicable	2 mg/m^3	0.15 mg/m^3	Not applicable	Not applicable
Bentonite	Not applicable	Not applicable	Not applicable	6.0 mg/m^3	Not applicable
Crystalline silica, tridymite	Not applicable	2 mg/m^3	0.15 mg/m^3	0.1 mg/m^3	Not applicable
Crystalline silica, cristobalite	Not applicable	2 mg/m^3	0.15 mg/m^3	0.1 mg/m^3	Not applicable

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White to light straw
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	2.65
Density @ 20 C (kg/l):	Not Determined
Bulk Density @ 20 C (kg/m^3):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (C):	Not Determined
Pour Point/Range (C):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (g/m^3):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Upper (g/m^3):	Not Determined
Flammability Limits in Air - Upper (%):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	5
Solubility in Solvents (g/100ml):	Not Determined
VOCs (g/l):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined

9. PHYSICAL AND CHEMICAL PROPERTIES

Molecular Weight (g/mole):	Not Determined
Decomposition Temperature (C):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Oxides of sulfur. Carbon monoxide and carbon dioxide. Amorphous silica may transform at elevated temperatures to tridymite (870 C) or cristobalite (1470 C).
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	Inhaled crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (IARC, Group 1). There is sufficient evidence in experimental animals for the carcinogenicity of tridymite (IARC, Group 2A). Breathing silica dust may cause irritation of the nose, throat, and respiratory passages. Breathing silica dust may not cause noticeable injury or illness even though permanent lung damage may be occurring. Inhalation of dust may also have serious chronic health effects (See "Chronic Effects/Carcinogenicity" subsection below).
Skin Contact	May cause mechanical skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	None known
Aggravated Medical Conditions	Individuals with respiratory disease, including but not limited to asthma and bronchitis, or subject to eye irritation, should not be exposed to quartz dust.

Chronic Effects/Carcinogenicity

Silicosis: Excessive inhalation of respirable crystalline silica dust may cause a progressive, disabling, and sometimes-fatal lung disease called silicosis. Symptoms include cough, shortness of breath, wheezing, non-specific chest illness, and reduced pulmonary function. This disease is exacerbated by smoking. Individuals with silicosis are predisposed to develop tuberculosis.

Cancer Status: The International Agency for Research on Cancer (IARC) has determined that crystalline silica inhaled in the form of quartz or cristobalite from occupational sources can cause lung cancer in humans (Group 1 - carcinogenic to humans) and has determined that there is sufficient evidence in experimental animals for the carcinogenicity of tridymite (Group 2A - possible carcinogen to humans). Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997) in conjunction with the use of these minerals. The National Toxicology Program classifies respirable crystalline silica as "Known to be a human carcinogen". Refer to the 9th Report on Carcinogens (2000). The American Conference of Governmental Industrial Hygienists (ACGIH) classifies crystalline silica, quartz, as a suspected human carcinogen (A2).

There is some evidence that breathing respirable crystalline silica or the disease silicosis is associated with an increased incidence of significant disease endpoints such as scleroderma (an immune system disorder manifested by scarring of the lungs, skin, and other internal organs) and kidney disease.

Other Information

For further information consult "Adverse Effects of Crystalline Silica Exposure" published by the American Thoracic Society Medical Section of the American Lung Association, American Journal of Respiratory and Critical Care Medicine, Volume 155, pages 761-768 (1997).

Toxicity Tests

Oral Toxicity: Not determined

Dermal Toxicity: Not determined

Inhalation Toxicity: Not determined

Primary Irritation Effect: Not determined

Carcinogenicity Refer to IARC Monograph 68, Silica, Some Silicates and Organic Fibres (June 1997).

Genotoxicity: Not determined

Reproductive / Developmental Toxicity: Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air) Not determined

Persistence/Degradability Not determined

Bio-accumulation Not determined

Ecotoxicological Information

Acute Fish Toxicity: Not determined
Acute Crustaceans Toxicity: Not determined

Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Transportation Information

Labels:	None

15. REGULATORY INFORMATION

EC Supply labeling Requirements	This product is not subject to the labeling requirements of EC Directives 67/548/EEC and 88/379/EEC as amended.
Classification	Crystalline silica is not classified as a carcinogen in EU Council Directives 67/548/EEC and 88/379/EEC.
Risk Phrases	None
Safety Phrases	None
EINECS Inventory	This product, and all its components, complies with EINECS
Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

16. Other Information

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

*****END OF MSDS*****

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **WALL-NUT® MEDIUM**

Revision Date: 05-Jan-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: WALL-NUT® MEDIUM
Synonyms: None
Chemical Family: Nut Hulls
Application: Loss Circulation Material

Manufacturer/Supplier
Baroid Fluid Services
Product Service Line of Halliburton
P.O. Box 1675
Houston, TX 77251
Telephone: (281) 871-4000
Emergency Telephone: (281) 575-5000

Prepared By
Chemical Compliance
Telephone: 1-580-251-4335
e-mail: fdunexchem@halliburton.com

2. COMPOSITION/INFORMATION ON INGREDIENTS

SUBSTANCE	CAS Number	PERCENT	ACGIH TLV-TWA	OSHA PEL-TWA
Walnut hulls	Mixture	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye irritation.

4. FIRST AID MEASURES

Inhalation Under normal conditions, first aid procedures are not required.

Skin Under normal conditions, first aid procedures are not required.

Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.

Ingestion Under normal conditions, first aid procedures are not required.

Notes to Physician Not Applicable

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Lower (oz./ft3):	0.07
Flammability Limits in Air - Upper (%):	Not Determined

Fire Extinguishing Media Water fog, carbon dioxide, foam, dry chemical.

Special Exposure Hazards Organic dust in the presence of an ignition source can be explosive in high concentrations. Good housekeeping practices are required to minimize this potential.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

NFPA Ratings: Health 0, Flammability 0, Reactivity 0
HMIS Ratings: Health 0, Flammability 0, Reactivity 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment.

Environmental Precautionary Measures None known.

Procedure for Cleaning / Absorption Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid creating or inhaling dust.

Storage Information Store away from oxidizers. Store in a dry location. Product has a shelf life of 60 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area.

Respiratory Protection Not normally needed. But if significant exposures are possible then the following respirator is recommended:
Dust/mist respirator. (95%)

Hand Protection Normal work gloves.

Skin Protection Normal work coveralls.

Eye Protection Safety glasses.

Other Precautions None known.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Solid

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Brown
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.2
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	45
Boiling Point/Range (F):	Not Determined
Boiling Point/Range (C):	Not Determined
Freezing Point/Range (F):	Not Determined
Freezing Point/Range (C):	Not Determined
Vapor Pressure @ 20 C (mmHg):	Not Determined
Vapor Density (Air=1):	Not Determined
Percent Volatiles:	Not Determined
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubility in Solvents (g/100ml):	Not Determined
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	Not Determined
Viscosity, Kinematic @ 20 C (centistrokes):	Not Determined
Partition Coefficient/n-Octanol/Water:	Not Determined
Molecular Weight (g/mole):	Not Determined

10. STABILITY AND REACTIVITY

Stability Data:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid	None known.
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	None known.
Additional Guidelines	Not Applicable

11. TOXICOLOGICAL INFORMATION

Principle Route of Exposure	Eye or skin contact, inhalation.
Inhalation	May cause mild respiratory irritation.
Skin Contact	None known.
Eye Contact	May cause mild eye irritation.
Ingestion	None known
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% are chronic health hazards.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	Not determined

Dermal Toxicity:	Not determined
Inhalation Toxicity:	Not determined
Primary Irritation Effect:	Not determined
Carcinogenicity	Not determined
Genotoxicity:	Not determined
Reproductive / Developmental Toxicity:	Not determined

12. ECOLOGICAL INFORMATION

Mobility (Water/Soil/Air)	Not determined
Persistence/Degradability	Biodegradable
Bio-accumulation	Not Determined

Ecotoxicological Information

Acute Fish Toxicity:	Not determined
Acute Crustaceans Toxicity:	TLM96: > 1,000,000 ppm (Mysidopsis bahia) SPP @ 10 ppb
Acute Algae Toxicity:	Not determined
Chemical Fate Information	Not determined
Other Information	Not applicable

13. DISPOSAL CONSIDERATIONS

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

Land Transportation

DOT
Not restricted

Canadian TDG
Not restricted

ADR
Not restricted

Air Transportation

ICAO/IATA
Not restricted

Sea Transportation

IMDG
Not restricted

Other Shipping Information

Labels: None

15. REGULATORY INFORMATION

US Regulations

US TSCA Inventory	All components listed on inventory or are exempt.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	None
EPA SARA (313) Chemicals	This product does not contain a toxic chemical for routine annual "Toxic Chemical Release Reporting" under Section 313 (40 CFR 372).
EPA CERCLA/Superfund Reportable Spill Quantity	Not applicable.
EPA RCRA Hazardous Waste Classification	If product becomes a waste, it does NOT meet the criteria of a hazardous waste as defined by the US EPA.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
MA Right-to-Know Law	Does not apply.
NJ Right-to-Know Law	Does not apply.
PA Right-to-Know Law	Does not apply.

Canadian Regulations

Canadian DSL Inventory	All components listed on inventory.
WHMIS Hazard Class	Un-Controlled

16. OTHER INFORMATION

The following sections have been revised since the last issue of this MSDS
Not applicable

Additional Information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Material Safety Data Sheet for this or other Halliburton products, contact Chemical Compliance at 1-580-251-4335.

Disclaimer Statement

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END OF MSDS

HALLIBURTON

SAFETY DATA SHEET

WellLife™ 734

Revision Date: 21-Apr-2011 **Revision Number:** 5

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product Identifier

Product Name WellLife™ 734

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use Cement Enhancer

Uses Advised Against No information available

Details of the supplier of the safety data sheet

Halliburton Manufacturing Services, Ltd.
Halliburton House, Howemoss Crescent
Kirkhill Industrial Estate
Dyce
Aberdeen, AB21 0GN
United Kingdom

Emergency Phone Number: +44 1224 795277 or +1 281 575 5000

www.halliburton.com

For further information, please contact

E-Mail address: fdunexchem@halliburton.com

Emergency telephone number

+44 1224 795277 or +1 281 575 5000

Emergency telephone §45 - (EC)1272/2008	
Europe	**112**
Denmark	Poison Control Hotline (DK): +45 82 12 12 12
France	ORFILA (FR): + 01 45 42 59 59
Germany	Poison Center Berlin (DE): +49 030 30686 790
Italy	Poison Center, Milan (IT): +39 02 6610 1029
Netherlands	National Poisons Information Center (NL): +31 30 274 88 88 (NB: this service is only available to health professionals)
Norway	Poisons Information (NO):+ 47 22 591300
Poland	Poison Control and Information Centre, Warsaw (PL): +48 22 619 66 54; +48 22 619 08 97
Spain	Poison Information Service (ES): +34 91 562 04 20
United Kingdom	NHS Direct (UK): +44 0845 46 47

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Classification Not Classified

2. HAZARDS IDENTIFICATION

Risk Phrases None

Label Elements
Not classified

Signal Word **None**

Other Hazards
None known

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substances	EINECS	CAS Number	PERCENT	EEC Classification	EU - CLP Substance Classification	REACH No.
Glass	Listed	Proprietary	60 - 100%	Not applicable	Not applicable	No data available

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first aid measures

Inhalation Under normal conditions, first aid procedures are not required.
Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin Under normal conditions, first aid procedures are not required.
Ingestion Under normal conditions, first aid procedures are not required.

Most Important symptoms and effects, both acute and delayed
No significant hazards expected.

Indication of any immediate medical attention and special treatment needed
Notes to Physician Treat symptomatically

5. FIREFIGHTING MEASURES

Extinguishing media
Suitable Extinguishing Media
All standard fire fighting media
Extinguishing media which must not be used for safety reasons
None known.

Special hazards arising from the substance of mixture
Special Exposure Hazards
Not applicable.

Advice for firefighters
Special Protective Equipment for Fire-Fighters
Not applicable.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment.
See Section 12 for additional information

Environmental precautions
None known.

Methods and material for containment and cleaning up
Scoop up and remove.

Reference to other sections
See Section 12 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Material is slippery underfoot. Keep floors clean of spills.
Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice

Conditions for safe storage, including any incompatibilities
Store in a dry location. Product has a shelf life of 60 months.

Specific End Use(s)
Exposure Scenario No information available
Other Guidelines No information available

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Substances	EU	UK OEL	Netherlands	France OEL	Germany MAK/TRK
Glass	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Substances	Italy	Poland	Hungary	Czech Republic	Denmark
Glass	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Derived No Effect Level (DNEL) No information available.
Predicted No Effect Concentration (PNEC) No information available.

Exposure controls
Engineering Controls None known.
Personal protective equipment
Respiratory Protection Not normally necessary.

Hand Protection Normal work gloves.
Skin Protection Normal work coveralls.
Eye Protection Wear safety glasses or goggles to protect against exposure.
Other Precautions None known.
Environmental Exposure Controls No information available

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties
Physical State: Solid **Color:** White to Variable
Odor: Odorless

Property Remarks/ Method	Values
pH:	No data available
Melting Point/Range	No data available
Freezing Point/Range (C):	1200
Boiling Point/Range	No data available
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available

9. PHYSICAL AND CHEMICAL PROPERTIES

Vapor Density	No data available
Specific Gravity	2.62
Water Solubility	No data available
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

Other information

VOC Content (%)	No data available

10. STABILITY AND REACTIVITY

Reactivity
Not applicable
Chemical Stability
Stable
Possibility of Hazardous Reactions
Will Not Occur
Conditions to Avoid
None anticipated
Incompatible Materials
None known.
Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on Toxicological Effects
Acute Toxicity

Inhalation	None known.
Eye Contact	May cause mechanical irritation to eye.
Skin Contact	None known.
Ingestion	None known

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 1% are chronic health hazards.

Substances	LD50 Oral	LD50 Dermal	LC50 Inhalation
Glass	No data available	No data available	No data available

12. ECOLOGICAL INFORMATION

Toxicity
Ecotoxicity Effects

Substances	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Daphnia Magna (Water Flea)
Glass	No information available	No information available	No information available	TLM96: > 1,000,000 ppm (Mysidopsis bahia)

Persistence and degradability
No information available

Bioaccumulative potential
No information available

Mobility in soil
No information available

Results of PBT and vPvB assessment
No information available.

Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal Method	Bury in a licensed landfill according to federal, state, and local regulations.
Contaminated Packaging	Follow all applicable national or local regulations.

14. TRANSPORT INFORMATION

IMDG/IMO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

RID

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

ADR

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

IATA/ICAO

UN Number:	Not restricted.
UN Proper Shipping Name:	Not restricted
Transport Hazard Class(es):	Not applicable

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories

EINECS Inventory	This product, and all its components, complies with EINECS
US TSCA Inventory	All components listed on inventory or are exempt.
Canadian DSL Inventory	All components listed on inventory or are exempt.

Legend
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List

Germany, Water Endangering Classes (WGK)	WGK 0: Generally not water endangering.

Chemical Safety Assessment
No information available

16. OTHER INFORMATION

Full text of R-phrases referred to under Sections 2 and 3
None

Key literature references and sources for data
www.ChemADVISOR.com/

Revision Date:	21-Apr-2011
Revision Note	Not applicable

This safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006

Disclaimer Statement
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End of Safety Data Sheet

APPENDIX F

Drilling Mud Processing and Treatment

INTRODUCTION

This report gives an overall of mud processing equipment and indicates what is installed on the *ENSCO 5006*. A normal mud processing routing includes flowing through scalper shakers and shale shakers into a settling/processing pit (sand traps). Once in the sand traps the mud can be circulated and processed by equipment including degasser, mud cleaner, desander, desilter and centrifuge.

SCALPER SHAKER

The Scalper Shaker is designed to remove larger, sticky particles normally from clay type formations and allows the shale shakers to operate more efficiently. The Belt type scalper utilizes a variable speed conveyor screen belt to transport solids off the machine without vibration. The mesh screening on the conveyor belt is a larger size than that installed in the Gumbo box. The conveyor bed is set on an upward pitch, which allows a high flow rate to be easily processed.

The *ENSCO 5006* has two Derrick Flo-Line Scalper installed immediately downstream of the gumbo box.

SHALE SHAKERS

Shale shakers separate solids from liquids by utilizing a vibrating basket, which is outfitted with specially designed and sized screens. These units remove the majority of drilled solids generated during the typical drilling process. Shale shakers can generate up to eight G-forces of energy for removing solids from the mud system. Shale shakers are generally designed around a 4-panel arrangement with 2 vibrating motors which provide the linear motion. The screen panels vary in type plus mesh size and are easily replaced and interchanged, giving numerous combinations to best suit drilling operations. One shaker can process up to 900 GPM of low weight drilling fluid. The *ENSCO 5006* has five FLC 514 4-Panel shakers installed immediately downstream from scalper shakers and flow divider.

MUD CLEANER

The mud cleaner consists of a desander and desilter in which the underflow is further processed by a fine vibrating screen, mounted directly under the cones. The liquid underflow from the screens is fed back into the mud, thus conserving weighting agent and the liquid phase but at the same time returning many fine solids to the active system. A hydrocyclone is also present, consisting of an inverted cone. A volume of mud is pumped into the wide upper section of the hydrocyclone; as the mud flows around and gradually down the inside of the cone shape, solids are separated from the liquid by centrifugal forces. The solids continue around and down until they exit the bottom of the hydrocyclone, while the cleaned liquid exits at the top and returns to the system.

The *ENSCO 5006* has one Derrick FLC 500 Mud Cleaner installed in the shaker house and lined up with the processing pits.

DESANDER

A desander is a hydrocyclone device which removes drilled solids from the drilling fluid. The hydrocyclones are generally greater than 5 inches in diameter. Desanders are installed downstream fromthe shale shakers to remove solids which have passed through the shale shaker screens. A 6 inch hydrocyclone will generally remove silt down to a 25 micron size.

The ENSCO 5006 has a Derrick desander integrated with the mud cleaner that has three 10 inch hydrocyclones.

DESILTER

A desilter is a hydrocyclone device, designed to separate the fine solids, like sand and silt from thedrilling fluids the 4 inch hydrocyclones will remove finer silt down to a 15 micron size, dependant on the model.

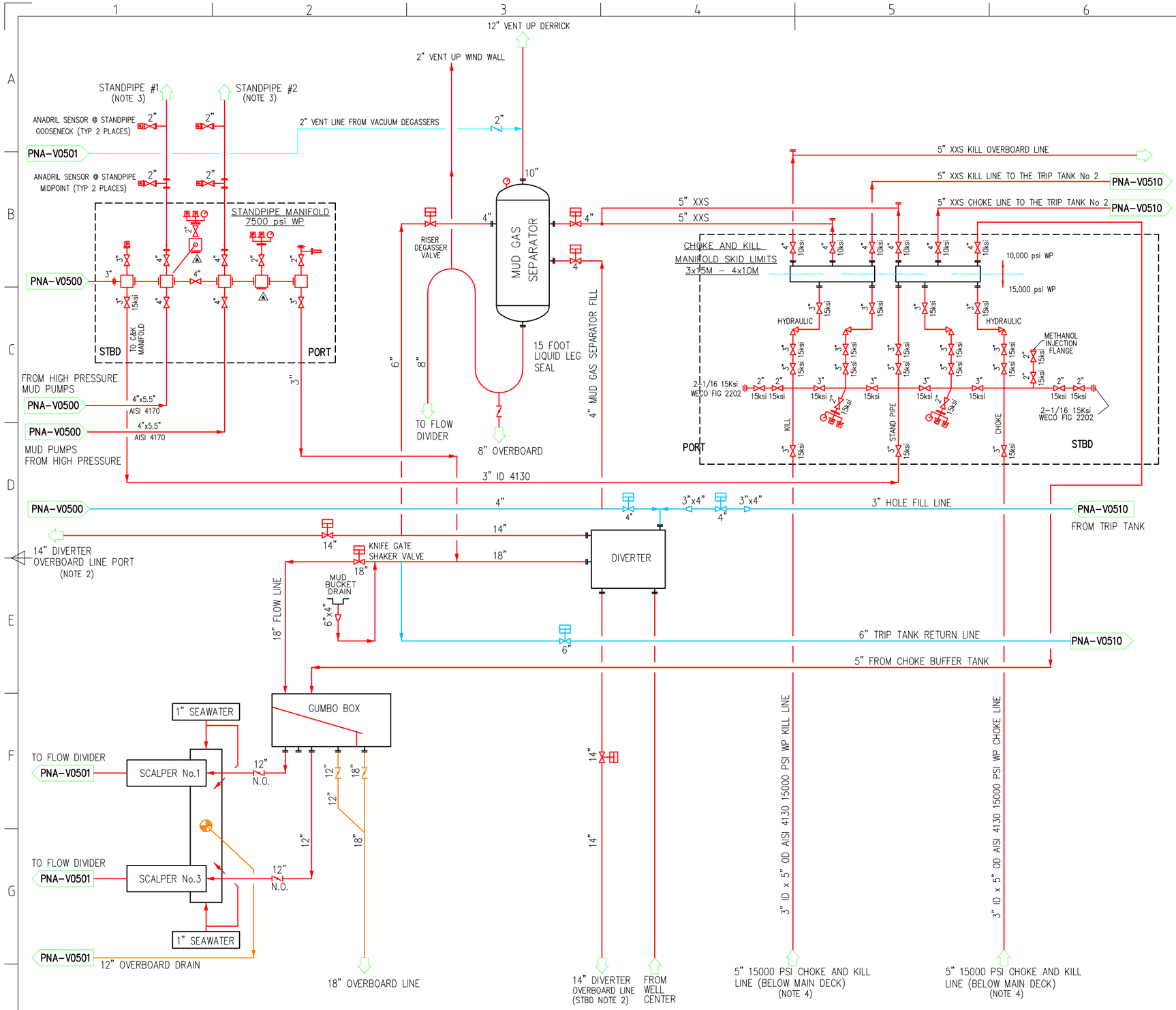
The *ENSCO 5006* has two Derrick desilters. One is integrated with the mud cleaner that has twenty 4 inch hydrocyclones installed. The second is mounted over shaker #3 and also has twenty 4 inch hydrocyclones installed.

