Exposure to Hazards

COPCL implements strict operational procedures to prevent accidental releases. An accidental release is therefore considered an unplanned event and any potential impact of accidental releases on the environment is discussed under unplanned events.

Changes to fish taste, recreation/tourism, visual aesthetics could potentially affect public health. These potential impacts were discussed in *Sections 5.1.1.1, 5.3.3.1, 5.6.2.1*, respectively. The significance of these potential impacts was rated as negligible.

Regardless of actual impacts, safety record of Chevron, operational procedures to prevent/reduce potential impacts, there could be a perceived concern in the community regarding any oil production in/near their country/community. COPCL will address perception of hazards through its communication plan.

5.8 Assessment of Potential Impacts from Unplanned Events

Screening was conducted on five unplanned event scenarios. The potential impacts from some of potential events (well blowout and FSO rupture) are related to accidental releases. The assessment of these unplanned events is therefore grouped together in one section.

5.8.1 Collision

Collisions could potentially occur during transport of materials and/or crew, and during drilling/installation, operations and abandonment. Transportation of crude oil will be done by third party vessels and is not considered in the assessment.

The following section assesses the potential impact of collisions on public health. Collisions could also result in accidental releases that impact the environment. Accidental releases resulting from collisions are not assessed in this section but addressed in the Accidental Release section.

The International Maritime Organization (IMO) keeps records of serious casualties of maritime accidents. Out of a total of 552 accidents that occurred since 2000, 236 resulted in very serious casualties. Two of the 552 accidents were in the Gulf of Thailand. In 2000, an accident involved machinery damage and serious injury on an oil tanker. In 2002 a collision between a chemical tanker and container ship resulted in serious casualties (IMO, 2011) . The latest collision accident in the Gulf of Thailand was in June 2009 between a break-bulk carrier and a fishing boat, resulting in one death.

Statistics indicate that fatalities and serious injuries may occur in the industry. Collisions could involve non-project vessels and thus result in social and public health impacts. The consequence is therefore rated as severe for potential social and public health impacts. Given COPCL's mitigation measures and very low marine traffic resulted from project, the probability of a collision resulting in severe injuries and death for the lifecycle of the Apsara project is rare. Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk is at a low level and will be controlled to prevent increased risk.

COPCL will reduce the risk of collisions by adopting the following mitigation measures:

- At least 45 days prior to rig and installation vessels mobilization, a Notice to Mariners will be issued; this will be done in coordination with Cambodian authorities regarding project activities.
- A 500 m safety zone will be established around the drilling rig, FSO and platforms.

- Support vessels will be used to warn off traffic.
- Appropriate lights and warning signals will be provided on all vessels and topside facilities (FSO, platforms) to prevent accidental collision.
- Should an incident occur, the Emergency Response Plan would be implemented. Emergency response exercises will be held regularly. A communication plan addressing Public Health issues management will also be developed.

These mitigation measures have been implemented on other Chevron installations.

5.8.2 Fire or Explosion

Fire is an inherent risk in production of gas and oil because of their flammability. The E&P Forum QRA Directory (1996) data are presented in **Table 5-29**.The "large oil, 1980-90" platform category is the most similar to the Apsara Development Project. However, the Block A project is designed using recent standards and risk mitigation measures. The below statistics are therefore considered a worst case.

Accidental releases resulting from fire/explosion are not assessed in this section but addressed in the Accidental Release section.

Table 5-29: Fire/Explosion Statistics by Installation Type

Platform Type	No. Fires / Explosions	Platform Years	Fire / Explosion per Platform Year
Large, oil, pre-1980	13	264	0.049
Large, oil, 1980-90	1	81	0.012
Gas Complex	1	300	0.003
Small Integrated	1	170	0.006
Unmanned	0	245	<0.004
Total	16	1060	-

Source: E&P Forum QRA Directory (1996)

Statistics from the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE), previously Mineral Management Service (MMS, US Department of Interior) show that there were a total of 680 offshore incidents involving fires and explosions during 2006-2010 in the USA. One of these fires/explosions was catastrophic, 3 were major (damage > 1 million dollars), 32 were minor (damage 25,000-1 million dollars). These fires and explosions resulted in 1 fatality and 22 injuries(BOEMRE, website, 2011).