DEGASSER

A horizontal vacuum degasser uses a vacuum pump to pull a vacuum on the mud drawn into the degassing chamber where decreased pressure causes gas bubbles to surface from the fluid more rapidly.

The *ENSCO 5006* has two Swaco Horizontal Degassers installed in the shaker house, lined up with the processing pits.

Components of the ENSCO 5006 mud treatment and processing systems are provided in the attached diagrams.



SYMBOLS

BUTTERFLY VALVE	GLOBE VALVE	COMPANY SUBCONTRACTOR
GATE VALVE	BALL VALVE	HP or SUCTION
HYDRAULIC GATE VALVE	HUB ADAPTOR	LP or DISCHARGE
PLUG VALVE	MUD GUN	DUMP LINE
ADJUSTABLE CHOKE	AGITATOR	TEMPORARY LINE
RELIEF VALVE	FLEXIBLE JOINT	TEMPORARY LINE
CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE	MIXER HOPPER	
HAMMER UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
QUICK UNION		PG PRESSURE GAUGE
CONCENTRIC REDUCER		

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
–	–	–	–

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
GUMBO BOX	BRANDT	NUTEC MUD BOX
SCALPER N° 1	DERRICK	FLOW LINE SCALPER
SCALPER N° 2	DERRICK	FLOW LINE SCALPER
MUD GAS SEPARATOR	STI Eng.	48" OD x 15 FT HIGHT

–NOTES–

1. BRINE, MULTIPURPOSE FLUID, SEAWATER, SYNTHETIC MUD, LOADING BUNKERS AND DRILL WATER SHOWN ON THERE RESPECTIVE P&ID's.
2. DIVERTER OVERBOARD PIPING IS TARGETED WITH 3D CUSHIONED TEES.
3. ROTARY HOSES ARE 7500 PSI WORKING PRESSURE, 4–1/16 10KSI BX–155 BY FIGURE 1002 FEMALE UNION 4" ID x 83 FT. WITH STAINLESS STEEL ARMOR.
4. SUPER CHOKE AND KILL, STAINLESS STEEL ARMORED, FIRE RESISTANT, 3" ID x 83 FT., 15,000 PSI WORKING PRESSURE, 3–1/8 15ksi BX–154 BY 3–1/8 15ksi NO 6 HUB, H2S SERVICE.

DRAWING ISSUED FROM DWG N° 325.1035 (MARINE DRILLING)

REVISED TO ENSCO STANDARDS	Fa	19.09.11	C. ALLRED	M. DIEHL
UPDATED AFTER SURVEY NOV. 2009	F	15.01.10	DURGEAU G.	SOULE F.
UPDATED	E	25.08.09	DURGEAU G.	SOULE F.
UPDATED AND CHANGED NUMBER OF DWG	D	13.09.07	DAVID.L	FERRAN.P
UPDATE AFTER VISIT MB / JAN 2007	C	31.01.07	DURGEAU.G	BARDES.M
UPDATE AFTER VISIT MB / MAY 2005	B	20.05.05	DAVID.L	DURGEAU.G
UPDATED – COMMENT'S DNV 01.09.2004	A	18.04.05	DAVID.L	DURGEAU.G
REVISION	N°	DATE (D.M.Y)	DRAWN	APPR'D

ENSCO 5006 / PNA

HP MUD CONNECTION

DWN: DAVID.L	CKD: DURGEAU G.	APPR'D: FERRAN.P
SCALE: NONE (A2)	DATE: 06.02.2003	SHEET: 1/2

ENSCO

5847 SAN FELIPE #3300, HOUSTON, TX 77057 WWW.ENSCOPLC.COM

DWG N° PNA-321-D-V0500 REV Fa

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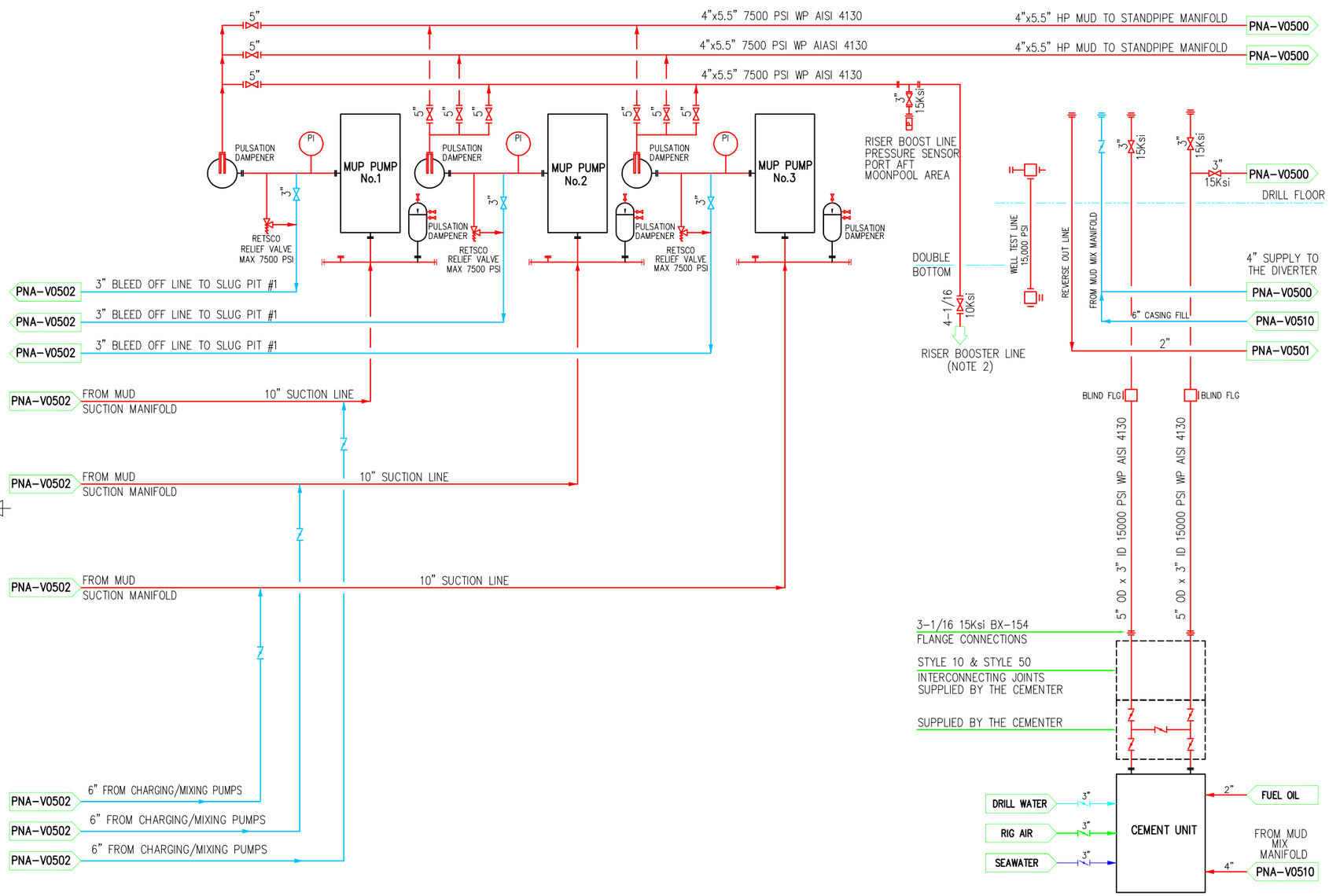

SYMBOLS

BUTTERFLY VALVE	GLOBE VALVE	COMPANY SUBCONTRACTOR
GATE VALVE	BALL VALVE	HP or SUCTION
HYDRAULIC GATE VALVE	HUB ADAPTOR	LP or DISCHARGE
PLUG VALVE	MUD GUN	DUMP LINE
ADJUSTABLE CHOKE	AGITATOR	TEMPORARY LINE
RELIEF VALVE	FLEXIBLE JOINT	TEMPORARY LINE
CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE	MIXER HOPPER	
HAMMER UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
QUICK UNION		PG PRESSURE GAUGE
CONCENTRIC REDUCER		

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
–	–	–	–

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
HP MUD PUMP N° 1	NATIONAL	TRIPLEX 14 P 220 – 7500 psi WP
HP MUD PUMP N° 2	NATIONAL	TRIPLEX 14 P 220 – 7500 psi WP
HP MUD PUMP N° 3	NATIONAL	TRIPLEX 14 P 220 – 7500 psi WP

–NOTES–

1. BRINE, MULTIPURPOSE FLUID, SEAWATER, SYNTHETIC MUD, LOADING BUNKERS AND DRILL WATER SHOWN ON THERE RESPECTIVE P&ID's.
2. RISER BOOST LINE TERMINATES WITH AN 83 FT. 7500 psi WORKING PRESSURE, 4" ID, SUPER DRILL HOSE WITH A 4-1/16", 10KSI, NO. 6 HUB.

DRAWING ISSUED FROM DWG N° 325.1034 (MARINE DRILLING)

REVISION	N°	DATE (D.M.Y)	DRAWN	APPR'D
REVISED TO ENSCO STANDARDS	Fa	19.09.11	C. ALLRED	M. DIEHL
UPDATED AFTER SURVEY NOV. 2009	F	15.01.10	DURGEAU G.	SOULE F.
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UPDATED – COMMENT'S DNV 01.09.2004	A	18.04.05	DAVID.L	DURGEAU.G

PRIDE NORTH AMERICA

HP MUD PUMP DIAGRAM

DWN: DAVID.L	CKD: DURGEAU G.	APPR'D: FERRAN.P
SCALE: NONE (A2)	DATE: 06.02.2003	SHEET: 2/2

DWG N° PNA-321-D-V0500 REV Fa

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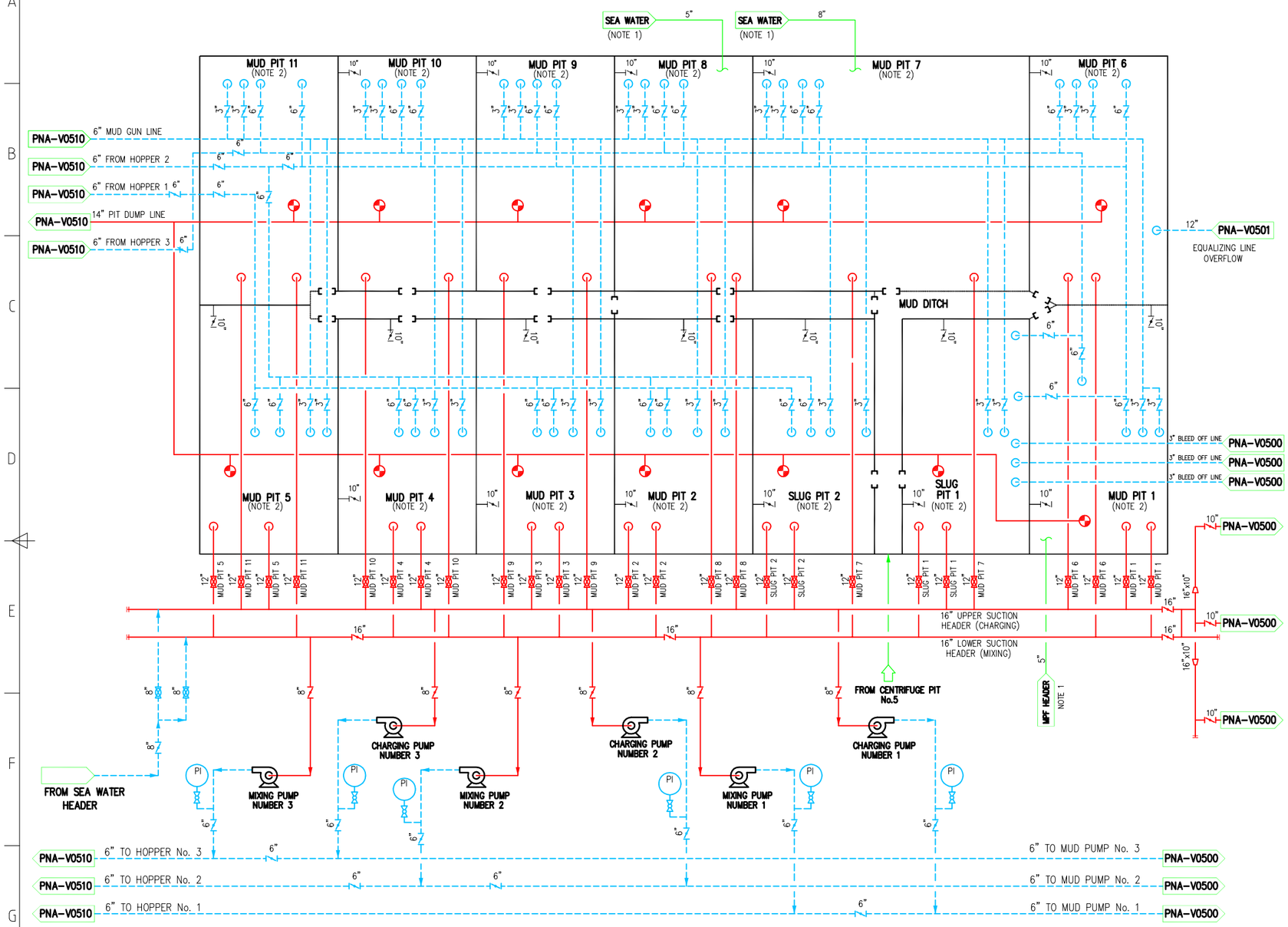

UNDER FLOW BETWEEN ALL TANKS

SYMBOLS

BUTTERFLY VALVE	GLOBE VALVE	COMPANY SUBCONTRACTOR
GATE VALVE	BALL VALVE	HP or SUCTION
HYDRAULIC GATE VALVE	HUB ADAPTOR	LP or DISCHARGE
PLUG VALVE	MUD GUN	DUMP LINE
ADJUSTABLE CHOKE	AGITATOR	TEMPORARY LINE
RELIEF VALVE	FLEXIBLE JOINT	TEMPORARY LINE
CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE		
HAMMER UNION	MIXER HOPPER	
QUICK UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
CONCENTRIC REDUCER		PG PRESSURE GAUGE

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
SLUG PIT N°1	SLUG TANK	166 bbls	1 AGITATOR PHILADELPHIA 10 HP
SLUG PIT N°2	SLUG TANK	166 bbls	1 AGITATOR PHILADELPHIA 10 HP
MUD PIT N°1	ACTIVE/RESERVE TANK	480 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°2	ACTIVE/RESERVE TANK	443 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°3	ACTIVE/RESERVE TANK	439 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°4	ACTIVE/RESERVE TANK	434 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°5	ACTIVE/RESERVE TANK	480 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°6	ACTIVE/RESERVE TANK	420 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°7	ACTIVE/RESERVE TANK	487 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°8	ACTIVE/RESERVE TANK	382 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°9	ACTIVE/RESERVE TANK	380 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°10	ACTIVE/RESERVE TANK	390 bbls	1 AGITATOR PHILADELPHIA 25 HP
MUD PIT N°11	ACTIVE/RESERVE TANK	428 bbls	1 AGITATOR PHILADELPHIA 25 HP

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
CHARGING PUMP N°1	CENTRIFUGAL PUMP	6 x 8 x 10 1/2 – 100 hp
CHARGING PUMP N°2	CENTRIFUGAL PUMP	6 x 8 x 10 1/2 – 100 hp
CHARGING PUMP N°3	CENTRIFUGAL PUMP	6 x 8 x 10 1/2 – 100 hp
MIXING PUMP N°1	CENTRIFUGAL PUMP	6 x 8 x 14 – 100 hp
MIXING PUMP N°2	CENTRIFUGAL PUMP	6 x 8 x 14 – 100 hp
MIXING PUMP N°3	CENTRIFUGAL PUMP	6 x 8 x 14 – 100 hp

DRAWING ISSUED FROM DWG N° 325.1033 (MARINE DRILLING)

REVISION	N°	DATE (D.M.Y)	DRAWN	APPR'D
REVISED TO ENSCO REQUIREMENTS	Ea	19.09.11	C. ALLRED	M. DIEHL
UPDATED AFTER SURVEY NOV. 2009	E	15.01.10	DURGEAU G.	SOULE F.
UPDATED	D	25.08.09	DURGEAU G.	SOULE F.
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UPDATED – COMMENT'S DNV 01.09.2004	A	18.04.05	DAVID.L	DURGEAU.G

PRIDE NORTH AMERICA

LP MUD DIAGRAM

ENSCO

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DWN: DAVID.L	CKD: DURGEAU G.	APPR'D: FERRAN.P
SCALE: NONE (A2)	DATE: 06.02.2003	SHEET: 1/1

DWG N° PNA-322-D-V0502 REV Ea

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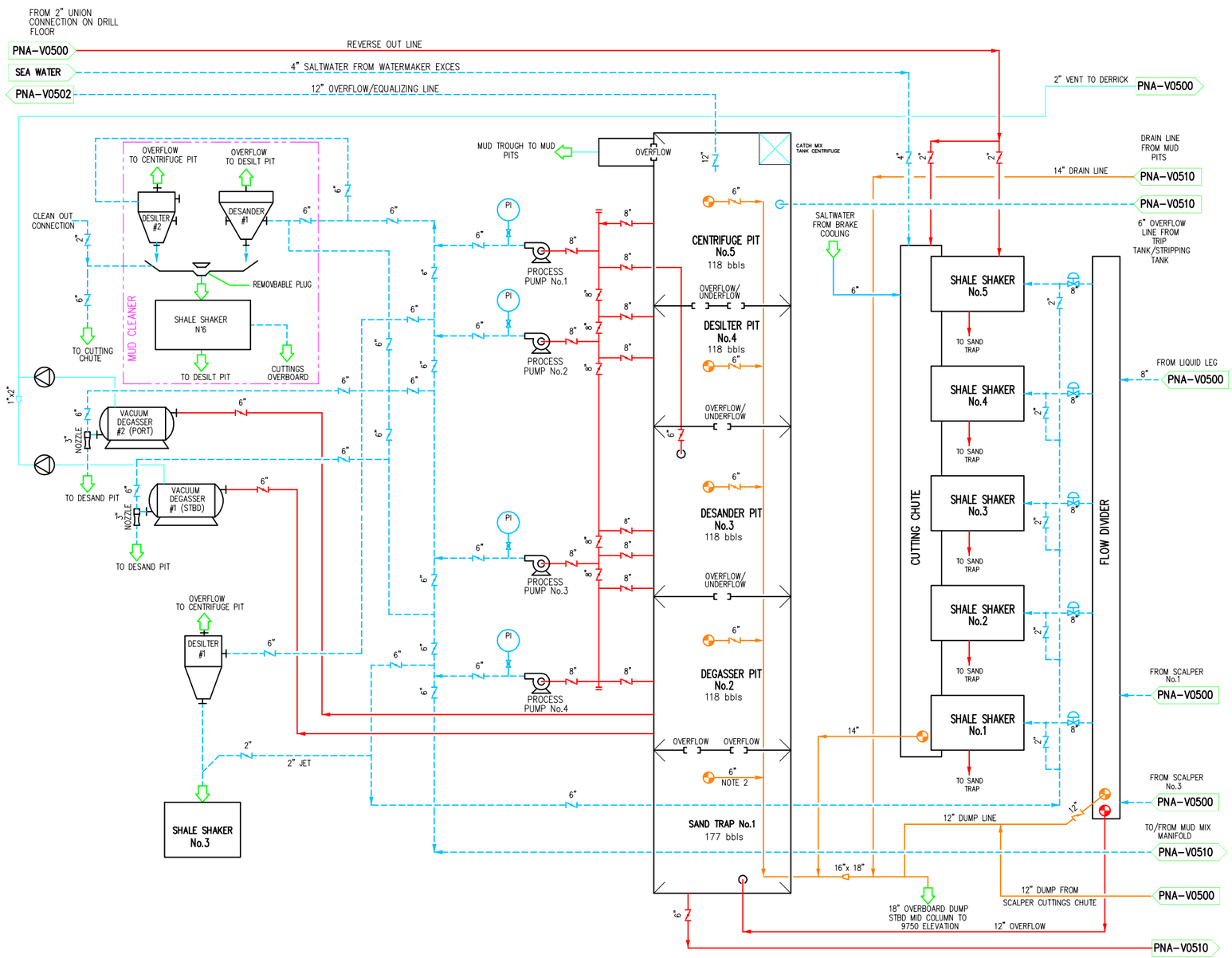

SYMBOLS

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GATE VALVE	BALL VALVE	HP or SUCTION
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CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE		
HAMMER UNION	MIXER HOPPER	
QUICK UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
CONCENTRIC REDUCER		PG PRESSURE GAUGE

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
PIT N°1	SAND TRAP	117 bbls	–
PIT N°2	DEGASSER	118 bbls	–
PIT N°3	DESSANDER	118 bbls	–
PIT N°4	DESILTER	118 bbls	–
PIT N°5	CENTRIFUGE	118 bbls	–

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
PROCESS PUMP N° 1	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 2	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 3	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 4	CENTRIFUGAL PUMP	6 x 8 – 100 hp
SHAKER N° 1 to 5	DERRICK	FLOW LINE SHAKER 8G – 4 PANNELS
MUD CLEANER–DESANDER	DERRICK	3 x 10"
DESILTER N° 1	DERRICK	20 x 4"
MUD CLEANER–DESILTER	DERRICK	20 x 4"
MUD CLEANER	DERRICK	TRIPLE COMBO SEE ABOVE DESILTER AND DESANDER
DEGASSER N° 1	SWACO	HORIZONTAL VACUUM DEGASSER
DEGASSER N° 2	SWACO	HORIZONTAL VACUUM DEGASSER

DRAWING ISSUED FROM DWG N° 325.1037 (MARINE DRILLING)

REVISION	N°	DATE (D.M.Y)	DRAWN	APPR'D
REVISED TO ENSCO REQUIREMENTS	Ea	19.09.11	C. ALLRED	M. DIEHL
UPDATED AFTER SURVEY NOV. 2009	E	15.01.10	DURGEAU G.	SOULE F.
UPDATED	D	25.08.09	DURGEAU G.	SOULE F.
UPDATED AND CHANGED NUMBER OF DWG	C	13.09.07	DAVID.L	FERRAN.P
UPDATE AFTER VISIT MB / MAY 2005	B	20.05.05	DAVID.L	DURGEAU.G
UPDATED – COMMENT'S DNV 01.09.2004	A	18.04.05	DAVID.L	DURGEAU.G

ENSCO 5006 / PNA

LP MUD TREATMENT

DWN: DAVID.L | CKD: DURGEAU G. | APPR'D: FERRAN.P

SCALE: NONE (A2) | DATE: 06.02.2003 | SHEET: 1/1

DWG N° PNA-322-D-V0501 | REV Ea

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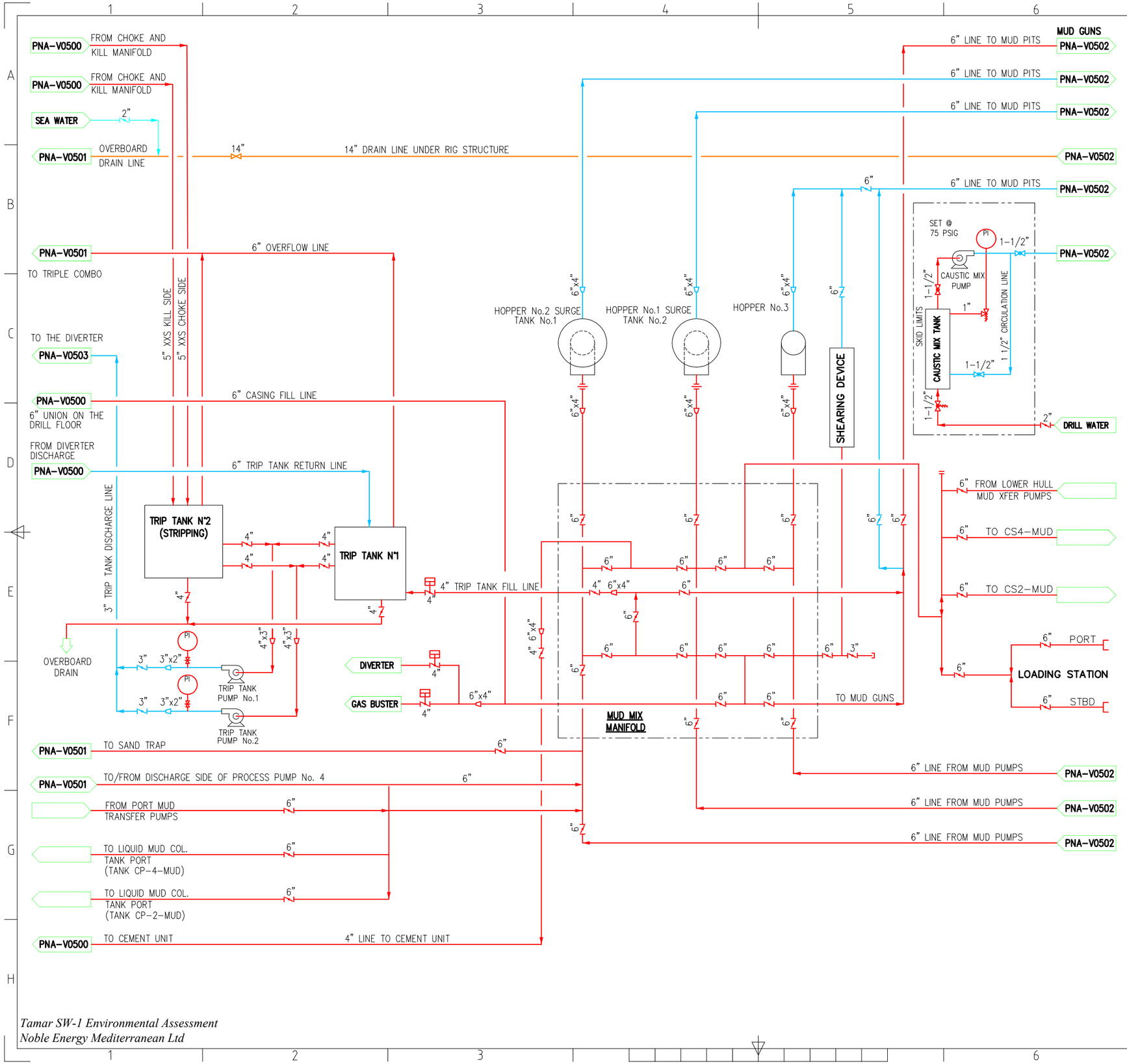

SYMBOLS

BUTTERFLY VALVE	GLOBE VALVE	COMPANY SUBCONTRACTOR
GATE VALVE	BALL VALVE	HP or SUCTION
HYDRAULIC GATE VALVE	HUB ADAPTOR	LP or DISCHARGE
PLUG VALVE	MUD GUN	DUMP LINE
ADJUSTABLE CHOKE	AGITATOR	TEMPORARY LINE
RELIEF VALVE	FLEXIBLE JOINT	TEMPORARY LINE
CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE		
HAMMER UNION	MIXER HOPPER	
QUICK UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
CONCENTRIC REDUCER		PG PRESSURE GAUGE

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
TRIP TANK N° 1	TRIP TANK	44.5 bbls	–
TRIP TANK N° 2	STRIPPING TANK	15.6 bbls	–

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
TRIP TANK PUMP N° 1	CENTRIFUGAL PUMP	4 x 3
TRIP TANK PUMP N° 2	CENTRIFUGAL PUMP	4 x 3
HOPPER N° 1	–	MUD MIX HOPPER 6" WITH VENTURY
HOPPER N° 2	–	MUD MIX HOPPER 6" WITH VENTURY
HOPPER N° 3	–	MUD MIX HOPPER 6" WITH VENTURY
SURGE TANK N° 1	BARITE/BENTONITE	CAPACITY 240 ft3 – 10 t.
SURGE TANK N° 2	BARITE/BENTONITE	CAPACITY 240 ft3 – 10 t.

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REVISION	N°	DATE (D.M.Y)	DRAWN	APPR'D
REVISED TO ENSCO REQUIREMENTS	Fa	19.09.11	C. ALLRED	M. DIEHL
UPDATED AFTER SURVEY NOV. 2009	F	15.01.10	DURGEAU G.	SOULE F.
UPDATED	E	25.08.09	DURGEAU G.	SOULE F.
UPDATED AND CHANGED NUMBER OF DWG	D	13.09.07	DAVID.L	FERRAN.P
UPDATE AFTER VISIT MB / JAN 2007	C	31.01.07	DURGEAU.G	BARDES.M
UPDATE AFTER VISIT MB / MAY 2005	B	20.05.05	DAVID.L	DURGEAU.G
EMISSION	A	18.04.05	DAVID.L	DURGEAU.G

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LIQUID MUD SYSTEM DIAGRAM

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SCALE: NONE (A2) | DATE: 06.02.2003 | SHEET: 1/1

DWG N° PNA-322-D-V0510 | REV Fa

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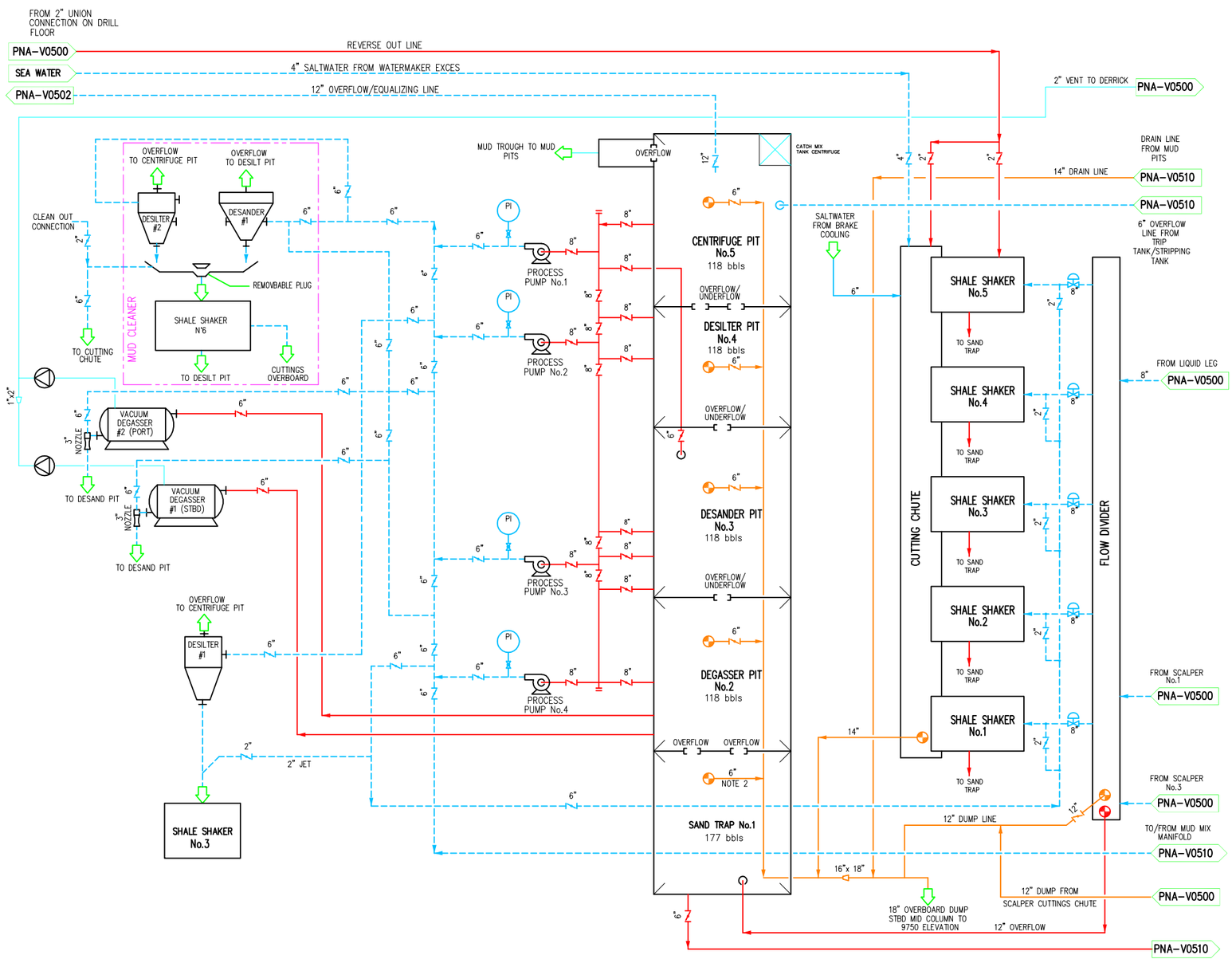

SYMBOLS

BUTTERFLY VALVE	GLOBE VALVE	COMPANY SUBCONTRACTOR
GATE VALVE	BALL VALVE	HP or SUCTION
HYDRAULIC GATE VALVE	HUB ADAPTOR	LP or DISCHARGE
PLUG VALVE	MUD GUN	DUMP LINE
ADJUSTABLE CHOKE	AGITATOR	TEMPORARY LINE
RELIEF VALVE	FLEXIBLE JOINT	TEMPORARY LINE
CHECK VALVE	CENTRIFUGAL PUMP	
DUMP VALVE	STRAINER	
FLANGE		
HAMMER UNION	MIXER HOPPER	
QUICK UNION	PULSATION DAMPENER	PT PRESSURE TRANSMITTER
CONCENTRIC REDUCER		PG PRESSURE GAUGE

TANKS

TAG N°	DESCRIPTION	CAPACITY	AGITATOR
PIT N°1	SAND TRAP	117 bbls	–
PIT N°2	DEGASSER	118 bbls	–
PIT N°3	DESSANDER	118 bbls	–
PIT N°4	DESILTER	118 bbls	–
PIT N°5	CENTRIFUGE	118 bbls	–

EQUIPMENTS

TAG N°	DESCRIPTION	MODEL
PROCESS PUMP N° 1	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 2	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 3	CENTRIFUGAL PUMP	6 x 8 – 100 hp
PROCESS PUMP N° 4	CENTRIFUGAL PUMP	6 x 8 – 100 hp
SHAKER N° 1 to 5	DERRICK	FLOW LINE SHAKER 8G – 4 PANNELS
MUD CLEANER–DESANDER	DERRICK	3 x 10"
DESILTER N° 1	DERRICK	20 x 4"
MUD CLEANER–DESILTER	DERRICK	20 x 4"
MUD CLEANER	DERRICK	TRIPLE COMBO SEE ABOVE DESILTER AND DESANDER
DEGASSER N° 1	SWACO	HORIZONTAL VACUUM DEGASSER
DEGASSER N° 2	SWACO	HORIZONTAL VACUUM DEGASSER

DRAWING ISSUED FROM DWG N° 325.1037 (MARINE DRILLING)

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APPENDIX G

ENSCO 5006 Emergency Response Manual

EMERGENCY RESPONSE MANUAL

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1 PURPOSE

The purpose of this Manual is to describe the contingency arrangements to be taken within the Ensco Unit if a major accident, major incident, fatality, or disaster occurs on one of our rigs.

The offshore Emergency Response Team (ERT) will be established in accordance with events described within this Manual at the request of the OIM and the Vice President.

Mobile Installations

The Ensco onshore emergency response teams shall be established and act in accordance with the established Ensco / Customer Management System Bridging Documents.

Procedural Assumptions

An emergency situation will not change the normal responsibilities and lines of command of the personnel involved within the Emergency Response Team. It is desirable as far as possible to maintain the normal lines of communication to avoid confusion.

Each emergency response team member is responsible for assigning his/her deputy.

Flowcharts have been used to aid the understanding of procedural requirements**.** Each member of the emergency response team shall be trained and exercises shall be carried out to test the contingency arrangements.

All onshore emergency response teams shall be trained as per PR-EUM-HR-019 Training. Departmental managers are responsible for ensuring that the appropriate training has been conducted.

2 ADMINISTRATION

2.1 Roles and responsibilities

2.1.1 Operations On-Call Representative

The first point of contact for all emergencies on an Ensco rig is the Operations On-Call Representative. This position is rotated amongst the Rig Managers, this person will:

a. Gather as much information as possible about the situation to complete the Situation Report.
b. Call the Manager – Operations and the Rig Manager for the rig initiating the call.

c. Pass on all the information known on the Situation Report and then proceed to the Ensco emergency control room.

2.1.2 Vice President

The Vice President will:

a. Lead the emergency response team.
b. Approve the Holding Statement and update when information allows.
c. Inform the Ensco (Office of the President and Chief Operating Officer) of the situation.
d. In conjunction with the Customer compile the Press Statement, verify the contents and authorise its release.

The Holding Statement provides the initial information for the Media Response, Relative Response and Internal Response Teams. The Vice President is responsible for approving the "Holding Statement" and updating when more information becomes available.

2.1.3 Manager - Operations

The Manager - Operations will:

a. Establish the initial emergency response team according to the initial response flowchart.
b. Notify the Vice President and if necessary mobilise further personnel to increase the scope of the Emergency Response Team.
c. Draft the Holding Statement (form 2.4) for approval by the Vice President.

The Manager - Operations is responsible for notifying (as required):

a. HR Personnel (On-Call)
b. SHEQ Personnel (On-Call)

The Manager - Operations primary role is to maintain contact with the Rig Manager, involved with the incident, and advise the Vice President on all matters relating to the situation.

2.1.4 Rig Managers

Rig Manager (involved with the incident)

The Rig Manager will:

Notify the Manager - Operations, if not already informed, and decide, with the Manager - Operations, whether to mobilise the Emergency Response Team.
Communicate with the Installation and the Customer and assist as appropriate.
Maintain direct contact with the Offshore Installation Manager and keep Ensco and the Customer's Emergency Response Team updated of the situation

Depending upon the Management System Bridging Document, the Rig Manager may be in attendance at the Customer's Premises or at the Ensco Office.
On receiving a call from the OIM the Rig Manager shall appraise himself of the situation and note the status on the Situation Report Form (2.3).

Other Rig Managers

All other Rig Managers will continue with their normal day-to-day operations. Their assistance may be required if the emergency situation is prolonged or escalates then one of the other rig managers may be called upon to assist as directed by the Emergency Response Team Leader.

2.1.5 Human Resources

The Manager - Human Resources will manage the Human Response and Relative Response aspects of the event and will:

a. Mobilize the Human Resource / Relative Response Emergency Response Team and provide general advice and support.
b. Arrange, in advance, a contingency plan that will contain details of reception facilities, hotel accommodation, transportation, emergency clothing and any other logistic arrangements as per the rigs operating contract.
c. Obtain the personal details of persons listed in the Persons On Board, i.e. Name, address, Next of Kin etc. for use by the Relative Response Team.
d. Pass and receive information from and to medical facilities and the Company (Police) Liaison representative.

2.1.6 SHE&Q

The Manager – SHE&Q will:

Keep a log of events as they occur and inform the Vice President.
Liaise with the relevant coastal state external emergency response agency (e.g. H.M. Coastguard) government bodies and other external agencies as required.
Ensure a Company (Police) Liaison Representative is appointed.
Inform the Medical Management consultants who will in turn communicate and liaise with the following;

1. Rig medic
2. Customers medical staff
3. The local health service

And take all necessary steps to provide whatever healthcare is needed.

2.1.7 Asset Management

The B.U. Asset Manager will:

Provide technical information and expertise to the Emergency Response Team

2.1.8 Offshore Installation Manager (OIM)

The OIM will:

Contact the relevant coastal state external emergency response agency (in the UK this would be H.M. Coastguard) and advise the situation, actions taken and request any assistance required
Contact the operations–on-call representative
Pass on all the information required to complete the "Initial Situation Report"

2.1.9 Administrator to Management

The Administrator to Management will:

a. Provide secretarial services for the Emergency Response Team.
b. Type the Press Statement and, when approved, distribute to named individuals or organisations authorized by the Vice President. These may include:

    1. The Relative Response Team
    2. The Manager HR
    3. Other Ensco staff
    4. Ensco Sub-Contractors
    5. Press organisations
    6. The Customer
    7. IADC, UKOOA
    8. Offshore Union Representatives

c. If required, form part of the Relative Response Team.

2.1.10 Supply Chain

The Manager Supply Chain will:

Provide logistic support and arrange land, sea and air transportation as directed by the Emergency Response Team leader.

2.1.11 Director – Finance & Administration

The Director – Finance & Administration will:

a. Initiate company financial procedures to track all costs involved supporting the situation and provide emergency funds if needed.
b. Handle requests from media agencies and log all calls using the Media Response Form.