Statistics indicate that fatalities and serious injuries occur in the industry. However, a fire and explosion would not affect members of the public due to the facility's location far offshore. The risk of potential social and public health impacts has therefore been rated as incidental. The probability of this consequence of potential social and public health impact may have occurred in the industry and is therefore rated as remote (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a fire/explosion resulting in potential health and social impacts is therefore rated as low.

COPCL will implement the following mitigation measures regarding fire:

- Fire extinguishers, alarms and windsocks will be installed on FSO (to be audible and visible from whole site).

- COPCL will implement its Emergency Response Plan Procedure to reduce possible consequences if a fire occurs.

5.8.3 Accidental Releases

Accidental release prevention measures have been built into the design of the project. In addition, COPCL implements strict operational procedures to prevent accidental releases, including spills. An accidental release is therefore considered an unplanned event and any potential impacts from an accidental release are discussed below.

The potential environmental consequences of an accidental release are dependent on a number of factors:

- The location of the release;
- The size of the release;
- The type and properties of the released material;
- The prevailing metocean conditions at the time of the release (winds, currents);
- The time of the year the release occurred;
- The environmental and social sensitivities that could be impacted by the release;
- The success of the oil spill contingency plan.

Type and Location of Release: The following materials will be handled during the life of the project and have the potential to be released from the locations listed below:

- Produced fluid (gas, water and crude prior to separation) from platforms and flowlines;
- Marine diesel Oil from FSO, rig and platforms;
- Helifuel (jet fuel) from FSO;
- Intermediate fuel oil from FSO;
- Lube oil from FSO, platforms and rig;
- Produced water from Processing Platforms and FSO;
- Chemicals including drilling mud from FSO, platforms and rig;
- Crude oil from pipeline, Processing Platforms and FSO;
- Waste from platforms and FSO.

Size of Releases: Most of the potential release scenarios for the materials listed above are likely to be small. Medium, major and worst case releases are rare unplanned events, for instance crude oil spills. The different sized releases are discussed separately below.

Environmental and Social Vulnerability to Accidental Releases: Potential environmental and social effects of accidental releases depend in part on the toxicological characteristics of the material released. Most of the material with the potential to be accidentally released is oil. The toxicological characteristics of oil in general are discussed below. The toxicological characteristics of other released material are discussed within the specific small spill assessment below.

Potential effects of oil/fuel releases in the marine environment have the potential to include ecological, physiological and behavioural impacts among a wide range of marine and seabirds organisms (OSB, MB, TRB 2003) as well as potential social effects (e.g., potential impacts on fisheries, aquaculture, coastal tourism, aesthetics).

Potential effects of oil on animals include:

- Direct short-term effects on animals from direct oil/fuel exposure (e.g., ingestion or coating birds);
- Short-to-medium term impacts include those associated with the chemical toxicity of oils/fuels, primarily due to the water soluble aromatic hydrocarbons (e.g. benzene). Exposure to these toxic compounds may occur via direct contact with oil/fuel, and/or accumulation of soluble hydrocarbons in the water column or impacted sediments.

Seabirds spending time on the sea surface are considered vulnerable to surface oil pollution due to the high affinity between oil and plumage. Although oil ingested during attempts by birds to clean plumage may be lethal, the most common cause of death is from loss of body heat, starvation and drowning following damage to the plumage of the oil (OSB, MB, TRB 2003). Plumage is essential to flight, heat insulation and waterproofing. Oiled birds may rapidly die from exhaustion.

Fish – Fish are generally not affected by oil slicks on the sea surface. Depending on levels of hydrocarbons in the water, potential sublethal effects of released oil include impairment of reproductive systems or increased vulnerability. Potential effects on fish populations could however potentially occur if an accidental release occurred in fish spawning / nursery areas during sensitive periods.

High molecular weight polycyclic aromatic hydrocarbons (PAH) may bioaccumulate in fish. Bioaccumulation is the buildup of a chemical substance in an organism to levels that are higher than in the environment where the organism lives. Polycyclic aromatic hydrocarbons (PAHs) are the chemicals in petroleum□based oils most likely to bioaccumulate in seafood tissues. The size of a PAH affects both its tendency to bioaccumulate and its toxicity. Smaller PAHs can be acutely toxic to fish and shellfish (NOAA, 2010). However, smaller PAHs may result in taint (a disagreeable flavor or odor not typical of the seafood itself) (NOAA, 2010).