2.1.12 Receptionist

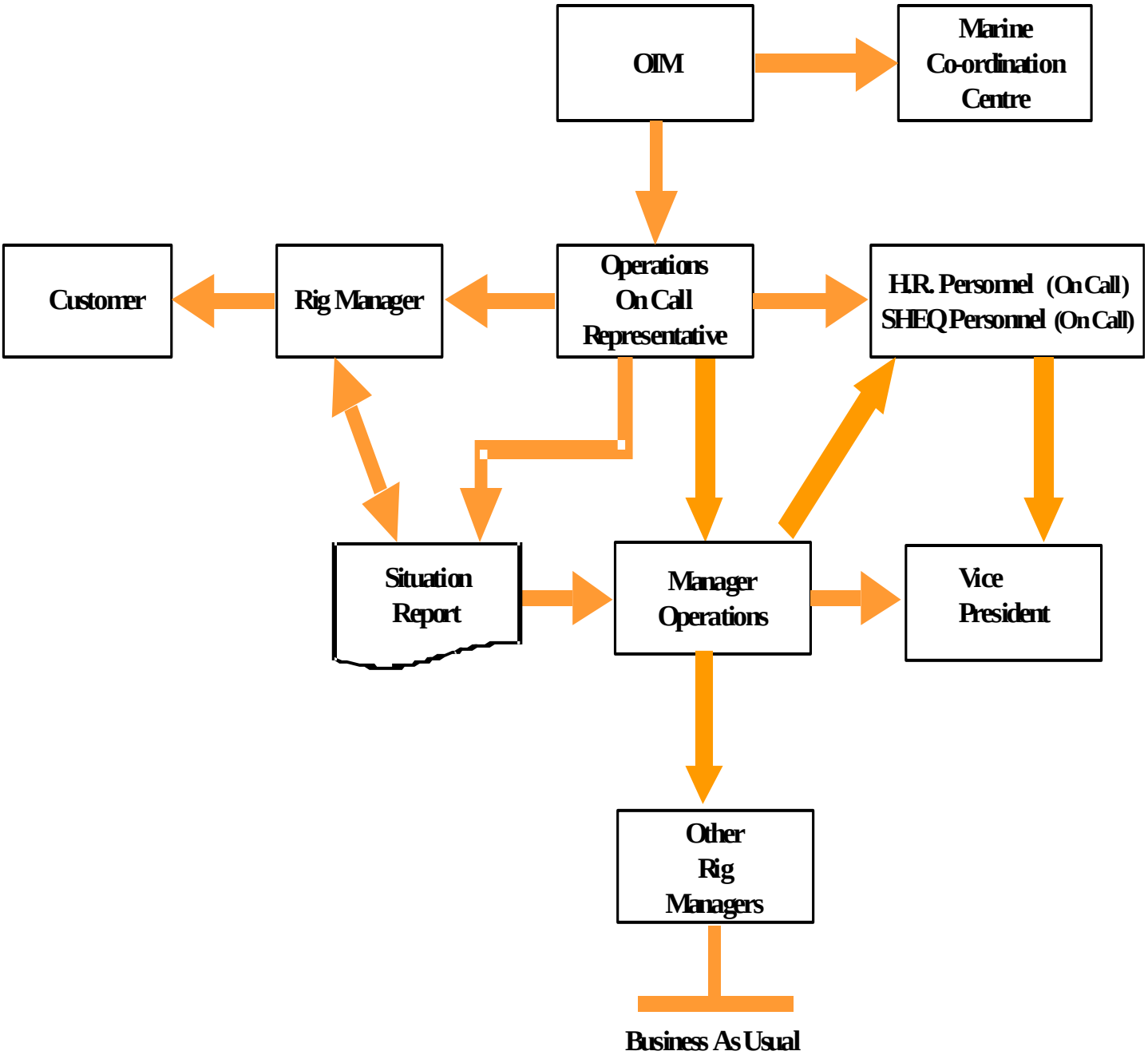
The Receptionist will:

a. Direct all calls associated with the situation to the relevant Emergency Response Team.
b. Maintain normal day-to-day business communications by directing normal calls to the respective personnel.
c. Not pass on any unconfirmed or unauthorized information.

The Receptionist has a responsible of the telephone system by setting a priority to each call and only allowing essential calls through to the Emergency Response Teams.

2.1.13 Initial Response Flowchart

2.2



2.2 Emergency Response Team

The Emergency Response Team will be established at the request of the Vice President, Manager - Operations or upon a request from the Customer.

The Emergency Response Team shall consist of the following personnel. They shall have the responsibility for mobilizing resources and the actions described within this document. The Emergency Response Team shall communicate in accordance with the flowchart described in section 4.1 and the Incident Response Matrix 3.6. A record of all events is to be kept using the Emergency Log Sheet.

Responsible	**Deputy**
Vice President	Manager - Operations
Manager Operations	Rig Manager
Rig Manager	Assistant to Operations Manager
Manager – SHE&Q	Advisor SHE&Q (On-call)
Manager - Human Resources	HR Analyst 11

2.3 Technical Response Team

The Technical Response Team shall be established upon a request from the Emergency Response Team Leader. The Technical response Team shall consist of:

Responsible	**Deputy**
B.U. Asset Manager	Rig Asset Manager

The Technical Response Team has the responsibility to communicate according to the flowchart described in section 4.2 of this document and have a major role in supporting and advising the Emergency Response Team, the Rig Manager and the Customer in creating solutions to prevent escalation of the event. A record of all events is to be kept using the Emergency Log Sheet.

2.4 Human Resources / Relative Response Team

The Human Resource / Relative Response Team shall be established upon request from the Emergency Response Team Leader.

The Manager – Human Resources will establish necessary communication interface and communicate in accordance with the flowchart described in section 4.3 of this document. The Relative Response Team will deal with all telephone calls received from personnel's next of kin (NOK). A Relative Response Telephone Call Log Form will be completed for the initial and each subsequent call.

The Relative Response Team will only be given information they can give to relatives, i.e. information from the press release and if persons are confirmed as being safe and/or evacuated. If persons are known

to be seriously injured, missing or dead, their NOK shall be given information as directed by the respective Police force for the area of operation.
In the event of a call from a sub-contractor Next of Kin (NOK) the Relative Response Team should confirm from the Person on Board (POB) list that the person was on board or otherwise and thereafter, refer them to the sub-contracting company for further information.

Responsible	**Deputy**
Manager Human Resources	HR Analyst 11
Receptionist	
Human Resources Analyst	

2.5 Media Response Team

The Media Response Team shall be established upon request from the Emergency Response Team Leader. The Media Response Team shall consist of:

Responsible	**Deputy**
Vice President	Director Finance & Administration

The Media Response Team will communicate in accordance with the flowchart described within section 4.4 of this document.

In cases where Ensco has the primacy all media statements shall be authorized by the Vice President or his delegate. Where the Customer has primacy, the Vice President or his delegate shall agree the statement with the Customer.

2.6 Incident Response Matrix

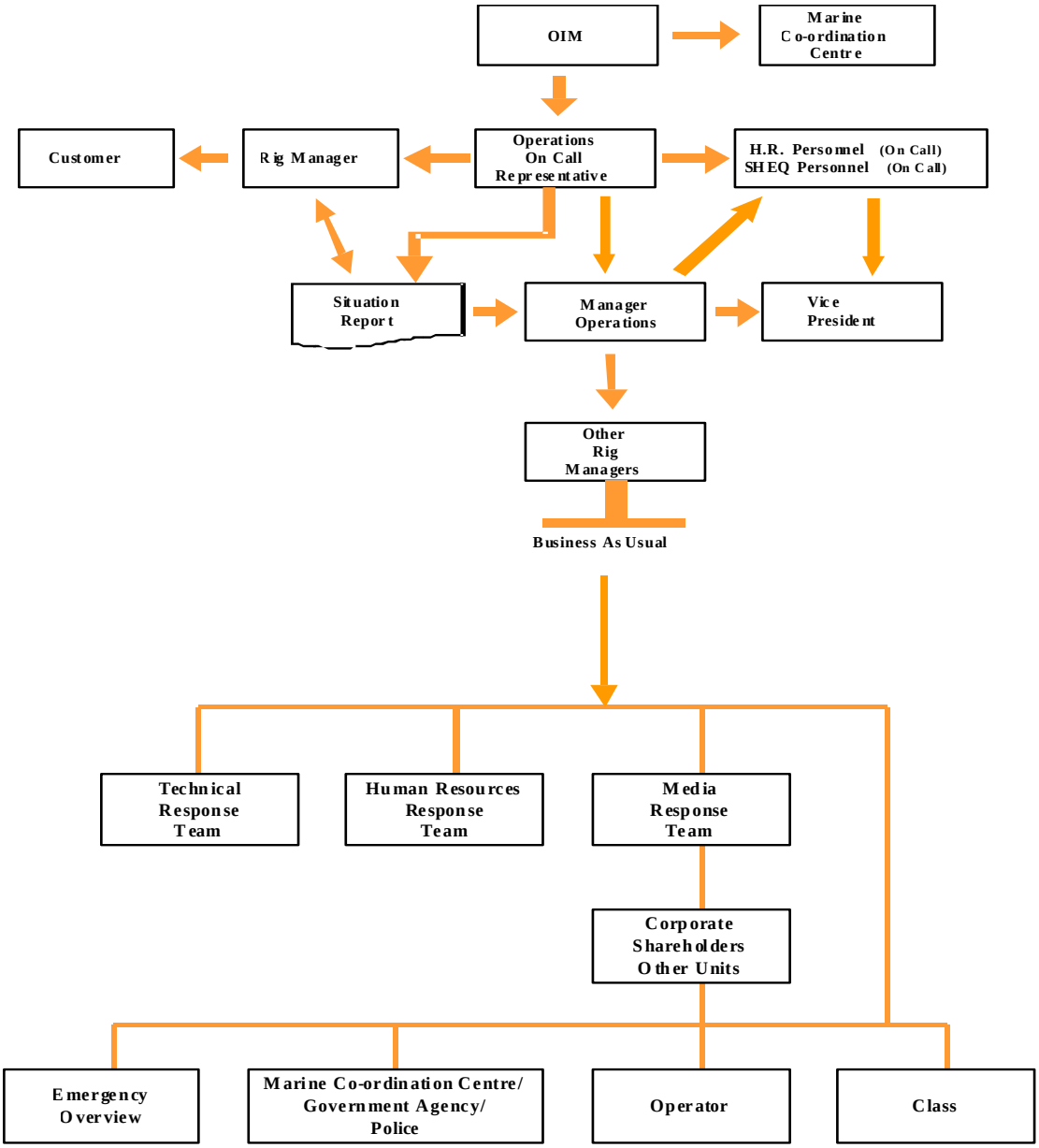
	ASSISTANCE							NOTIFICATION						
	COASTGUARD	MEDICAL MANAGEMENT	HELICOPTER OPERATOR	VESSEL OPERATOR	FIRE SERVICE	HOSPITAL		GOVERNMENT AGENCIES	DIVING CONTRACTOR	POLICE	IMMIGRATION/CUSTOMS	CERTIFYING AUTHORITY	CUSTOMER	CORPORATE
EVENT														
Death of a Person	●	■	■					■		■	■		■	■
Serious Accident / Illness	●	■	■			■							■	■
Man Overboard	■	●				●		■		●			■	●
Fire and Explosion	■	●	●	●	●			■					■	■
Helicopter Crash	■	■	■		●							■	■	■
Serious Crime Onboard			●							■	●		■	●
Diving Incident	■	■	●	●		●		■	■				■	●
Well Control Incident	■		●	●				■					■	■
Sabotage	■		●					■		■			■	■
Failure of Equipment Affecting Safety	●		●					■				■	■	■
Storm / Severe Weather	■		■							●	●		■	●
Movement of Seabed Affecting Rig	■		■					■				●	■	■
Structural Failure	■							■				■	■	■
Oil / Condensate Spillage/Hydrocarbon	■			■				■					■	●
Escape of Flammable Toxic Gases	■	●	●	●				■					■	●
Vessel Collision	■			■								■	■	●
Vessel Overdue	■			■									■	
Helicopter Overdue	■												■	
Rig Evacuation	■	●				●					■	●	■	■

■ **Mandatory** – Assistance calls would be made first. Notification calls would be made when the initial incident was controlled and normal communication could be resumed.

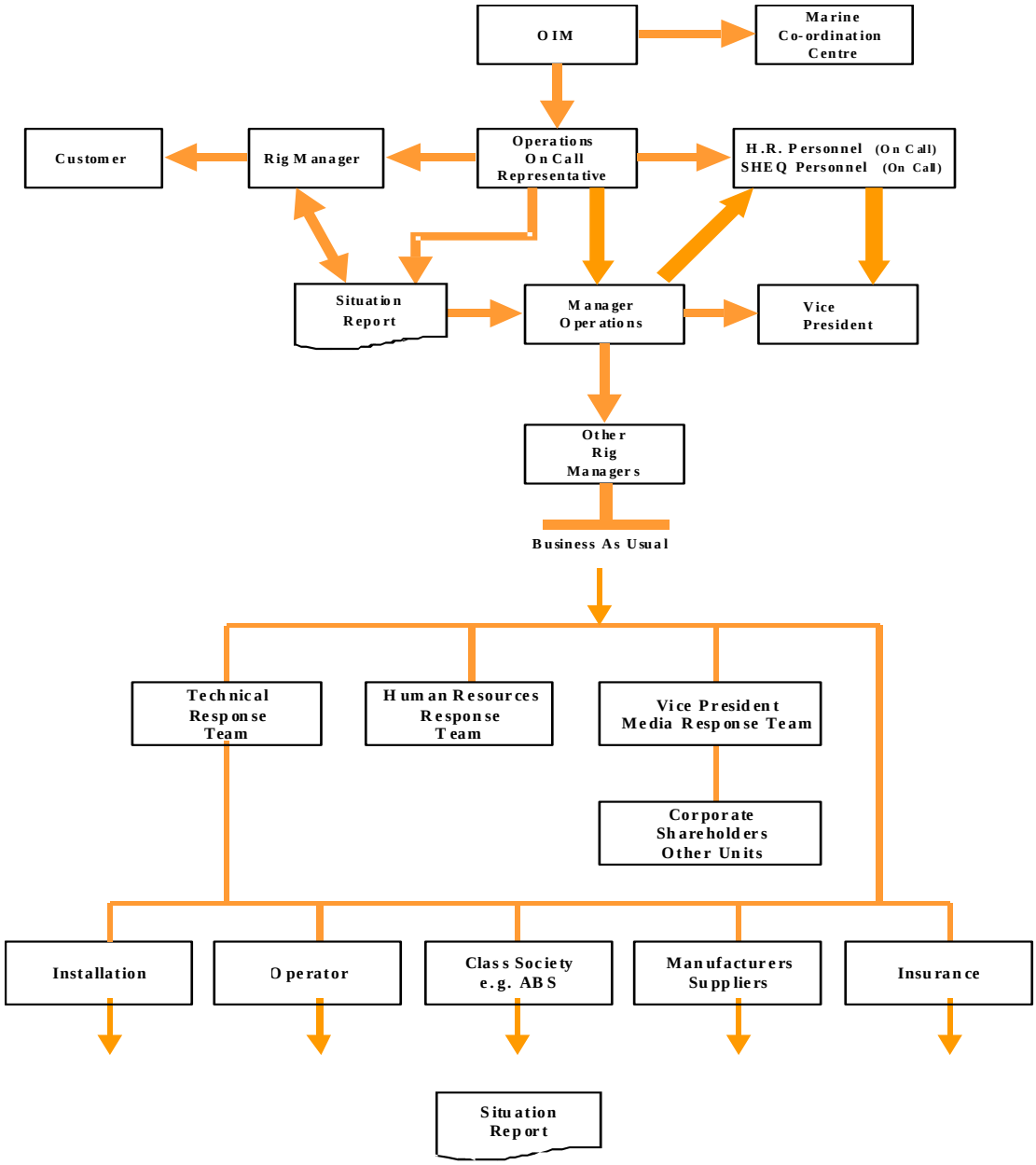
● **As required** – Depending on the severity of the incident and possible escalation.

3 Mobilization

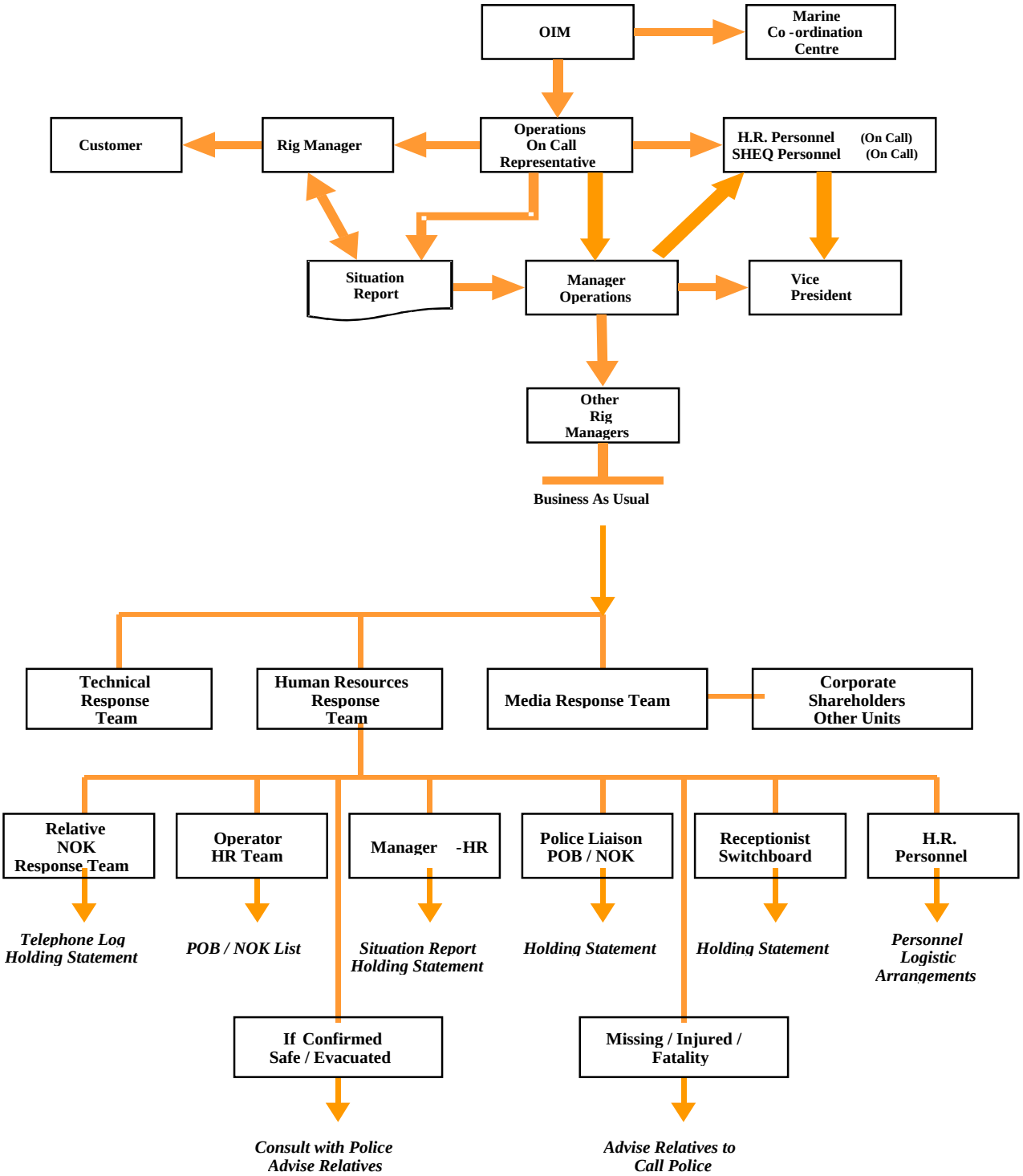
3.1 Mobilization of the Technical, Human Resources / Relative Response and



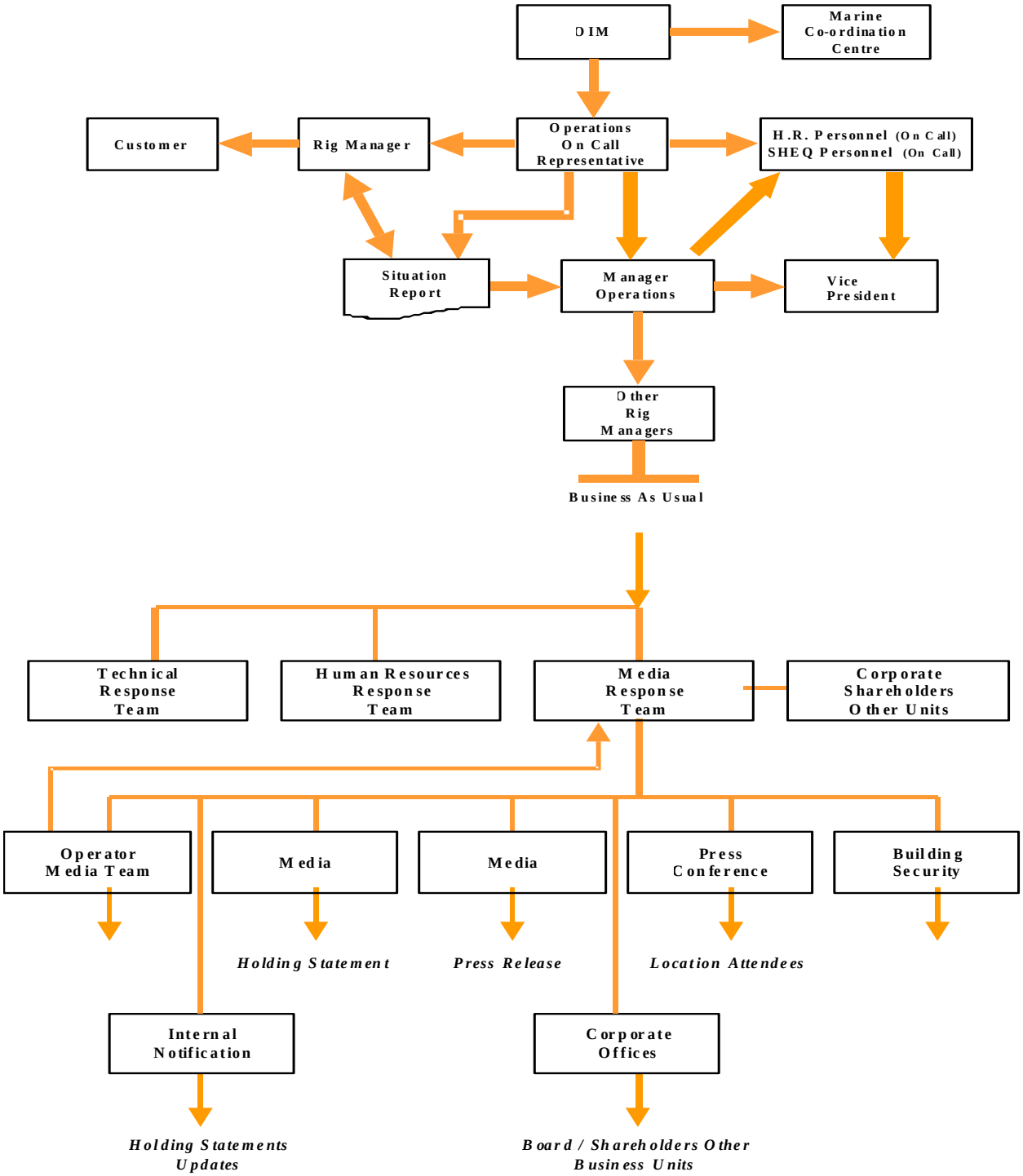
3.2 Mobilization and Roles of the Technical Response Team



3.2.1 Mobilization and Roles of the Human Resources / Relative Response Team



3.2.2 Mobilization and Roles of the Media Response Team



4 Communication

4.1 Guidance for Communication during an Emergency:

DO

- Be polite, helpful, calm and concerned; remember you are the voice of Ensco.
- Confirm whom you are talking to by verifying the caller's name, address, telephone number and relationship to the person they are asking about
- Forward the call to the most appropriate person who can deal with the query.
- Ask people to call back should they need more information.
- Assume everything you say will be printed or quoted by the media.
- Log all enquiries.