Accidental releases may affect fish behavior: wild fish have been observed swimming away from accidental releases of oil. This avoids long term effects on local fish populations. However, fish populations moving back into an area following an accidental release may take some time to recover if the area is used for feeding and breeding (IPIECA, 1997).

Plankton – Eggs and young stages are more vulnerable to oil pollution than adults (IPIECA, 1997).

Marine Mammals such as whales and dolphins in the open sea do not appear to be particularly at risk from most oil spills as they are highly mobile and swim away from the affected areas. Marine mammals may become exposed to oil by ingesting prey that have oil or its metabolites in their tissues. Oil can also indirectly affect the survival or reproductive success of marine birds and mammals by affecting the distribution, abundance or availability of prey.

Air Breathing Mammals may be affected by inhalation of volatiles, however this has not been reported as a major concern.

Sensitive Environments: Mangroves are vulnerable to accidental releases of oil. Oil slicks enter mangrove forests at high tide and are deposited on the aerial roots and sediment surface when the tide recedes. Mangroves can be killed by heavy oils that cover the trees' breathing pores thereby asphyxiating the subsurface roots which depend on the pores for oxygen. Mangroves can also be killed through the toxicity of substances in the oil, especially lower molecular weight aromatic compounds which damage cell membranes in the subsurface roots (IPIECA, 1993). Due to the low-energy environment, effects from an oil spill may be long-lasting (OSB, MB, TRB, 2003).

Organisms living among and on the mangroves trees can be affected as a direct result of the oil. For instance, oil can penetrate in the sediments and kill sediment benthic animals, and indirectly through the death of the mangrove trees (IPIECA, 1993). Oil degradation and reduction in toxicity is likely to occur over time.

Sensitive Environments - Coral Reefs: oil is less dense than water so it generally floats over the reefs. Exposed reefs and reefs exposed during low tides may come into direct contact with oil, resulting in smothering. Dissolved hydrocarbons may form droplets and can also come in contact with coral reefs. Most studies, conducted in laboratories show a wide range of effects on corals resulting from exposure to oil such as decrease in growth, or decrease in colonization capacity (IPIECA, 1992).

Fisheries, Public Health and Social Implications: An accidental release of oil has the potential for the following effects:

- Direct effects on fish and plankton as described above;
- Direct effects on fisheries – including aquaculture:
  - Tainting –fish exposed to oil may become tainted by oil-derived substances. Tainting is of particular concern in caged fish and immobile shellfish which cannot swim away.
  - Commercial catches may also become contaminated from contact with oil fouled fishing gears. Taint is usually lost through the normal processes of metabolism once the oil source has gone but testing is needed to demonstrate when fish are fit to eat. Studies have not demonstrated any increased risks of diseases in humans through eating seafood from areas where accidental releases of oil have occurred.
  - Fishing activities: major spills can result in loss of fishing opportunities with boats unable or unwilling to fish due to the risk of fouling; this may cause temporary financial loss to commercial fishermen and temporary food shortage to artisanal fishermen;
- Indirect effects through ecosystem disturbance as seen in 'sensitive environments'.
- Indirect public health and social effects:
  - The disagreeable flavor or odor not typical of the seafood itself may result in loss of income, which may have additional potential social and/or public health impacts.
  - Bioaccumulation of the larger PAHs are believed to cause cancer in humans.
  - Reduces aesthetic value of nearshore areas and loss of tourism and recreational opportunities.

The health rating of diesel fuel and crude oil are listed in **Table 5-30**.

Table 5-30: Potential Health Effects of Fuel and Crude Oil

Chemical	Potential Health Effects
Diesel Fuel	HMIS Rating: Health: 0; Flammability: 2; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health hazard, fire hazard May result in mild eye irritation; skin irritation with prolonged/repeated contact; may result in chemical pneumonia, severe lung damage, respiratory failure and even death upon ingestion; irritation to nose, throat, lungs, respiratory tract and central nervous system effects including death
Crude Oil	NFPA Rating: Health: 1; Flammability: 3; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health hazard, fire hazard May result in slight to moderate eye, moderate skin irritation; may result in chemical pneumonia; extremely irritating to throat and stomach

5.8.3.1 Classification of Accidental Release

Accidental releases are classified as per the Tiered system (**Table 5-31**).

The Tiered system gives a structured approach to both establishing oil spill preparedness and undertaking a response. Conventionally, the concept has been considered as a function of size and location of a potential oil spill, with three tiers defined (IPIECA, 2007). Spills tiers have been classified as per Industry best practices.

Table 5-31: Oil Spill Response Tiers (adapted from IPIECA)

Tier	Definition
1	Operational in nature Occurring at or near an operator's facilities as a consequence of its own activities. On-site equipment and resources and sufficient to respond to the spill
2	Are more likely to extend outside the remit of Tier 1 response area and possibly be larger in size, where additional resources are needed from several potential sources. Above the capabilities of the Tier 1 resources, requiring regional assistance
3	When on-site and local resources and inadequate to deal with the response. Due to its scale a large oil spill which requires external response contractors and Tier 3 Global oil spill response equipment.

Tier I

Small volumes of diesel fuel, crude oil, and lubricating oil caused from minor incidents that do not represent a safety hazard, and are unlikely to impact environmentally sensitive areas. This level of impact is within the capabilities of COPCL's on site resources to control. Tier 1 spills are discussed in Section 5.8.3.2

Tier II

Larger volumes of oil spillage which cannot be readily controlled using on site resources. The probability of a Tier 2 spill is lower than for a Tier 1 spill; however the potential consequence could be higher than for a Tier 1 spill. Such an accidental release may necessitate mobilization of regional equipment to minimize potential impacts.

Tier III

Large accidental release (e.g.: large uncontrolled well blowout) is beyond the combined capability of COPCL and regional capabilities to respond to. In this situation COPCL would mobilize worldwide equipment and resources. Tier 3 spills are discussed in Section 5.8.3.3

5.8.3.2 Accidental Releases during Bunkering or Ship to Ship Transfers: Fuel, Chemicals, Produced Water, Crude Oil

Causes of accidental releases include mechanical failure (e.g., hose rupture) or human error. For instance, diesel, intermediate fuel oil, mud transferred in bulk, may be accidentally released during bunkering operations. However, the volumes of potential fuel releases during fuel handling are normally small, typically in the few barrels range.

Occurrences of small accidental releases could be during bunkering of drilling mud, diesel, and intermediate fuel oil. Small releases during ship-to-ship transfer could occur during transfer of crude oil from FSO to export tankers. Most chemicals will be transferred in tote tanks.

Diesel, Intermediate Fuel Oil and Crude Spills - small releases of hydrocarbons could occur, average volumes would be a few barrels. Light hydrocarbons are likely to be dispersed and evaporated. Limited clean up response may be required for accidental releases of crude oil but

volumes would be small and the oil would not be expected to reach shore. These accidental releases would be expected to be Tier 1 releases. Potential environmental impacts are likely to be localized and short-term and are therefore rated as incidental (**Table 5-6**). The probability of this consequence (release of a few barrels) could occur during the lifecycle of this project and is therefore rated as occasional. Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a diesel spill resulting in potential environmental impacts is therefore rated as low.

Chemical Spills - The environmental toxicity of hydrostatic test chemicals and drilling chemicals is provided in **Table 5-20** and **Table 5-22**. The environmental toxicity of production chemicals is provided in **Table 5-32**.

Table 5-32: Environmental Toxicity of Production Chemicals Used in this Project

Chemical	Environmental Effects
Production Chemicals	
EC1304A	Not classified as hazardous [2]
EC6509A	Potential to bioconcentrate Potential environmental hazard is moderate [2]
PX0191	Potential environmental hazard is moderate [2]
EC1118A	Potential environmental hazard is high [2]
EC6264A	- [4]
EC1122A	Potential environmental hazard is moderate [2]
ADAPTA™	- [4]
ALDACIDE®G (glutaraldehyde)	Fish: sheephead minnow 4-d LC50 31.4 mg/L Crustacean: *Acartia tonsa* 48-hr TLM 0.11 mg/L [2]; opossum shrimp 4-d LC50 7.1 mg/L [1] Mollusc: *Crassostrea virginica* 4-d EC 50 intoxication 0.78 mg/L [1] Alga: *Skeletoneme costatum* EC50 8.1 mg/L [2] Readily biodegradable [2]
BARABLOK® 400	Crustacean: *Mysidopsis bahia* 96-hr TLM 717 g/L Slowly biodegradable [2]
BARAZAN ® D PLUS (Xanthan gum)	Fish: rainbow trout 96-hr TLM 320-560 mg/L [2] Crustacean: *Mysidopsis bahia* 96-hr TLM 75 g/L [3]
Calcium Chloride (powder)	See above
Chrome Free Desco® Deflocculant	Fish: flounder 96-hr LC50 >1800 mg/L Crustacean: *Acartia tonsa* 48-hr EC50 73.2 mg/L Biodegradation 38% in 28 days [2]
DEXTRID ® LTE	- [4]
DRILTREAT®	Crustacean: *Mysidopsis bahia* 4-d TLM 497,500 mg/L [2]
EZ-MUD ® DP	Crustacean: *Acartia tonsa* 2-d TLM 2202 mg/L Algae: *Skeletonema costatum* EC50 4310 mg/L [2]
EZ MUL®NT	Fish: *Corophium volutator* EC50 1701 mg/L Crustacean: *Acartia tonsa* 2-d TLM 199.4 mg/L [2]
FACTANT	Fish: bluegill 4-d LC50 2.2 mg/L; rainbow trout 4-d LC50 2.4 mg/L [1,3]
GELTONE®V	- [4]