DO NOT

- Speculate.
- Get angry, agitated or excited. Do not lose your temper.
- Promise to call back.
- Be drawn into giving unauthorized information.
- Give information "off the record".
- Disclose your normal position within the Company.
- Tie up phone lines with unnecessary callers.

4.2 Media Response

Any incident offshore is likely to cause a great deal of interest to the media. You may be the person who answers the call from the media. If you are, you should respond to them in the following way;

- Show concern, but do not get involved in detailed conversations.
- If possible forward the caller to the designated Media Response person.
- Confirm publicly held knowledge

- Do not speculate or admit responsibility. We are doing all we can to help the situation; liability and responsibility can be sorted out later when all personnel are safe and the incident is over.
- Read out the initial press release "Holding Statement"
- Confirm that there has been an incident, but at this time you cannot give any more information (other than was given in the press release).
- Confirm there will be further press releases and they are free to call back later.. More information should hopefully be available then.

Give telephone numbers and contact names, if available, of the applicable Customer if they have primacy of response, stating we would prefer that they be contacted for more information.

4.3 Relative Response

ALWAYS ASK

- Always ask for the full name, including the middle name or initial, and date of birth of the person they are asking about.
- Ask which company does he or she work for.
- Verify these facts against current Personnel on Board list (POB).
- When you have established they have a legitimate right to information, ask the caller for their name, address, telephone number and relationship to the person they are asking about.
- If they are shocked or incoherent, ask them if they have a friend or neighbour who can come and sit with them.
- Should you need to contact Next of Kin (NOK) but cannot establish contact, ask other relatives, if known, - but with discretion.
- Consult with the team leader if you are in any doubt about what to say.
- Only give authorized and accurate information.
- Never break news of a death or an injury; this is the responsibility of the Police.

YOU

- Give your name, but do not disclose your normal Company position. If asked, say you are a Company spokesperson, or a member of the emergency response team
- Keep calm. If the pressure is too much, ask if you can take a short break.
- Do not promise to ring back unless you absolutely have to; but if you do promise, keep your promise.
- Keep records of those you have spoken to, and what you have said

5 CONTACT LISTS

5.1 Contact information

- Contact information for Ensco operations duty cover is detailed in the "Ensco Europe and the Mediterranean Unit- Operations Duty Cover" list. This list details the duty cover "On-Call" persons for the Operations. It is issued weekly before 16.30 hrs each Friday to all Ensco onshore personnel and Operators personnel as per contract.
- Contact information for Ensco onshore head office and regional office employees is provided in the "Ensco Unit Onshore Telephone List".
- Contact information for Coastal State Regulatory and Emergency Services is provided in the "Ensco Europe and Mediterranean, Authority and Emergency Services Telephone List"
- Contact information for customers, third party companies contracted to the rig, either directly by Ensco or the customer, and Ensco personnel is contained in the "Ensco Unit Operations Telephone List".

5.2 Responsibilities

Rig Manager

Each Rig Manager is responsible for providing a list of current contact information for his rig for each contract, location and customer. This includes the information requested on form FM-EUM-SHE-039, Emergency Logistic Arrangements shown in this manual. The Rig Manager must updated it for every new Operator and location, post a copy in the base office emergency control room and send a copy to the SHE&Q Advisors. The SHE&Q Advisor shall put a copy in the Aberdeen Emergency Response Room.

Contract Information Sources

Each member of the emergency response team, human resources / relative response team, media response team and the technical response team is responsible for providing the SHE&Q Advisor with personal contact information initially and when ever details change. The originator of additional contact information shall inform the SHE&Q Advisor e-mail or fax.

5.3 Contact List Users

Operations on Call personnel, emergency response team members, Base office Administrators and Offshore Installation Managers are designated Contact List Users. They are responsible for printing out and retaining a hard copy of the current CONTACT LIST.

Aberdeen Contact List Users can access the CONTACT LIST at any time while in WORD™ by clicking on Share>Office>Emergency Response Information>Emergency Telephone Lists, this will pull up the Ensco WORD™ Document Templates. Select CONTACT LISTS from the folder menu.

You will now be given the choice of accessing the following documents:

- Ensco Europe and the Mediterranean Authority and Emergency Services Telephone List
- Ensco Onshore Telephone List
- Ensco Unit Operations Telephone List Operations all rigs

Double click to select and open the required folder. The selected document will open. It is a WORD™ document and can be printed in the usual way to your assigned printer.

6 OFFSHORE EMERGENCY RESPONSE

Rig specific emergency response arrangements are detailed in respective rig safety cases in Section 5.0, Emergency Response. This details rig organisation, fire control and life saving equipment and evacuation, escape and rescue plans.

Well specific emergency response arrangements are detailed in the current rig specific Ensco/Operator Management System Interface Document.

6.1 General

U.S. and non-U.S. legislation requires Ensco as the rig owner to provide emergency response procedures and competent personnel to ensure they are carried out. To ensure the prompt and efficient carrying out of these duties, Ensco has appointed Offshore Installation Managers who are responsible for the welfare, health and safety of all persons onboard and for the good practice and security of the rig.

It is noted that the scope of work for this manual will cover only emergency or unusual conditions and in no way is intended to be a full operations manual.

The following incidents are typical of emergency situations but is not meant to be fully inclusive:

- Serious accident or illness
- Man overboard
- Fire or explosion
- Evacuation of the rig
- Helicopter incident
- Serious crime
- Diving incident
- Sabotage
- Equipment failure affecting the safety of persons
- Storm or severe weather conditions affecting rig stability
- Structural failure affecting the safety of the installation
- Movement of the sea bed affecting the stability of the rig
- Failure of the structure of the rig
- Leak/spillage or escape of any oil or gas
- Collapse of a lifting appliance
- Collision or interference by vessels
- Death of a person
- Blow out
- Failure of the means of keeping the rig on station and any other situation in which aid must be urgently given by the rig's own rescue services or third party.

Ensco has recognized the need for instructions to be given to OIMs and onshore staff that provide guidance in how to react to foreseen emergencies on the rig. These instructions indicate action to be taken in the event of incidents which involve or may involve danger of life, property or the environment.

It must always be borne in mind that the primary obligation in any situation is the preservation of life.

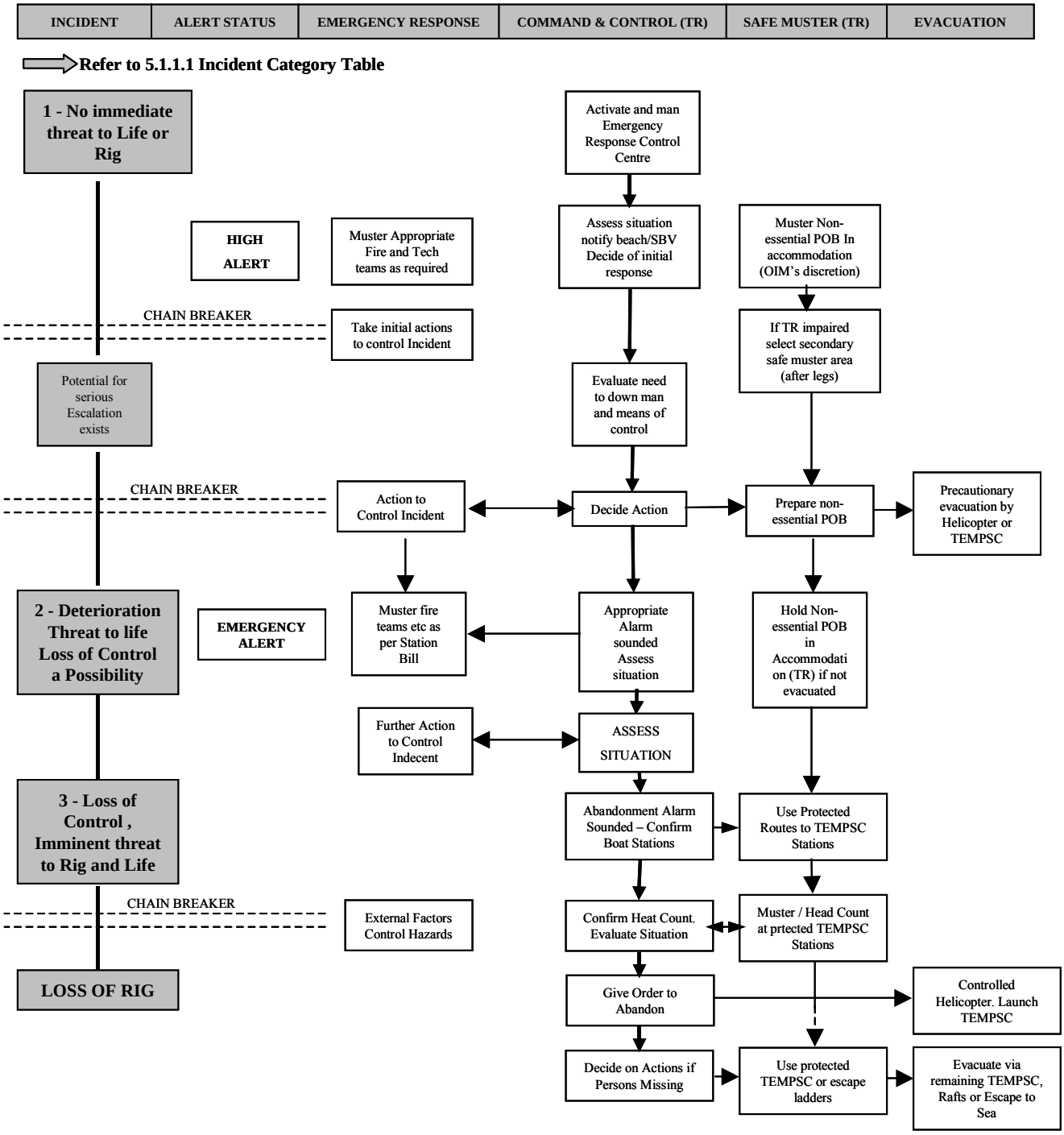
Therefore certain actions may well be required to be taken from an operational point of view, before the administrative authorities can be fully informed. It is to be a duty, nevertheless, to keep all authorities as fully informed as possible.

The OIM has the authority delegated by Ensco and stipulated by regulation to take whatever means are necessary or expedient to meet or avoid any emergency that may endanger the sea worthiness or stability of the rig or otherwise involving a risk of death or serious personnel injury.

6.2 Classification of Incidents

INCIDENT	TYPICAL EXAMPLES OF INCIDENT - CATEGORY
1.	**NO IMMEDIATE THREAT TO LIFE OR TO RIG**
	- Loss of Well Control (Serious Kick) - Fire - Equipment Failure - Helicopter Emergency - Moderate Structural Damage - (Very) Heavy Weather - (Minor) Storm Damage - Operational SBV Impact - Threat of Drifting Vessel Impact
2.	**DETERIORATION, SERIOUS THREAT TO LIFE, POSSIBLE LOSS OF CONTROL**
	- Deteriorating Well Control - Gas Accumulation on RIG - H^2S Emergency - Subsea Release/Bubbles - Moderate/Major Fire - Helicopter Crash - Major Equipment Failure - Major Structural Failure - Loss of Towline in Heavy Weather - Loss of Stability (soil failure) - Serious Threat of Ship Impact
3.	**LOSS OF CONTROL, IMMINENT THREAT TO RIG INTEGRITY AND LIFE**
	- Major unignited or ignited subsea release/shallow gas blowout - Major unignited or ignited blowout on rig - Major and uncontrolled loss of Stability (foundation collapse) - Major ship impact or structure failure

6.3 TR Muster/Evacuation Response Philosophy



6.4 Media Contact

6.3.1 Ensco Primacy

During an emergency all media statements shall be authorised by the Ensco Vice President or his designate.

6.3.2 Client Primacy

Where the Client has primacy for informing the media, the Vice President will agree the statement with the Client.

6.5 Responsibilities

Offshore Installation Manager

The Offshore Installation Manager (OIM) is the legally appointed representative of Ensco and is responsible to the company under existing law for the Ensco rig. The OIM is fully conversant with legislation with regard to other countries who may have authority over the rig.

Duty Officer

At each base office a Duty Officer is nominated from the Operations Group to be the Primary Contact for the OIM in the event of an emergency.

The Duty Officer, after consulting with the Vice President or his designate shall be responsible for calling out members of the ERT as required. The Duty Officer shall be available on a 24 hour basis and remain within 1 hours drive from the base office.

6.6 Personnel On Board (POB) Lists

The Offshore Installation Manager (OIM) is responsible for ensuring that a complete and accurate POB list is compiled and maintained as current at all times. The POB list being updated after any arrival and / or departure of persons to and from the rig.

POB List Procedures must be followed.

The standby vessel (when applicable) shall be informed after every flight of the numbers of personnel onboard. He shall also be informed of current operations in progress and with the arrival of a new standby vessel possible escape routes of personnel from the rig shall be explained in detail.

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7 LINES OF COMMUNICATION

7.1 Command during Emergencies

Key Responsibilities

The OIM is the On Scene Commander, he has overriding authority in an emergency situation, meaning the overall responsibility to evaluate and respond to emergency situations as he sees fit.

The OIM or his designate has the primary responsibility to initiate an emergency procedure. He is responsible to identify when the emergency proceeds from one phase to the next.

All persons on board have a duty to co-operate and obey instructions. Any individual becoming aware of factors not known to the OIM, should bring this to his attention. Similarly, onshore management may make recommendations to the OIM.

7.2 Rig Command Structure in an Emergency

The rig command structure during an emergency situation follows the Offshore Organizational Chart, refer to Section 2.3.2.1.1 of the respective rig Safety Case. Should the OIM be incapacitated for any reason the on tour Toolpusher takes command.

During emergency situations the Operators Representative on board and specialist third party personnel will support the OIM or his designate. The Barge Engineer is the Muster co-ordinator. He receives the muster checker information and informs the OIM. During an emergency, one or more persons may become incapacitated and their roles and responsibilities will have to be assumed by another individual. The following lists the principles and their designates.

Position	Designate
OIM	Toolpusher
Driller	Assistant Driller
Fire/Rescue Team Leader	Back Up Fire Rescue Team leader
Fire/Rescue Team	Back Up Fire Rescue Team
Medic	First Aiders

Position	Designate
Helicopter Landing Officer (HLO)	Off duty HLO
Radio Operator	Off Duty Radio Operator
Muster Checker	Back Up Muster Checker
Coxswain	Back up Coxswain

The Emergency Team Members and the actions to be taken in the event of an emergency are detailed in the rig specific Station Bill that are posted onboard the rig.

7.3 Training for Emergencies

All OIM'S and Toolpushers attend a "Controlling Emergencies" training centre, the course duration is 4 days.

The input will take the form of a series of presentations and syndicate forums covering the following subjects:

- Command and control techniques
- Information management systems
- Pre-planning for incidents recognized to have high potential
- Identifying and coping with stress in self and others
- Post incident considerations

The practical aspect of the course takes the form of series of themed emergency exercises with the object of gaining practical experience of the core performance criteria, listed by COGENT, to be considered when assessing the competence of those to be appointed as OIM, and acting OIM.

- Assessing the situation
- Taking effective actions
- Maintaining communications
- Delegating authority
- Managing self and team performance
- Identifying and dealing with stress

7.4 Drill & Exercises

Briefings, drills and exercises are the primary means Ensco uses to:

- Test the emergency response arrangements
- Ensure personnel on board the rig have sufficient knowledge and familiarity with equipment to ensure their safety.
- Ensure emergency response actions are consistent and effective to meet the situation.
- Enable personnel to become familiar with the Operators emergency plans and requirements for the particular location the rig is operating in.

A range of simulated major accident hazard emergency drills are undertaken, including;

- Simulated Fire
- Man Overboard
- Tank and Confined Space Rescue
- Abandon Rig Drill
- Combustible Gas Drill
- Toxic Gas Drill
- Simulated injury at any location
- Helicopter Crash on Deck
- Helicopter Crash Close-by the Rig
- Ship collision

Drills and exercises are intended to test the reactions and actions of all personnel on the rig and the Evacuation, Escape and Rescue system performance standards, in the case of a man overboard drill, this tests the actions and response times of the Standby Vessel.

7.5 Procedures for Emergency Services

Under normal circumstances Emergency Procedures can be controlled by the regular in place logistics teams, e.g. boats, helicopters and communication facilities. These will normally be alerted by the rig.

In the event that these services should prove to be inadequate, further assistance could be required and these back-up services can be obtained through the coastal state authorities, for example, the following agencies can be contacted for assistance, refer to 5.1 Contact Information:

U.K.	**Holland**	**Denmark**
HM Coastguard	Coastguard	Maritime Rescue Coordinator Centre (MRCC)
Health & Safety Executive (HSE)	State Supervision of Mines	Danish Energy Authority
	NOGEPA Sector Clubs	

Either the rig or the ERT will call for additional assistance as the situation dictates.

The Coastguard has the overall responsibility for co-ordinating rescue efforts, and for initiating search and rescue operations and should be notified as soon as possible that an emergency may develop (do not wait until it has developed).

In addition to reports to the Police concerning serious accidents, emergencies and criminal activities, other government agencies may need to be informed of defence or security incidents, including safety zone infringements by submarines, surface vessels or aircraft, interference with navigation of other operational activities and threat of violence against rigs.

Contact numbers for these Agencies are in the Contact List in section 5.3 of this document.

NOTE: All verbal communications should be backed up by a paper copy of the communication to aid clarity, especially when transmitting names, times or numbers.

7.6 Emergency Messages (MAYDAY)

In an emergency, the nearest Coast Radio Station should be contacted, the situation explained and priority treatment requested. Should the situation be of such a serious nature the safety of personnel are at risk, the person making the call should prefix those calls with "MAYDAY, MAYDAY, MAYDAY".

The Internationally recognised signal should bring an immediate response from, not only a Coast Radio Station, but any Mobile Radio Station, either a ship or aircraft in the vicinity.

It is essential when communicating with Ensco base office, Coast Radio and other authorities that the message is clear and brief. The following format is suggested for all reports of emergencies:

- Name and position of rig, for example, Ensco ??
- Latitude: 53 deg. 36' 52" N;
- Longitude: 02 deg. 19' 59" E
- Give a short description of the emergency
- Number of persons on board
- Time of start of incident
- Severity of incident and description of damage
- Actions already taken by the OIM
- Details of any injuries (the estimate number of casualties and seriousness of their condition)
- Status of life saving equipment
- Restrictions on helicopter and marine operations
- Number of divers under pressure
- Location of nearest platform/drilling rig
- What additional help is required
- Weather conditions (including wind speed, visibility and any other factors

7.7 Communication Procedure

All messages of an emergency nature, concerning in particular matters of safety and security of the rig or personnel on the rig, that requires immediate action to be taken by the ERT must be prefixed by "EMERGENCY, EMERGENCY, EMERGENCY". The onus for indicating the urgency of the message must rest with the originator and not left for the decision of the person transmitting the message.

Such messages requiring immediate action shall only be transmitted on the authority of the OIM or his appointed representative.

On receipt of such message, the Duty Officer (or ERT member) will inform the Vice President or his designate of the incident by the quickest possible means.

If the Duty Officer of a ERT member cannot be contacted another responsible person should be informed.

This information is to be passed on to those responsible for initiating emergency procedures. This instruction does not preclude the use of the normal words URGENT or PRIORITY but it is intended to emphasise the emergency nature of the messages.

7.8 Radio and Communications

7.8.1 Offshore Communication to Ship

Communication during an emergency is to be on VHF Channel 16 or International calling and Distress Frequency and/or Distress Frequency (MF) 2182 KHz.

7.8.2 Offshore Installation to Shore

Communication is to be on International Marine Channels, or by any other established links. It is important that all marine units involved in the emergency should maintain radio communication with the same (controlling) Coast Radio Station. (If available, cellnet telephones or direct land lines may be used, the important point is to communicate your position and circumstances as clearly and concisely as possible).

7.8.3 Air to Offshore Installation

Communication shall be established on VHF with the rig on the assigned helicopter operator frequency.

7.8.4 Coastguard

Coastguard stations have VHF channel 16 for local rescue communication. For communications at longer range, the messages are passed through Coast Radio Stations. Coastguard stations keep listening watch on 2182 KHz R/T (the Emergency Contact List gives the local telephone numbers for your location).