Chemical	Environmental Effects
LIME , HYDRATED	See above
INVERMUL®NT	Fish: *Corophium volutor* EC50 1785 mg/L Crustacean: *Acartia tonsa* 2-d TLM 33.9 mg/L Algae: *Skeletonema costatum* EC50 8.4 mg/L [2]
PAC-LE	
RM-63™	- [4]
SODA ASH	Fish: bluegill 1-d TLM 385 mg/L [2,3] Crustacean: Baltic prawn 48 hr LC100 700 mg/L [1]
STEELSEAL 100	- [4]
STEELSEAL 400	- [4]
STEELSEAL 50	- [4]
VIS-PLUS®	- [4]

Notes: [1] Source - http://cfpub.epa.gov/ecotox/quick_query.htm; [2] Source - MSDS; [3]Freshwater biota info; no info on saltwater available; [4]No ecological information available

The potential health effect of chemicals is provided in **Table 5-33**. The accidental release of some of the chemicals has the potential for acute and chronic health hazards.

Table 5-33: Potential Health Effects of Chemicals Used during Project Life

Chemicals	Potential Health Effects
Drilling Chemicals	
Barite	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 SARA Hazard Class: Acute and chronic health effect May result eye, skin and respiratory tract irritation; contains cancer agent crystalline silica
Xanthan Gum	HMIS Rating: Health: 0; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result mild eye irritation; may impede respiration
PAC	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None Corrosive; May result in mild eye irritation; may impede respiration
DESCO	NFPA Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health effects May result in eye, skin and mucous membrane irritation; may result in respiratory tract irritation when inhaled; prolonged or repeated exposure may result in cancer due to presence of iron dust
Primary Emulsifier (Invermul NT)	HMIS Rating: Health: 2; Flammability: 2; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard and fire hazard May result in skin, respiratory and severe eye irritation; may result in central nervous system depression when ingested or inhaled
Secondary Emulsifier (EZ Mul NT)	HMIS Rating: Health: 2; Flammability: 2; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard and fire hazard Combustible; may result in skin, respiratory and severe eye irritation; and central nervous depression
Gilsonite	HMIS Rating: Health: 0; Flammability: 1; Stability/Reactivity: 0 SARA Hazard Class: Acute health effect May result in eye, skin and respiratory tract irritation; repeated exposure may result in sensitization

Chemicals	Potential Health Effects
Pliolite	NFPA Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 SARA Hazard Class: None May result in eye, skin and respiratory tract irritation; repeated exposure may result in sensitization
Organophylic Clays (Geltone V)	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health hazard May result in eye, skin and respiratory irritation and central nervous depression; contains cancer agent crystalline silica dust and suspected cancer agent trimydite
Lime	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard May result in severe eye and skin irritation and burns, respiratory irritation; mouth, throat and stomach irritation when ingested
Calcium Chloride	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 SARA Hazard Class: Acute human health hazard May result in severe eye irritation and corneal injury; may result in skin and respiratory tract irritation; burns of mouth, throat and stomach when ingested
Saraline 185v	Flammable. Lung damage when swallowed; repeated exposure may result in skin dryness and cracking
Hydrostatic Test Chemicals	
Hydrosure O-3670R (EC6226A, 60-100% Ammonium Bisulphite; CAS 10192-30-0)	NFPA Rating: Health: 2; Flammability: 0; Stability/Reactivity: 0 Corrosive. Considered an irritant according to European Regulations Irritating to eyes, respiratory system and skin.
Fluorescein Sodium Salt	NFPA Rating: Health: 3; Flammability: 1; Stability/Reactivity: 0 Considered a hazardous substance according to OSHA 29 CFR 1910.1200 Risk of serious damage to eyes; may result in sensitization upon skin contact; irritating to respiratory system and skin.
Production Chemicals	
EC1304A	HMIS Rating: Health: 3; Flammability: 2; Stability/Reactivity: 0 Not classified as hazardous in Europe and Malayia Corrosive to eye and skin; nausea, dizziness, vomiting, unconsciousness when ingested or inhaled.
EC6509A	HMIS Rating: Health: 2; Flammability: 2; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health hazard and fire hazard Mild irritation to eye; moderate irritation to skin; nausea and vomiting when ingested; may irritate respiratory tract; contains suspected cancer agents naphthalene and ethylbenzene
PX0191	NFPA Rating: Health: 2; Flammability: 2; Stability/Reactivity: 0 Acute and chronic human health hazard; combustible Mild irritation to eye; irritation to skin and respiratory tract with prolonged exposure; contains suspected cancer agent naphthalene
EC1118A	HMIS Rating: Health: 3; Flammability: 2; Stability/Reactivity: 0 High potential human hazard Corrosive; severe irritation to eye and skin on contact; burns to gastro-intestinal tract; irritation to eye, nose, throat and lungs on inhalation; contains suspected cancer agent naphthalene and ethylbenzene
EC6264A	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 EPA SARA Title III rating: Acute human hazard Irritation to eye and to skin on frequent or prolonged exposure; ingestion may result in nausea and vomiting
EC1122A	HMIS Rating: Health: 2; Flammability: 3; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic human health hazard and fire hazard Mild irritation to eye; moderate irritation to skin; may result in nausea, vomiting, central nervous system depression on ingestion; irritation respiratory tract on repeated/prolonged exposure; contains suspected cancer agent naphthalene and ethylbenzene

Chemicals	Potential Health Effects
ADAPTA™	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: None Mild irritation to eye, skin, respiratory tract: irritation to mouth, throat and stomach upon ingestion
ALDACIDE®G (glutaraldehyde)	HMIS Rating: Health: 3; Flammability: 1; Stability/Reactivity: 0 SARA Hazard Class: Acute and chronic human health hazard Severe respiratory irritation; irritation to skin; May result in eye burns and permanent eye damage upon contact; burns of mouth throat and stomach on ingestion
BARABLOK® 400	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 SARA Hazard Class: Acute human health hazard May result in eye, skin and respiratory irritation
BARAZAN ® D PLUS (Xanthan gum)	HMIS Rating: Health: 0; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in mild eye irritation; may impede respiration
Calcium Chloride (powder)	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 SARA Hazard Class: Acute human health hazard May result in severe eye irritation and corneal injury; may result in skin and respiratory tract irritation; burns of mouth, throat and stomach when ingested
Chrome Free Desco® Deflocculant	NFPA Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute and chronic health effects May result in eye, skin and respiratory tract irritation; prolonged or repeated exposure may result in cancer due to presence of iron dust
DEXTRID ® LTE	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard May result in eye, skin and respiratory irritation; may result in nausea, vomiting and diarrhoea when ingested
DRILTREAT®	HMIS Rating: Health: 0; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in mild eye irritation
EZ-MUD ® DP	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in mild eye and skin irritation
FACTANT	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard May result in eye, skin and respiratory irritation and central nervous depression; irritation of mouth, throat and stomach when ingested.
LIME , HYDRATED	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard May result in severe eye and skin irritation and burns, respiratory irritation; mouth, throat and stomach irritation when ingested
PAC™-LE	HMIS Rating: Health: 0; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in mild eye, skin and respiratory irritation
RM-63™	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in mild eye and skin irritation
SODA ASH	HMIS Rating: Health: 2; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: Acute health hazard May result in mild eye, skin, mouth and respiratory irritation, and throat and stomach when ingested
STEELSEAL 100	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in eye, mild respiratory and skin irritation and mild gastric distress when ingested
STEELSEAL 400	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in eye, mild respiratory and skin irritation and mild gastric distress when ingested