7.8.5 Lifeboat/Liferaft

Communications with ships and helicopters should be carried out on VHF Channel 16.

All portable radios used during an emergency will be used on the same frequency and be capable of being used on VHF Channel 16.

Use of Communications Systems during an Emergency

In the event of an emergency situation, all communications systems on the rig must be available for dealing with that emergency. Normal use of all communications systems must therefore cease immediately when an alarm is sounded.

When an emergency is over, normal use of communications systems may be resumed.

Personal mobile telephones <u>must not be used</u> at any time.

Distress and Urgency Communications

If you hear a Distress call, write down the details. If no one else answers the call, you must do so. Then call a Coast Station or Coastguard Station with the details, taking care not to cause interference to further transmissions from the station in distress.

If such a message is received from an approaching helicopter, 8.11 Helicopter Crash and/or 8.12 Helicopter Overdue in this manual must be followed in addition.

7.9 Medical Services

24 Hour Medical Cover

Should an incident occur on the rig that requires the attendance of a Doctor to administer treatment, the relevant contact numbers should be used.

Advice

A Duty Doctor is available on a 24 hour basis, Any queries the Medic may have should be directed to the Duty Doctor.

8 EMERGENCY PROCEDURES

8.1 Emergency Signals and Alarms

Emergency signals are sounded on the Alarm Systems and are operated manually form the Control Room. The Fire and Gas Alarms also operate automatically on detection. Emergency Stations alarm can be operated from both the Control Room and other points onboard the rig.

In the event of a control room fire, the alternate command and control centre situated in the OIM's office shall be used.

If the situation develops to the extent that personnel are moved to the Temporary Refuge (TR), additional hand held portable radios shall be taken to the TR by the Radio Operator to supplement the radios already positioned in the TR.

Emergency Signals are:

- PREPARE FOR EVACUATION: A continuous signal of variable frequency and yellow flashing lights
- WARNING OF TOXIC GAS: A continuous signal of constant frequency and red flashing lights
- ALL OTHER CASES: An intermittent signal of constant frequency and yellow flashing lights

Specific signals vary from rig to rig. These will be explained to personnel during the induction briefing given to all arriving personnel. Other alarm signals may be used to comply with local Rules. These will be detailed in Operator/location specific Emergency Response Plans detailed in the Ensco/Operator Management System Interface Document.

8.2 Fire and Gas Detection System

A fire and gas detection system is provided to detect gas releases or cases of at an early stage so that mitigation measures can be put in place to prevent incidents from becoming major accident events.

Enclosed areas are provided with heat and/or smoke detection systems. Flame detection is provided in the generator room and in the emergency generator engine room.

The Fire Detection Panels and mimic boards (flame, heat & smoke detection) are located in the a A60 rated compartment. The Fire and Gas detection system is fed from the emergency generator switchboard and/or 24 volt batteries (located in the Emergency Generator Room) and is independent of the main engine electrical power system. All cabling from field devices and alarm sounders cabling is ABS approved flame resistant, capable of withstanding 20 minute exposure to a carbonaceous type fire.

The fire alarm is raised automatically while the other alarms are activated manually. After the alarm is activated an announcement is made over the PA system.

The gas alarm and trip settings are HC: 25% LEL low alarm 60% LEL high. H2S: 5 ppm low, 10 ppm high. In addition, all normally manned areas and most other areas are fitted with Manual Alarm Call (MAC) points.

8.2.1 Accommodation

The cabins have smoke detectors installed and the rest of the accommodation is also fitted with heat detectors. These are linked in the Radio Room and control room and will set off the General Alarm when activated. Throughout the whole accommodation unit a sprinkler system is installed to give quick response in case of fire.

Smoke, H_2S and CH_4 detectors have been installed at all intakes for the accommodation ventilation system. Smoke and Gas detection has also been provided downstream in the air movers/circulators located in the corridors at each level of the accommodation.

Automatic operated dampers have been provided at all the air intake and exhausts points in the accommodations. The Fire detection system when activated shuts down the accommodations ventilation system. Gas detection also initiates automatic shutdown of the accommodation ventilation system. Upon activation of the shutdown system, an alarm is automatically raised in the Control Room.

8.3 Emergency Shutdown System

An emergency shutdown is provided to ensure safe, sequential shutdown of equipment as a result of specific hazards. There are three (3) major shutdown levels 1, 2 and 3. Level 1 will in general be utilized for emergencies of a lesser severity, but the consequences of a level 2 and level 3 shutdown are more serious and entail major shutdown of equipment and systems. Level 3 will probably also entail evacuation of the crew or part of the crew, therefore prior to instigation of a level 2 or level 3 ESD, the consequences should be carefully considered.

8.4 PA System

A PA system is provided to enable announcements and alarms to broadcast. The PA system is equipped with intercoms and speakers in each major area of the rig. The PA and alarm system is feed from emergency power and has a battery supply for 60 minutes.

The PA and alarm system console is located in a separate enclosure within the A60 fire rated jacking control/radio room. Modular design of the alarm systems and PA systems ensures that local damage does not disable the whole system

8.5 Action to be taken on hearing Alarms

On hearing any of the various emergency signals, personnel must render safe any operation in which they are engaged and proceed as follows:

- All naked lights must be extinguished
- Smoking must cease
- Nominated personnel must proceed to their emergency positions and execute emergency duties
- All other personnel must proceed to the Muster Point and await instructions
- The Radio Operator shall close the Control Room shutters at the sounding of the emergency signals
- The Driller must secure all well operations on the sounding of the emergency signal
- In a fire situation developing in the Engine or Steam Generator Room, the Mechanic is responsible for shutting the remote fuel valves

8.6 Make safe any work and equipment

The design of the rig is such that continuous monitoring of operations ensure that, in most cases, abnormal conditions automatically initiate alarms. In other cases, equipment is rendered safe manually. The OIM, however, must ensure that the automatic operation has functioned, if not, manual operation must be initiated.

8.7 Emergency equipment plan location

The rig has various items of fire fighting equipment and emergency equipment. Location plans for this equipment can be found throughout the accommodation. Additional plans of all local fire fighting equipment can be found in each room on the machinery deck. Reference rig specific Fire Control Plan and Live Saving Appliance Plan provided in Appendix 3, Drawings and Schematics in rig specific Safety Cases.

8.8 Emergency Personal Protective Equipment

PPE appropriate to the rig operating location is provided. This typically consists of lifejackets, Breathing Apparatus (BA) sets. Smoke Hoods c/w gloves and heat resistant torches for 120% of the rig POB and Immersion suits for 150% POB. This equipment is described in section 5.4.2.3 of respective rig Safety Cases. The location of this equipment is shown in rig specific Fire Control Plans and Live Saving Appliance Plans provided in Appendix 3, Drawings and Schematics, rig specific Safety Cases.

8.9 Escape Routes

Performance Standard: There are at least two, clearly marked escape routes from all normally manned areas of the rig. Arrows at the floor level and eye level indicate the route to the nearest exit from the machinery deck to the main deck. The main deck escape routes have arrows showing the direction of escape to the TEMPSC embarkation points. Escape route indicating signs on the machinery deck are of the photo luminescent type to provide adequate direction in conditions of reduced visibility. The escape routes should remain usable of 5 minutes to allow passage of persons.

The escape routes are adequately illuminated. Should the main power generation fail, selected lights along the escape routes are by powered from the emergency generator.
The emergency generator will start and supply power to the lights within 45 seconds of the main generators stopping. Should the emergency power supply fail, the escape routes are automatically illuminated by selected battery powered lights.

Escape routes have been applied to main deck and machinery deck areas. They are identified with parallel yellow lines, spaced one metre apart. Photoluminescent arrows indicating escape routes are displayed on the bulkhead and accommodation walls in the machinery decks and accommodation areas.

8.10 Temporary Refuge

A temporary refuge has been provided. The usual configuration is the second level of the accommodation, the fourth level control and command centre and the stairway connecting the two areas. The actual TR configuration must be explained to all personnel upon arrival. This area is sufficient to muster the maximum crew, account for all personnel, decide on actions to take and, if necessary, prepare to abandon the rig.

8.11 Rescue Facilities

8.12 Evacuation

Evacuation and recovery to a place of safety is a place remote from the rig emergency, at a minimum this can be a (Totally Enclosed Motor Propelled Safety Craft) TEMPSC, preferably it is recovery from a helicopter or stand-by vessel. Helicopters are the preferred means of evacuation and will be used when sufficient time is available., suitable helidecks are provided.

4 TEMPSCs are provided two on each side of the accommodation. The rig's TEMPSC evacuation capacity is in excess of 200% of the potential maximum manning level.

The embarkation areas for the TEMPSC are well illuminated at all times, and in the case of the accommodation TEMPSC these are a short distance from the accommodation/TR egress points. These evacuation routes are well protected by the accommodation and the A60 rated walls acting as a barrier between them and the main source of any expected heat radiation, smoke and/or missile impingement. Each TEMPSC is provided with an emergency radio transceiver capable of receiving and transmitting on the emergency radio frequencies.

8.13 Rescue

The Operator provides a Standby Vessel (SBV) at or near to the rig location.

The SBV is required to be equipped with suitable rescue equipment and fully trained crew to enable the rescue of persons and to recover them to a place of safety, whether they are in TEMPSC, liferafts or directly in the sea.

8.13.1 Performance Standard

To ensure that rescue and recovery to a place of safety is achievable the operator and Ensco agree on the SBV arrangements. The rig is operated in accordance with the Ensco Adverse Weather Policy, PR-EUM-OPS-066 and / or the operator's adverse weather policy as agreed in a jointly prepared Management System Interfacing Document. Reference rig specific Safety Cases, Section 2.3.6.2, Adverse Weather Policy.

8.13.2 Site Specific / Client

Site specific SBV warning time and emergency response arrangements will be managed by location specific Ensco/Operator jointly prepared Emergency Response Plans or the Management System Interfacing Document. The SBV to be capable of providing a 20 minute warning of an errant vessel

(maximum speed of 24 knots) sailing towards rig, i.e. at 8 nautical miles distance from the rig. Evacuation by TEMPSC is achievable in 15 minutes, this is verified by "abandon rig – TEMPSC drills".

8.14 Rescue and Recovery performance standards

The performance standard for personnel falling into the sea during overside work

Where personnel enter the sea and, timed from the point at which the EERV is alerted.

- A rescue craft should be launched win two minutes;
- A rescue craft should be in position to rescue the first casualty within four minutes and
- Up to four personnel should be rescued and taken to a place of safety with twenty minutes, having due regard for the care and condition of the casualty.

The performance standard for random personnel overboard is:
A fast rescue craft is to be launched, or, in adverse weather conditions, the standby emergency response and rescue vessel is to be underway to the search area, within 2 minutes of the alarm sounding.

The performance standard for helicopter ditching is:
A fast rescue craft is to be launched, or the standby emergency response and rescue vessel is to be underway to the search area, within 2 minutes of the alarm being raised. The rescue boat shall be positioned to rescue up to 20 persons from within the 500-meter zone around the rig, and to take then to a place of safety within 120 minutes.

The performance standard for installation escape to the sea is:
A fast rescue craft is to be launched, or the standby emergency response and rescue vessel is to be underway to the search area, within 2 minutes of the initial alarm being raised.

Persons working over the side will wear thermal clothing. Ensco expect Operators to provide helicopter in-flight immersion suits and life jackets to recognised U.S. or International standards. Ensco shall ensure that returning passengers from ENSCO 71 wear this clothing.

8.15 Rescue Arrangements

Rescue arrangements under emergency situations fall into two general categories.

Limited Rescue -which may involve one or more personnel from the water without the safety of the rig being jeopardized.

Unlimited Rescue- that involves a complete evacuation of the rig by all personnel because the integrity of the rig is in danger or the atmosphere on the rig is untenable to personnel due to large concentrations of smoke, heat or gas.

A limited rescue may have the potential to turn into an unlimited rescue. The OIM must be aware of the potential and exert extreme care in the rescue operation to ensure that undue risk is not placed on additional personnel during any rescue operations.

The SBV plays a major role in either a limited or unlimited rescue and is provided with daily POB updates by the radio operator. Each time the SBV changes the OIM makes the Master familiar with the rig's escape routes to sea.

8.15.1 Responsibilities:

The OIM is responsible to ensure that all personnel are adequately informed upon arrival at the rig of the arrangements made for their safety and the lifesaving and rescue facilities available to them. The Radio Operator is responsible for informing the OIM of the arrival of a new SBV so that he can arrange for an induction to be given of the likely evacuation sites around the rig and the numbers of personnel involved.

It is the responsibility of all personnel on board the rig to:

- Familiarize themselves with their muster points and lifeboat stations
- Read and familiarize themselves with the rig Station Bill displayed on board the rig
- Make sure that in their cabin they have a life jacket and immersion suit
- Make themselves familiar with the position and use of all evacuation and rescue equipment

8.16 Offshore Emergency Plans

8.7 Serious Incident or Illness

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
1. Inform the Base Office and start log of events. 2. .If a serious incident occurs ….. 3. Make area/equipment safe 4. Note position of valves/controls if they have to be moved. 5. Where possible, impound tools, equipment, materials that may have contributed to the incident. 6. Collect eye-witness accounts as soon as possible, and take photographs if conditions and circumstances permit. Ensure that accounts and photographs are countersigned. **Medivac** 7. If helicopter in field, arrange Medivac and inform Base Office. 8. If no helicopter in the field, advise the Operator's Drilling Supervisor, requesting a helicopter. 9. Medic will discuss symptoms and treatment with onshore doctor. 10. Prepare casualty for flight ashore. 11. Medic or trained first aider will either accompany casualty or provide written report of treatment given, etc. 12. Inform Base Office of details of incident, ETA and destination of helicopter, if known. 13. Inform standby vessel of situation and ETA of helicopter when known. 14. Complete Ensco and operators Unplanned Event Report and additional Report Forms.	In the event of a report from the Rig of a serious incident or illness, the ERT must keep a log of events and then proceed as follows: 1. Allow sufficient time for the OIM to contact the doctor and liaise with the doctor to ensure that he is aware of the situation. 2. Inform the Police and Coastguard 3. Inform Coastal State authorities and ask if they wish to send an inspector. If not, ask if they wish the site to be left undisturbed pending investigation. 4. Ensure the Operator's Drilling Manager or Shore Base Supervisor is informed. 5. If landing at a non-scheduled landing site, advise the fire brigade. 6. Arrange transport of casualties to hospital by the quickest means. 7. Arrange that a representative meets the incoming flight to assist the injured, representatives may need to have a POB list to check-off arrivals. 8. If casualties are Ensco employees, next of kin are to be advised by the person nominated by the Emergency Response Team. If the casualties are Operators or other Contractors personnel, he is to advise the Operators and contractors base and head office to allow them to notify the next of kin.

8.8 Man overboard

Speed of action is vital since survival time is very limited even during summer months.

THE PERSON WHO OBSERVES A MAN FALLING OVERBOARD shall immediately throw a lifebuoy or any other floatable object towards him and raise the alarm by means of the intercom or shouting **MAN OVERBOARD** and continue to attract attention.

- Keep the man constantly in sight.
- Report position of the man to control room.

Consideration should also be given to throwing additional liferings at intervals to assist rescuers in identifying a drift pattern the MOB may have taken.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of a MAN OVERBOARD alarm , the OIM must proceed as follows: 1. Alert the standby vessel and initiate the recovery procedure and start log of events. 2. Station the observer with binoculars to keep track of the man and direct the rescue. 3. Inform the Base Office by the quickest means. Follow up with Fax message. 4. Inform the doctor and helicopter services. 5. Consider the use of personnel basket to recover the man. 6. On recovery of the man, he must immediately be treated for Hypothermia (consult nominated Medic). NOTE: If the man is not sighted or recovered, a warning to shipping should be made through coastal radio station and coastguard, requesting search and rescue assistance. When it becomes apparent that the person has been lost, the procedure for death of a person must be followed. In the event of a person being reported missing, without evidence of falling overboard, the OIM should carry out a complete muster of persons onboard to establish last whereabouts and initiate *a* search.	In the event of a report of MAN OVERBOARD alarm from the Rig the ERT must proceed as follows: 1. Start log of events. 2. Ensure the helicopter service is aware of the situation and that the doctor has been placed on standby. 3. If the search and rescue has been initiated, contact Coastguard to ensure that they have received the message. 4. If the man is recovered initiate Serious Accident Procedure. 5. Inform the Government Agency. 6. Inform the Police. 7. Ensure that the Operators Drilling Manager is informed. NOTE: When it becomes apparent that the person has been lost, the procedure for death of a person must be followed

8.9 Fire and Explosion

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of a fire or an explosion on the Rig, the OIM must proceed as follows: 1. Give warning by activating fire alarm (if not already activated automatically). Start log of events. 2. Muster Fire Team, Back-up Fire Team and BA Team. Ensure that manual shutdown is initiated, request the shutdown of mud circulation, and secure well if required. If shutdown is automatic, check system has functioned. 3. Detail Fire Team to attack fire, Back -up Team to assist. 4. Inform the Base Office by the quickest means. Follow up with Fax message . 5. Inform Coastguard and Coast Radio. 6. Muster and check the names of all personnel not directly involved with fire-fighting. 7. Prepare to launch lifeboats/liferafts 8. Inform the Standby Vessel of situation and order it to proceed to Rig. The safe evacuation of all persons must have priority. 9. Consider evacuation of the Rig and alert helicopter service and place on standby. 10. Continue to pass situation reports to Base Office. 11. If the fire gets out of control send a MAYDAY message using the radio equipment on Distress frequencies, using MAYDAY procedure (Section 2, part 2.2). The OIM must put the safety of the crew before consideration of the equipment/material and not delay escape. 12. If fire has been controlled and extinguished, muster all personnel and report to Base Office. 13. If there are any casualties, initiate Serious Accident Procedure. 14. Stand down helicopters if not required. 15. Complete Coastal State reporting requirements within three days of injury. All accidents/incidents must be reported to Base however small. *<u>NOTE:</u> FURTHER IGNITION SOURCES IN THE FORM OF PRESSURE VESSELS, DRUMS, HELIFUEL TANKS MAY BE PRESENT. ALL CARE MUST BE TAKEN BY THE FIRE TEAM MEMBERS AND THOSE DIRECTING THEIR MOVEMENTS TO AVOID THESE HAZARDS*	In the event of a report of a fire or an explosion on the Rig the ERT must proceed as follows: 1. Start log of events. 2. Ensure that the helicopter service is aware of the situation and that a helicopter has been placed on standby. 3. Inform Coastguard. 4. Inform the Police. 5. Ensure that the Doctor is aware of the situation. 6. Inform the Coastal State authorities. 7. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. 8. If necessary, the Operators Management will obtain assistance from other operating companies, where available.

8.10 Evacuation of the Rig

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of the necessity to EVACUATE the Rig the OIM must proceed as follows: THE ORDER TO ABANDON THE RIG WILL BE GIVEN BY WORD OF MOUTH BY THE OIM OR HIS DEPUTY ONLY. 1. Decide on the urgency of the situation and determine how the evacuation shall be performed: • By Helicopter • By Standby Vessel/Supply Vessel • By Lifeboat/Liferaft 2. Inform Base Office of the decision taken and what help is required using the quickest means. Follow up with Fax message. 3. Start log of events 4. Inform the helicopter service. 5. Inform Coastguard. 6. Inform Coastal Radio Station by "MAYDAY" signal and request immediate assistance. 7. Inform standby vessel of course and action to be taken. 8. Send MAYDAY message requesting assistance from any vessel in the vicinity. 9. Sound ABANDON RIG alarm 10. Initiate shutdown procedures as appropriate (as per Station Bill) 11. Shutdown Rig. 12. All personnel shall be assembled at their Muster Point at Abandon Rig Stations wearing lifejacket, adequate warm clothing, carrying their Exposure suit and Smoke Hoods. 13. Check off names and prepare to evacuate Rig. <u>Evacuation by Helicopter</u> Personnel will remain at the Muster Point until detailed to board the aircraft as directed by the OIM. <u>Evacuation by Standby Vessel/Supply Vessel</u> Personnel will remain at the Muster Point until detailed to board the vessel as directed by the OIM using personnel basket at emergency evacuation points as appropriate. The OIM will pass a message to the Master of the Vessel acknowledging that the Master of the Vessel is in control. <u>Evacuation by Lifeboat/Liferaft</u> In the case of evacuation by lifeboats/liferafts, the OIM must proceed as follows: Check that all personnel onboard have been accounted for. Instruct all personnel to board lifeboats/liferafts as directed by the persons nominated on the Station Bill to be in charge of those lifeboats/liferafts. Immediately all lifeboats/liferafts are water-borne and a rescue vessel is in the vicinity, acknowledge that the Master of the Vessel is in control of the evacuation.	In the event of a report that the Rig is to be evacuated, the ERT must proceed as follows: 1. Ensure the helicopter service and a Doctor are fully aware of the situation and are on standby. Start log of events. 2. Contact Coastguard to confirm message has been received and to find out what action is to be taken. 3. Ensure contact with standby vessel. 4. Inform Customs and Immigration Department, of arrival points and ETA. 5. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. 6. Make urgent enquiries to alternative helicopter landing sites in conjunction with the helicopter service. 7. Inform the Coastal State authority and ask what action they wish to take. 8. If the Rig is likely to offer a hazard to navigation contact the relevant Coastal State authorities as designated in the Emergency Contact List. *<u>NOTE:</u> IT MAY BE PREFERABLE TO DISEMBARK SURVIVORS AT A NEARBY RIG RATHER THAN BRING THEM BACK TO BASE.* The following proceedings may be done in conjunction with the Operator: a. Arrange for representative to proceed to disembarkation point (helicopter or harbour) to identify and take care of evacuees and provide muster lists to that survivors can be checked off. b. Arrange for representative to proceed to Police Headquarters and/or operator to act as liaison officer. c. Compile a detailed list of all persons on the Rig and make copies available to authorities as requested, Operators or Ensco's Public Relations Officer, etc. d. Arrange for medical assistance at disembarkation point.

8.11 Helicopter Crash

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of a helicopter crash, the OIM must proceed as follows: ACTION IN CASE OF A HELICOPTER CRASH ON THE RIG. 1. Give warning by activating the EMERGENCY ALARM. Start log of events. 2. Inform Coastguard and tell them if search and rescue assistance is required. 3. Detail Fire Team to stand by with appliances in case of fire. 4. Detail Back-up/BA or emergency crew to remove occupants from the helicopter as soon as possible. 5. Alert the nominated Medic. 6. Ensure that an immediate distress broadcast is made on the Maritime Distress frequencies. 7. Assemble all other persons not directly involved in the rescue at the Muster Point and check off their names. 8. Inform helicopter service of incident and state whether the helideck is useable for landing/take off. 9. Inform Base Office using quickest means. Follow up with Fax message. 10. If there are casualties, initiate Serious Accident or Illness Procedures (PR-EU-EP-001). *NOTE: IN THE EVENT OF THE HELIDECK BEING UNFIT FOR HELICOPTER LANDING, EVACUATION OF CASUALTIES MAY BE BY WINCHING OR BY PERSONNEL BASKET TO A SUITABLE VESSEL. FROM THERE, CASUALTIES WILL EITHER BE WINCHED OFF THE VESSEL OR TRANSPORTED TO ANOTHER RIG FOR TREATMENT OR EVACUATION.*	In the event of a report from the Rig of a helicopter crash, the ERT must proceed as follows: 1. Start log of events. Ensure the helicopter service is aware of the situation and that a helicopter has been despatched with a doctor aboard, if necessary. 2. If search and rescue has been initiated, contact Coastguard to ensure that they are aware of the situation. 3. Initiate Serious Accident or Illness Procedure as in PR-EU-EP-001. 4. Inform the Police 5. Ensure that the Operators Drilling Manager or ShoreBase Supervisor is informed. 6. Inform the Coastal State authorities. 7. Inform the Air Accident Investigation Branch of the Coastal State authorities 8. Inform Customs (for rapid clearance of personnel and services needed during Emergency Action). 9. Inform immigration Department.
ACTION IN THE CASE OF A HELICOPTER CRASH INTO THE SEA IN THE VICINITY OF THE RIG 1. Activate the MAN OVERBOARD Alarm Procedure as in PR-EU-EP-002. Start log of events. 2. Inform standby vessel and initiate the recovery procedure. 3. Inform Coastguard. 4. Detail all supply vessels in the vicinity to assist in the rescue, under the direction of the standby vessel. 5. Consider the use of Rig lifeboat to assist rescue. 6. Inform the Onshore Doctor and the helicopter service. 7. Inform Base Office using quickest means. Follow up with Fax message. On recovery of survivors, they must immediately be treated for hypothermia and any other injuries. The condition of and any injuries known must be relayed to the Medic and the Onshore Doctor. 1. Check off names of survivors against the helicopter passenger list, if available. 2. If persons are missing, a warning to shipping must be made through Coastal Radio Stations. If there are casualties, initiate Serious Accident or Illness procedure PR-EU-EP-001.	1. Start log of events. Ensure the helicopter service is aware of the situation and that a helicopter has been despatched with a doctor aboard if necessary. 2. If search and rescue has been initiated, contact Coastguard to ensure that they are aware of the situation. 3. Initiate Serious Accident or Illness procedure as in PR-EU-EP-001. 4. Inform the Police. 5. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. 6. Inform the Coastal State authorities. 7. Inform the Air Accident Investigation Branch of the Coastal State authority 8. Inform Customs (for rapid clearance of personnel and services needed during Emergency Action). 9. Inform Immigration Department.

8.12 Helicopter Overdue

Once a routine communication has been established between helicopter and the Rig and the Pilot has designated flight watch to the Rig, a helicopter is to be considered overdue if it has not arrived at the latest advised ETA plus 5 minutes. En route, when a call has not been received for more than 15 minutes and communications cannot be re-established, a distress call is intercepted.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
a. Start log of events. Endeavour to make contact with the helicopter by all available means. b. Contact the helicopter company by the quickest possible means. c. Contact the **Air Traffic Control Centre,** for the Coastal State authorities (see emergency contact list) Be prepared to give as much of the following information as possible: 1. Aircraft identification and name of Operator. 2. Type of Aircraft 3. Point of Departure 4. Time of Departure 5. Speed Level and Route 6. Destination and ETA 7. Time of last contact and means (Frequency) 8. Last reported position and method of determination 9. Action taken by reporting unit. 10. Other information (this may include recommended SAR action, if appropriate) **The Emergency call should not be delayed simply because some of the above information is not immediately at hand.** d. Warn standby vessel to prepare for search and rescue action. e. Warn all supply vessels in the vicinity to prepare for search and rescue action. f. Inform Coastguard and Coastal Radio Stations. g. Inform base by quickest means. Follow up with Fax message. h. If no confirmation of the safety of the helicopter is received, dispatch vessels to best estimated position, maintaining radio contact for passing further information.	In the event of a report from the Rig that a helicopter is overdue or a distress call has been intercepted the ERT must proceed as follows: a. Start log of events and contact helicopter service for information. b. Keep the Rig informed and up-to-date. c. Contact Coastguard to exchange information. d. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. e. Once confirmation is received that an aircraft is overdue and may be ditched. 1. Inform the Police 2. Inform the Coastal State authorities *<u>NOTE:</u> SHOULD IT BECOME APPARENT THAT THE OVERDUE HELICOPTER HAS BEEN INVOLVED IN AN ACCIDENT RESULTING IN CASUALTIES, <u>NO</u> CONTACT SHOULD BE MADE WITH NEXT OF KIN WITHOUT REFERENCE TO THE POLICE. <u>NO</u> CALLS SHALL BE MADE FROM THE RIG TO NEXT OF KIN OF PERSONNEL ON THE HELICOPTER. IF THE OPERATORS OR OTHER THIRD PARTY EMPLOYEES ARE ONBOARD ADVISE THE RELEVANT EMPLOYEES OFFICES.*

8.13 Serious Crime Onboard

Crimes that require restraint or protective custody and for which the Police are to be informed are murder, sabotage or arson, deliberate injury (actual or grievous bodily harm and wounding), significant threat and drugs use. Criminal Acts within 500 metres of the Rig are regarded as having occurred within the relevant Coastal State.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of an alleged crime on the Rig, the OIM must proceed as follows: a. Consider placing the alleged offender under restraint. Start log of events and inform the Base Office by the quickest means, giving fullest details. b. Inform the doctor if necessary. c. Inform the helicopter services. d. Take preliminary statements from witnesses. Establish the available facts. Ascertain names of suspects and witnesses. e. Take such photographs as are necessary to establish facts. f. Prepare to receive Police Officers onboard.	In the event of a report from the Rig concerning an alleged serious crime, the ERT must proceed as follows: a. Start log of events and inform the Police. b. Inform the Doctor if necessary. c. Arrange helicopter for Police Officers to go to the Rig. d. Prepare to receive a Police Officer at base office for liaison duties. e. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. f. Inform other authorities if necessary. g. Inform the Coastal State authorities. h. In the event of a serious crime, the Police to direct all subsequent actions except for the OIM's responsibility for safety of Personnel/equipment.

8.14 Diving Accident

Current legislation requires the Diving Contractor to issue Diving Rules and provide Emergency Service during diving operations. The Diving Rules and particulars of the Emergency Services are to be made available to the OIM by the Diving Contractor at any time diving is taking place from or in the vicinity of the Rig.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of a diving accident on or near the Rig the OIM must proceed as follows: a. Start log of events and inform Base Office by quickest means. Follow up with Fax message. Standby boat/helicopters in field/medic, indicating a diving accident. THE DIVING SUPERVISOR IS AT ALL TIMES RESPONSIBLE FOR THE SAFETY OF DIVERS UNDER HIS CONTROL AND MAY AT ANY TIME REQUEST ASSISTANCE, WHICH MUST BE GIVEN IF POSSIBLE BUT ALL PERSONNEL MUST BE AWARE OF THE DANGER TO THE DIVER IN ATTEMPTING TO AID HIM WITHOUT THE SUPERVISOR'S EXPLICIT INSTRUCTIONS OR EXPERT ADVICE. b. Afford all facilities to the Diving Superintendent to contact his base for professional advice. *NOTE: THE DIVING COMPANY DUTY SAFETY OFFICER WILL ARRANGE FOR MEDICAL ADVICE AND THE ATTENDANCE OF A QUALIFIED DOCTOR IF NECESSARY.* When operating through Coastal Radio Stations prefix all messages with "DIVING EMERGENCY PRIORITY". c. If requested, arrange for a helicopter. d. Make all preparation onboard for reception of doctor and/or evacuation of patient. *CAUTION: THE PILOT OF THE HELICOPTER MUST BE ADVISED OF ANY HEIGHT RESTRICTION WHEN CARRYING DIVERS WHO HAVE BEEN OPERATING WITHIN THE PREVIOUS 24 HOURS.* e. Ensure that all personnel papers and medical records accompany the patient. f. Ensure that any diving equipment involved is not interfered with.	a. Start log of events and contact the Diving Contractor. b. Inform the helicopter service. c. Ensure Drilling Manager or Shore Base Supervisor is informed. d. Inform the Police. e. Inform the Coastal State authority responsible for diving emergencies (See emergency contact list). *NOTE: WHEN OPERATING THROUGH COASTAL RADIO STATIONS, PREFIX ALL MESSAGES WITH "DIVING EMERGENCY PRIORITY"*

8.15 Sabotage (Offshore Security Plan) Nov 2006

This may involve threats from various sources including unauthorised boarding by persons for purposes including; Non Governmental Organisations (NGOs) environmental activists, acts of piracy, armed robbery, labour dispute takeovers, terrorism and hijacking (hostage taking), bomb threats and the threat of or actual sabotage. In the event of an implied security threat to the Rig, the recipient must inform the base office and Rig of the threat by the quickest means possible. In the event of an attack on the Rig the preservation of life is to be placed above all other considerations. Criminal acts within 500 metres of the Rig are regarded as having occurred within the relevant Coastal State.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
Approach of unknown craft a. Raise the external alarm and inform the Operator's Representative that a vessel has or is about to breech the 500 metre zone b. Observe and monitor the craft as it approaches. c. Instruct the support vessel to intervene use search lights and whistle to make the vessel aware that it has been sighted **Hostile Boarders (NGOs, piracy or armed robbery** a. Raise the external alarm and inform the Operator's Representative b. Shut down and secure the well c. Consider using the fire hoses, but ONLY if the attackers are unarmed d. All personnel are to be directed to muster in the accommodation e. If attackers are onboard do NOT offer resistance f. Allow boarders to leave the rig event of sabotage. **Sabotage or Bomb Threat** a. Raise the external alarm and inform the Operator's Representative b. Shut down and secure the well c. A search must be carried out for any suspicious object. If anything is discovered it MUST NOT be touched or moved and the surrounding area should be cleared of personnel pending advice or assistance from Base d. Inform Base of actions taken, including the result of the search, in the message form as detailed in Section 2, Part 2.2 Emergency Messages. e. Systems must be isolated and/or shut down as decided by the OIM. f. Should either complete or partial evacuation be necessary, the procedure detailed in Procedure 8.10, "Evacuation of the Rig" must be followed.	In the event of a security threat or breech the ERT must proceed as follows: a. Start log of events, form and obtain advice from: 1. The Police 2. Coastguard 3. Coastal State authorities 4. Operators Representatives. *<u>NOTE</u> THE ABOVE AUTHORITIES MAY ALERT THE NECESSARY DEFENCE AUTHORITIES* b. The Police or local defense authorities are to direct all subsequent action except for the OIM's responsibility for safety of Personnel/equipment. c. In the event of complete or partial evacuation becoming necessary the procedure 8.10, Evacuation of the Rig must be followed. d. In the event that a security breech results in damage and/or loss of life, procedure 8.23, "Death of a Person" and procedure 8.16, "Failure of any equipment affecting safety of persons" must be followed.

8.16 Failure of any equipment affecting safety of persons

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of the failure of any equipment affecting the safety of persons the OIM must proceed as follows: a. Start log of events and ensure where possible that the scene of the accident/incident is left undisturbed. *<u>NOTE:</u> THIS IS TO FACILITATE INSPECTION BY THE APPROPRIATE INSPECTORS. IF CONDITIONS AND CIRCUMSTANCES PERMIT, EVERY EFFORT MUST BE MADE TO OBTAIN PHOTOGRAPHIC EVIDENCE.* b. Ensure that any equipment that is in a dangerous position or condition is secured. c. Inform Base Office giving fullest details by quickest means. Follow up with Fax message. d. If there are any casualties proceed as for Serious Accident or Illness Procedure. e. Obtain all necessary information regarding the incident that the authorities will require, take interim statements and photographs and have then countersigned if possible by the Safety Representative. f. <u>Fire and Gas Detection Systems</u> If the failure is local, portable equipment and/or sentries are to be provided. If the failure is total, operations must cease. g. <u>Fire Extinguishing Systems</u> Should a failure of any of these systems leave areas unprotected, the OIM is to cause temporary arrangements e.g. sentries, portable equipment, etc. to be made. h. <u>Ventilation/Pressurisation Systems</u> If a failure affects integrity of the area classification then operations which could either directly cause an ingress of gas to these areas must be shut down. Where loss of ventilation could result in a dangerous accumulation of gas, then operations which could cause this accumulation must be shut down. i. <u>Essential Plant, Machinery and Services</u> In the event of failure of specific items, e.g. power generation, communication systems, etc., which may affect the safety of the Rig the OIM is to take measures to isolate or eliminate the areas of potential hazard.	In the event of a report of the failure of any equipment affecting the safety of persons from the Rig, the ERT must proceed as follows: a. Start log of events and inform the Operators Drilling Manager or Shore Base Supervisor. They may also wish to accompany any authority inspectors to the Rig. b. Contact the Coastal State authorities informing them of circumstances of the accident and ascertain if they wish to send Inspectors to view the site. c. Keep the Rig and the operator advised of the wishes of the Coastal State authorities. d. If there are any casualties, proceed as for Serious Accident or Illness (Procedure PR-EU-EP-001). e. The class authority, ABS, are to be informed for inspection purposes.

8.17 Storm or severe weather conditions affecting the stability of the rig

The Rig has been designed to withstand the most severe weather conditions that could statistically be expected to occur in the area and, as such, it is not envisaged that Rig evacuation will be necessary due to weather conditions. However, in the unlikely event that it is considered necessary to evacuate the Rig, it must be remembered that if such action is considered, plans must be implemented in sufficient time to enable the rescue services to operate before weather conditions deteriorate to such a degree that an evacuation becomes impossible.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the unlikely event that it is considered necessary to evacuate the Rig, then action must be taken as in Evacuation of the Rig (Procedure PR-EU-EP-004). It must be remembered, however that if such action is considered, plans must be implemented in sufficient time to enable the rescue services to operate before weather conditions deteriorate to such a degree that an evacuation becomes impossible. Should the situation not require evacuation of the Rig, the OIM must still take all reasonable measures to protect the personnel, Rig and the environment. These measures should include but not be limited to: a. Start log of events and cease all operations. b. Assemble all personnel onboard, check status against POB list. c. Inform Base Office, Coastguard and helicopter contractor. d. Refer to Rig Moving Guidance Manual, for Emergency Jacking Instructions. e. Refer to Operating Manual, for Emergency Procedures for unexpected Heel or Trim which afloat. f. Refer to Operating Manual, for Operational Instructions for severe storm conditions while elevated. g. Should it be necessary to undertake any activity outside of the living quarters, life lines should be rigged where necessary and the "buddy" system of always having at least two personnel undertake a task employed. h. If a threat to the safety of personnel, the Rig or the environment develops request Base Office to alert emergency rescue services. i. If required and not already done so, consider securing the well.	In the event of a report of severe weather conditions developing proceed as follows: a. Start log of events and ensure that weather information is passed on regularly to the Rig. b. Inform the helicopter services if a standby vessel seeks shelter. c. Maintain constant contact with the Rig. d. If a threat to the safety of personnel, the Rig or the environment develop Base Office is to alert Coastguard. e. Ensure the Operator is kept informed of situation.

8.18 Movement of the seabed affecting the stability of the rig

Continuous monitoring of the seabed conditions which are likely to have any effect on the stability of the Rig must be carried out. In the event of any indication of movement, this Procedure must be initiated.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the unlikely event of an unexpected sea-bed movement affecting the stability of the Rig, the following procedure must be adopted. a. Assess the situation, start log of events, notify shore base by quickest means. Follow up with Fax. message. The message is to contain as a minimum:- 1. Details of the emergency 2. Actions taken 3. Action proposed. b. Inform standby vessel of the situation. c. Secure the well if required. d. If a decision is made to evacuate the Rig and time permits, carry out evacuation procedure as detailed in Procedure PR-EU-EP-004. e. In the event of an emergency abandonment, a MAYDAY transmission must be made if possible. f. Complete any Coastal State reporting requirements	Start log of events and ensure the helicopter service is aware of the situation. Inform Coastguard. Ensure the doctor is aware of the situation. Ensure that the Operations Drilling Manager or Shore Base Supervisor is informed. Inform the Police. Inform the Coastal State authorities If it is decided to evacuate the Rig, proceed as in Procedure PR-EU-EP-004.

8.19 Failure of the structure of the rig

Nearly all failures on Rigs have been progressive and fairly rapid. The OIM should therefore view very seriously even the smallest signs of failure, paying particular attention to cracking in deck beams, support columns and excessive movement of legs, derrick or other structures

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of any indication of structure failure, the OIM must proceed as follows: a. Raise the alarm and start log of events. b. Direct crew/personnel to safe area. c. Inform Base Office giving fullest details of any such signs by quickest means. Follow up with Fax message. d. Consider evacuation of the Rig. e. Alert the helicopter services, standby vessel and Coastguard. f. Inform the doctor. g. Contact the Coast Radio Station. h. As far as possible, maintain a log of events and copy this information to the standby vessel. i. If the situation deteriorated sufficiently to warrant evacuation of the Rig, proceed as in Procedure PR-EU-EP-004. j. Complete Coastal State reporting requirements.	In the event of a report of structural failure from the Rig, the ERT must proceed as follows: a. Start log of events and ensure the helicopter service is aware of the situation. b. Inform Coastguard. c. Inform the Police d. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. e. Ensure the doctor is aware of the situation. f. Inform the Coastal State authorities. g. Alert Diving Services if divers under pressure. h. Inform Customs (for rapid clearance of personnel and services needed during emergency action). i. Inform Immigration Department, . *<u>NOTE:</u> PREPARE TO COPE WITH LARGE NUMBERS OF PERSONNEL ARRIVING ONSHORE*

8.20 Oil or Condensate Spillage

Any spillage of oil or condensate will probably be of a minor nature only and, as such, can if required, depending on the regulations of the Coastal State, be effectively dealt with by the standby vessel which may be equipped with spray equipment and other oil dispersants. Action to take in the event of a major spill is contained in the Operators Oil Spill Contingency Plan and the Rig SOPEP plan.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of any spill on the Rig, the OIM must proceed as follows. a. **Immediately order the extinction and elimination of all ignition sources and start log of events**. b. Muster fire and back-up/BA teams. c. Consult the SOPEP plan. *NOTE: TREAT ALL LEAKS/SPILLAGE AS A POTENTIAL FIRE HAZARD.* In the event of any spill in the vicinity of the Rig, the OIM must proceed as follows: a. Make every effort to find the source of the leak and stop any further leakage. b. Inform the Master of the standby vessel and instruct him to standby for further instructions. c. Inform the Base Office giving brief details of the spillage by the quickest means. Follow up with Fax message. d. Update Base Office giving the following information: 1. Nature of the fluid spilled 2. Cause of the spill 3. Rate of discharge 4. Time of commencement of spill. 5. Measures in force for controlling flow. 6. Weather conditions. 7. Tidal information. e. Should the nature of the pollution present a danger to the Rig then the OIM should consider evacuation See PR-EU-EP-004. *NOTE: THE ABOVE ACTION BY THE STANDBY VESSEL MUST NOT BE ALLOWED TO PREJUDICE HER STANDBY AND SAFETY DUTIES.* f. Complete Coastal State required reporting	In the event of a report from the Rig that there has been a spillage of oil or condensate on or near the Rig, the ERT must proceed as follows:- a. Inform Coastguard, the Marine Pollution Control Unit and the Environmental Pollution Section of the Coastal State authorities (if any) (see Emergency Contact List PR-EU-HSE-010) Details to include: 1. The nature and degree of pollution. 2. The position, course and speed of the oil or other slick. 3. The position, course, speed and any distinctive or descriptive markings (including name) of any ship connected with the spillage or observed in the vicinity. b. Inform the relevant conservation agency. c. Contact the Coastal State authorities d. In the event of a major pollution hazard refer to: 1. Rig SOPEP Plan 2. Operators Oil Spill Contingency Plan 3. Ensure the Operators Drilling Manager or Shore Base Supervisor is informed. 4. Any industry body contingency plans for oil spill clean up.

8.21 Escape of flammable gases

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of the escape of flammable gases, the OIM must proceed as follows: a. Give warning by activating the gas alarm (if not already operated automatically) and start log of events. b. **Immediately order the extinction and elimination of all ignition sources.** c. Muster Fire Fighting team and Back-up/BA Team. d. If required shutdown team are to initiate manual shutdown procedures as described on the Station Bill and start Well Control Procedures. e. If shutdown is automatic, check system has functioned. f. Inform Base Office by quickest means. Follow up with Fax message. g. Muster all other personnel not directly involved. h. Consider evacuation of the Rig, inform the helicopter service and place on standby. i. Inform Coastguard and Coast Radio Stations. j. Continue to pass reports to Base Office. k. If gas ignites, proceed as in Fire or Explosion Procedures (Procedure PR-EU-EP-003). l. If the situation has deteriorated sufficiently to warrant evacuation of the Rig, proceed as in Evacuation of the Rig (Procedure PR-EU-EP-004).	In the event of a report from the Rig that there has been an escape of flammable gases, the ERT must proceed as follows: a. Start log of events and ensure the helicopter service is aware of the situation. b. Inform the Coastguard. c. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. d. Inform the doctor to ensure he is aware of the situation. e. Inform the Police. f. Inform the Coastal State authority. g. If gas ignites, proceed as in Fire or Explosion (PR-EU-EP-003). h. If evacuation becomes necessary proceed as in Evacuation of the Rig (PR-EU-EP-004).

8.22 Collision or interference by vessels

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
In the event of a collision involving the Rig, the OIM must proceed as follows: a. Raise the alarm on the Rig. b. Start log of events and inform the Base Office stating clearly the problem and what assistance is required by quickest means. Follow up with Fax message. c. Inform the Standby vessel. d. Inform Coastguard and Coast Radio Station. e. Consider evacuation of the Rig, inform the helicopter service and place on standby. Continue to pass situation report to Base Office. f. Should Rig suffer damage which could lead to structural failure, proceed as in Structure Failure (Procedure PR-EU-EP-013). g. Similarly, if anyone is injured, proceed as in Serious Accident or Illness (Procedure PR-EU-EP-001). h. Complete Vessel Incident Form and forward to Base. <u>In the event of interference by Vessels</u> a. Attempt to contact the vessel by audio and visual signals and warn the vessel that she has committed an infringement and ask her to alter her course to avoid the 500 metre zone. b. If vessel is on likely collision course, raise the alarm and have crew assemble at <u>safest</u> muster point. c. Note the name, port of registration, identification number and colouring of the vessel, if possible, make photographic record. d. Note the position and estimated movement of the vessel, weather conditions at the time of the incident. e. Inform the Base Duty Officer and Coastguard. f. Complete Coastal State reporting requirements.	In the event of a report from the Rig of collision or interference by vessels the ERT must proceed as follows: a. Start log of events and ensure the helicopter service and doctor have been alerted as necessary. b. Contact Coastguard to confirm message has been received and to ascertain what action is being taken. c. Ensure that the Operators Drilling Manager or Shore Base Supervisor is informed. d. Inform the Coastal State authorities and ascertain what action is being taken. e. Inform the Police

8.23 Death of a Person

DO NOT ASSUME DEATH OF A VICTIM; Continue to try to revive him even if it is apparently hopeless.

The authority of a doctor must be obtained since only a doctor can certify death. If there is any doubt whatever, the incident must be treated as a serious accident.

Where any person:

a. Dies on a Rig or is lost from a Rig in circumstances such as that it is reasonable to believe that he has died; or

b. Dies in or on a lifeboat, liferaft, or any other emergency survival craft belonging to the Rig or is lost there from in such circumstances as aforesaid; or

c. Otherwise dies or is lost in such circumstances as aforesaid in the neighbourhood of a Rig while engaged in any operation connected with the Rig

The OIM must complete and sign any Coastal State reporting requirements and send them to the Base Office within three days of the death or loss of the person.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE

ACTION TAKEN BY OIM (continued)	ACTION BY SHORE BASE (continued)
Note the position of Valves/controls if they have to be moved. Collect eye witness accounts as soon as possible. b. Consult the nominated medic onboard. c. Inform the Base Office giving details of the accident by quickest means. Follow up with Fax message. Do not use voice communication until told to do so by the Vice President/Unit Manager or Manager Operations. d. Request a helicopter at the earliest convenience through Base Office. e. Inform Standby vessel of events. f. If contact with Base Office is impossible, then communications should be via the Coastal Radio Stations. AT THIS STAGE THE PERSON'S IDENTITY SHOULD NOT BE DIVULGED. NB: Fatalities occurring in or from ships must be reported in accordance with instructions in any Merchant Shipping legislation of the Coastal State. g. Complete Coastal State reporting requirements and despatch to Base Office as soon as possible. *<u>NOTE:</u> EXPECT VISIT FROM POLICE, DOCTOR PLUS Ensco AND OPERATORS REPRESENTATIVES. AND REPRESENTATIVES FROM THE COASTAL STATE AUTHORITIES*	e. Inform the Coastal State authorities and ask them if they want to send an inspector, if their reply is negative, ask if the site has to be left undisturbed for the statutory three days. f. Inform the Customs of landing place. g. Once the identification has been made and the death certificate issued, if the person was an Ensco employee, the next of kin are to be advised by Police and an Ensco representative (if possible). If the person was an Operator's or third party contractor employee, the relevant company Head Office for the employee is to be notified. *<u>NOTE:</u> THE POLICE WILL USUALLY TAKE THE RESPONSIBILITY FOR INFORMING NEXT OF KIN AFTER A FATALITY. Ensco MAY WISH TO SEND A REPRESENTATIVE WITH THE POLICE TO THE DECEASED'S NEXT OF KIN. (THE SPECIFIC ARRANGEMENTS FOR NOTIFYING NEXT OF KIN WILLBE FOLLOWED FOR THE OPERATING AREA.*

8.24 Absence of a Standby Vessel

The standby vessel is to maintain station within an agreed radius of the Rig, endeavouring to remain within visual distance at all times and is to remain on station, unless specifically authorised otherwise. Full engine power must be available at all times. The only time when the standby vessel may disregard these instructions is in an emergency situation such as:-

a. Severe weather conditions making it unsafe for the standby vessel to remain on station.

b. Any condition on the standby vessel rendering her unseaworthy and thus making it necessary to put into port immediately.

c. Injury or illness to any crew member which requires the vessel to put into any port.

d. Is requested elsewhere for emergency duties.

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
If the standby vessel has to leave station for any reason the OIM must proceed as follows: a. Start log of events and inform Base Office of the position by quickest means. Follow up with Fax message. b. If there is an Rig in the vicinity, inform them of the situation and request the service of their standby vessel to be used on a joint basis for a short time. c. Inform the helicopter service of the situation and request that a helicopter is placed on standby. d. Inform any supply vessels working with the Rig of the absence of the standby vessel and nominate one of these vessels to temporarily act as standby vessel. e. Consider suspending any operations affected, e.g. working/overside, helicopters and diving. f. On return of the official standby vessel, stand down the other assisting vessels and helicopter service.	In the event of a report from the Rig that the Standby Vessel has left its station, the ERT must proceed as follows: a. Start log of events and ensure the helicopter service is aware of the situation and that the helicopter has been placed on standby. b. Notify Coastguard. c. Inform the Operators Drilling Manager or Shore Base Supervisor who will: 1. Contact the Standby Vessel owners and ascertain the length of time the vessel will be absent from standby duty. 2. Request the immediate services of another Standby Vessel from the same company. 3. If this is not possible, approach other companies with a view to providing a Standby Vessel on a temporary basis. d. Inform the Coastal State authorities

8.25 Standby Vessel on Station

ACTION BY THE MASTER OF STANDBY VESSEL

INTRODUCTION

The duty of the Standby Vessel is to maintain a continuous alert for any emergency which may occur on or in the vicinity of the Rig. On the receipt of instructions from the OIM, the actions to be carried out in the event of an emergency are detailed in the following paragraphs.

1. Man Overboard
2. Evacuation of the Rig
3. Leakage or Spillage of Oil or Gas
4. Helicopter Operations
5. Transmission of Emergency Signals
6. Fire
7. Fire Evacuation

1. MAN OVERBOARD

On receipt of a MAN OVERBOARD message the Master of the Standby Vessel must:

a. Proceed at a speed to the point where the man entered the water and COMMENCE A SEARCH OF THE AREA.

b. Alert the crew and make ready lifesaving and first aid equipment.

c. Swing out and man the rescue boats

d. Take note of instructions passed by the OIM.

e. Launch the rescue boat when the man is sighted.

f. Treat the man for hypothermia when recovered from the sea.

g. Return the man to the Rig as soon as possible for further treatment and possible evacuation.

h. Maintain direct radio communication with the Rig throughout the emergency.

2. EVACUATION OF THE RIG

On receipt of an ABANDON RIG message the Master of the Standby Vessel must:

a. Position the vessel to render the maximum assistance to survivors by rounding up survival units and recovering persons from the water or scrambling nets.

b. Avoid fire patches on or over the sea, as the Rig's lifeboats are equipped with systems to enable them to travel through oil fires. In addition to oil on the water, there may be flammable gas drifting on the wind on the lee side of the Rig.

c. Assume responsibility for all operations external to the Rig and instruct other vessels as necessary in order to ensure survival of the maximum number of persons.

d. Alert the crew and prepare all lifesaving and first aid equipment for reception of survivors.

e. Man and launch the rescue boat to give assistance if necessary.

f. Immediately treat survivors for hypothermia on recovery from the sea.

g. Arrange to transfer injured persons to nearby Rigs or suitably equipped vessels for medical treatment and evacuation.

h. Evacuate seriously injured persons by helicopter where possible and arrange suitable winching facilities.

i. An accurate head count of survivors should be kept, regular updates should be given to the Coastguard of numbers of persons onboard and numbers of personnel transferred to other Rigs or vessels.

ACTION BY THE MASTER OF STANDBY VESSEL (continued)

3. LEAKAGE OR SPILLAGE OF OIL OR GAS

On receipt of information regarding leakage or spillage of oil or gas, the Master of the Standby Vessel must:

a. Make ready all emergency systems on board the vesssel.

b. If the spillage is large, monitor the extent and drift for a maximum distance of five nautical miles or until relieved by surveillance aircraft or vessels dispatched by Base.

c. Avoid areas of gas eruption in the sea as the aeration of the water can reduce the buoyancy of the vessel.

d. Be aware that the gas may be drifting in the air on the lee side of the Rig, and use hand gas detection equipment if necessary.

4. HELICOPTER OPERATIONS

When advised by the Rig that helicopter operations are to take place, the Master of the Standby Vessel must:

a. Prepare lifesaving and first aid equipment for immediate use.

b. Position the vessel to leeward of the Rig and to one side of the anticipated flight path of the helicopters.

c. Launch the rescue boat if a helicopter ditches. The Standby Vessel must not approach the ditched helicopter at speed, as this may capsize the helicopter.

5. TRANSMISSION OF EMERGENCY SIGNALS

In the event that the Rig is unable to transmit emergency signals, the Standby Vessel must:

a. Immediately assume responsibility for communications with other vessels and onshore facilities as the situation so demands.

b. Initially transmit messages to Coastguard and other vessels and aircraft who can provide assistance.

c. Maintain communications with the Rig using all visual and audible means available for as long as possible.

6. FIRE

In the event of a fire or fire hazard aboard the Rig, all the vessel's firefighting and lifesaving equipment must be brought to an immediate state of readiness and the Rig closed.

If, in any of the above cases, no direct instructions are received from the Rig, the Master of the Standby Vessel is to take whatever action he considers necessary in the circumstances whilst endeavouring to establish communication with the manager.

7. FIRE EVACUATION

In the event of a fire necessitating the immediate evacuation of the Rig the Master of the Standby Vessel is to take appropriate action as described in Procedure PR-EU-EP-004 of this manual. NOTE further assistance may be given by directing fire hoses to a position above the evacuation points such that a curtain of water is obtained which will act to produce a cooling effect in way of the evacuation points to aid the safe evacuation of all personnel.

8.26 Vessel Overdue

ACTION BY OIM AND SHORE BASE

In general, the responsibility for reporting a vessel overdue at its destination, or failure to report within a period of 24 hours, rests with the owner. It is, however, incumbent on Ensco as a responsible operator to monitor such actions. The following procedures must be carried out as soon as a vessel is presumed overdue. The responsibility for starting the procedures rests with the Ensco OIM or ERT, depending on the destination of the vessel.

a. UNCERTAINTY PHASE

When a vessel is thought to be overdue:

1. Check with owners to establish last contact.
2. Inform Coast Radio Stations with a request to make contact.
3. Inform Harbour Masters in coastal areas, with a request to check arrivals.

b. ALERT PHASE

When a vessel has not arrived at destination or reported for 24 hours and the above have produced no results:

1. Inform Coastguard of situation.
2. Inform Coast Radio Stations with a request to make contact.
3. Inform Harbour Masters in coastal areas, with a request to check arrivals.

DISTRESS PHASE

When actions a) and b) have brought no results:

1. Report situation to Coastguard with request for search and rescue action.
2. Contact Operators management for air and sea search facilities.
3. Inform owners of action taken and request fullest information of vessel, crew, passengers and next-of-kin. In all cases, a detailed log of events must be maintained by the OIM if the destination of the vessel is the Rig the assistance of further company resources may be obtained.

8.27 Kicks

The severity of any well control problem will dictate the speed at which the Rig OIM will be able to notify the onshore office. As a rule, of course, notification should be sent immediately a problem starts. However, from an operational point of view the following guidelines should be followed.

High volume/high pressure influx call as soon as possible.

Low volume/low pressure during office hours call as soon as possible. Out of office hours, report situation at morning report.

Use 200 psi/20BBL influx as a cut off point for immediate or otherwise notification.

IF IN DOUBT, REPORT THE SITUATION IMMEDIATELY TO YOUR RIG MANAGER.

Remember: Always have all pertinent well control information available at report time.

ACTION BY SHORE BASE
a. Ensure the Operators Drilling Manager or Shore Base Supervisor is informed. b. Maintain constant contact with the Rig. c. According to the situation on the Rig, mobilise the appropriate equipment, etc. d. As details become clear it may be necessary to call the Coastal State authorities and complete any relevant reporting requirements e. Prepare to receive evacuated non essential personnel. f. Refer to Procedure PR-EUM-EP-001 for any casualty reception
ACTION BY THE DRILLER
Shut-In Procedure While Drilling - Surface BOP The Driller shall take the following steps to shut-in the well: a. Sound alarm b. Stop the pipe rotation and then pick up off bottom sufficient to ensure that the tool joints are clear of the stack ram closure position c. Stop the mud pumps d. Close the annular BOP and then open the hydraulic (HCR) choke line valve to the choke manifold. e. Verify that the well is shut-in.

f. Notify the OIM or Toolpusher.

g. Record the shut-in pressures and the pit gain. Initiate a kick log.

h. If the shut-in annular pressure exceeds 1000 psi, check the space-out and then close the upper pipe ram preventer.

i. Bleed off the pressure between the pipe rams and annular preventer and open the annular BOP, when possible.

Shut-In Procedure While Tripping – Surface BOP

Position the upper tool joint just above the rotary.

a. Ensure that the floor-crew sets the slips and unlatches the elevator.

b. Raise the top drive clear of the drill string.

c. Instruct the floor-crew to install the full open safety valve

d. Close the full open safety valve

e. Close the annular BOP

f. Open the hydraulic (HCR) choke line valve to the choke manifold.

g. Verify that the well is shut-in.

h. Notify the OIM or Toolpusher of the situation.

i. Make up the top drive onto the safety valve.

j. Instruct the crew to open the safety valve.

k. Record the shut-in pressures and the pit gain. Initiate a kick log.

l. If the shut-in casing pressure exceeds 1000 psi, check the space-out and then close the upper pipe rams.

m. Bleed off the pressure between the pipe rams and annular preventer and then open the annular. If pressure cannot be bled off before opening annular, ensure rotary bowls are locked and everyone clear of rotary area before opening annular.

Shut-In Procedure with Drill Collars in the Bop Stack

a. If flow occurs with the BHA in the stack, install an FOSV and close it. Perform a hard shut-in. Install a NRV and open FOSV. Immediately strip in the hole, crossing back to drill pipe as soon as practical. Close the pipe rams above a drill pipe tool joint if stripping is suspended.

b. If some of the full gauge BHA components (stabilizers, roller reamers etc.) straddle the BOP, it will not be possible to strip in. Either pull the assembly clear of the BOP and close the shear rams or run in the hole install an FOSV in the drill string and close it then close the annular above the stabilizers. Install a NRV, open FOSV. Open the choke line failsafe valves to the remote choke and record pressures.

c. If there is any reason to believe that the shut-in pressure will rise such that the upward force on the drill collars will exceed the string weight, then the string should be pulled above the stack or dropped and the shear rams closed.

d. Prepare to strip in or kill the well by an alternative method.

e. Caution: Taking a kick with the drill collars in the BOP is particularly hazardous because it is possible that the

upward force on the collars due to shut-in pressure may exceed the string weight at this point. It shall not be possible to hold the string down with the pipe rams as can be done with drill pipe. Always perform a flow check prior to pulling the BHA through the BOP stack to minimize the risk of taking a kick with the BHA across the BOP.

f. Always use trip tank while tripping to fill the hole at all time.

Shut-In Procedure with No Drill String in the Hole

a. If a flow occurs while out of the hole, close the blind/shear rams. If logging, have wire line cutters on the drill floor for cutting the cable at surface. Know whether the shear rams are capable of cutting the logging wire line before attempting to shear the line.

b. Open the failsafe valves the choke line against a closed choke. Monitor and record SICP at 1 minute intervals until it has stabilized.

c. Prepare to strip in or kill the well by an alternative method. The Drilling Superintendent must be consulted to discuss stripping or alternative methods of well control prior to commencing operations.

d. Note: Record pit gain and shut in pressure.

ACTION BY THE OIM
KICK KILL a. Prior to shoe drill out; fill out and maintain daily, a record of all pertinent pre-kick information (some operators have dedicated forms for this information they prefer to use). b. When kick pressures have stabilised and have been recorded; proceed with kill procedure calculations (Ensco prefers the wait and weight method of well control, however, it is understood that factors on site may determine the method of well control used). c. Weight mud in pits up to calculated kill weight. d. Plot/chart drill pipe pressure drops versus strokes to bit. e. Bring mud pump up to Initial Circulating Pressure (ICP) at kill rate Strokes per Minute (SPM). f. Adjust choke as needed to follow drill pipe pressure plot until kill weight mud reaches bit. g. Maintain final circulating pressure until mud reaches surface. NOTE: WELL KILL PROCEDURES ARE SUBJECT TO PARTICULAR OPERATOR WELL CONTROL POLICIES.

ACTION BY DERRICKMAN OR ASSISTANT DRILLER
KICK WHILE DRILLING a. To prevent gas migrating into machinery deck areas, close the thru-hull drain lines in the event of a well kick. GAS DETECTION IN THE MUD PITS ROOM a. On detection of gas in the Mud Pits Room, the mud circulation system shall be shut down and returns to the pits isolated.

8.28 H_2S Gas Release

ACTION TAKEN BY OIM	ACTION BY SHORE BASE
Whenever H_2S is expected for the particular location that the Rig may be working in, the Operator or Ensco may engage a specialist company to provide a range of breathing apparatus, associated equipment and training to meet all foreseeable circumstances. However, should concentrations of H_2S be found unexpectedly, the following actions should be taken. a. Give warning by activating the H_2S gas alarm (if not already operated automatically). Start log of events. b. Driller/Drill Crew to don BA gear (situated on Drill Floor) and make well safe. c. Muster: 1. All non essential personnel 2. Driller after making well safe at the H_2S muster point (as high as possible on the Rig). d. Inform standby boat and any other vessels in the area to move upwind and await instructions. e. If personnel are missing from muster: 1. Organise BA teams to start searching appropriate areas. f. Inform Base Office by quickest means. Follow up with Fax message using FLASH procedures (Section 2, part 2.3). Keep Base Office informed of the situation. g. Inform Coastguard and Coast Radio Stations. h. Inform helicopter company(s) and ask for them to stand by in case of evacuation. i. Inform all other Rigs in the immediate area and ask for any helicopters at those Rigs to be put on standby to evacuate personnel. j. If gas ignites, proceed as in Fire or Explosion (Procedure PR-EU-EP-003). k. If the situation has deteriorated sufficiently to warrant evacuation of the Rig, proceed as in Evacuation of the Rig (Procedure PR-EU-EP-004) H_2S in large concentrations is odourless and colourless **DO NOT TAKE RISKS** very small concentrations of H_2S can cause serious illness and death.	In the event that there is a report from the Rig that there has been an H_2S gas release the ERT is to proceed as follows: a. Start log of events and ensure the helicopter service is aware of the situation. b. Inform the Operators onshore representative (Drilling Manager or Shore Base Supervisor). c. Inform the Coastguard. d. As details become known inform the Coastal State authorities. e. Inform the Duty Doctor and ensure he is fully aware of the situation. f. Call and put on standby other personnel in the Ensco emergency call out team. g. If reported that gas has ignited or the Rig is evacuating personnel proceed as in Procedures PR-EU-EP-003 or PR-EU-EP-004.