Chemicals	Potential Health Effects
STEELSEAL 50	HMIS Rating: Health: 1; Flammability: 0; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in eye, mild respiratory and skin irritation and mild gastric distress when ingested
VIS-PLUS®	HMIS Rating: Health: 1; Flammability: 1; Stability/Reactivity: 0 EPA SARA Hazard Class: None May result in eye, skin and respiratory and irritation of mouth, throat and stomach when ingested

HMIS/NFPA Rating: 0 Insignificant; 1 Slight; 2 Moderate; 3 High; 4 Extreme

Most chemicals will be stored onboard in tanks or sealed drums with the exception of drilling mud, which will be stored in bulk. Any accidental releases are likely to be captured by the secondary containment. A release of chemicals to receiving waters is therefore extremely unlikely. Should there be an accidental discharge of chemicals into the receiving environment; the potential environmental impact is likely to be small given the small amount of chemical in a container.

As a result, potential environmental impacts are expected to be localized and short-term and are therefore rated as incidental (**Table 5-6**). The probability of this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a chemical release resulting in potential environmental impacts is therefore rated as low.

The public is unlikely to be directly exposed to chemicals released offshore; therefore the potential effects on public health have been rated as incidental. Indirect exposure of the public from a chemical release could include exposure through contaminated food or loss of aesthetic value, recreation and tourism opportunities. Due to the localized, short-term nature of a chemical release and its remote location, potential social impacts are rated as incidental. The probability of this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of an accidental chemical release resulting in potential social and health impacts is therefore rated as **low.** COPCL will implement strict control measures to reduce the likelihood of an accidental chemical release to the ocean.

Produced Water Release - Platform A is designed to reinject produced water into dedicated injection wells (*Section 5.3.2*). The produced water injection system will be capable of treating and disposing the design processing volume of produced water. In instances where water injection cannot be performed, for instance, during upsets of the injection pumps, water will be stored on the FSO and transported by barge to the platform for injection at a later date (see *Section 2.6.1.2*).

Should there be an accidental discharge of produced water into the receiving environment, the potential environmental impact is likely to be small given the level of water treatment proposed. Produced water will be treated to 100 ppm (100 mL/m^3) oil content; an accidental discharge of a one-day production of 18,000 barrels of treated water would result in only a very small volume (286 L) of oil being released into the receiving environment. The amount of oil would therefore be smaller than assessed for accidental releases evaluated above. However, produced water may also contain mercury (as mercury goes preferentially in the water phase of the fluid). Potential impacts of mercury on aquatic organisms were discussed in Section 5.4.1.4. Produced water containing by mercury could be toxic to aquatic organisms. However, a produced water release would not be expected to result in significant impacts as any impacts would be localized and would not be expected to create long-term degradation of sensitive habitat or widespread impacts to habitat or species; therefore the potential environmental impact has been rated as incidental (**Table 5-6**). The probability of this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a produced water spill resulting in potential environmental impacts is therefore rated as low.

The public will not be directly exposed to produced water; therefore potential effects on public health have been rated as incidental. Indirect exposure of the public from a produced water spill could include exposure through contaminated food. Due to the localized nature of a produced water spill, potential social impacts are rated as incidental. The probability of this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of an accidental produced water release resulting in potential social and health impacts is therefore rated as **low**.

COPCL will implement strict control measures to reduce the likelihood of an accidental release of produced water to the ocean.

Waste Release - An inventory of solid wastes (hazardous and non-hazardous) and how they will be managed is presented in *Section 2.17.2*. It should be noted that waste oil will be recirculated to the process to the extent possible, therefore it is not expected that large amount of waste oil be shipped. Waste will mostly consist of solid waste. Solid waste will be transported in containers and any waste liquids will be transported in sealed drums.

An accidental release of waste drums would be a rare event and would not be expected to result in significant environmental impacts as the products would be contained in drums. Should the drum fail and the liquid waste be spilled, the volumes would likely be very small.

A waste oil release –of small volume – would be expected to disperse rapidly and is likely to have only a localized, short-lived effect. As a result, potential environmental impacts are likely to be localized and short-term and are therefore rated as incidental (**Table 5-6**). The probability that this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of an accidental waste oil release resulting in potential environmental impacts is therefore rated as low.

It is unlikely that the public would be directly exposed to waste oil; therefore potential effects on public health have been rated as incidental. Indirect exposure of the public from an accidental waste oil release could include exposure through contaminated food or loss of aesthetic value, recreation and tourism opportunities. Due to the localized, short-term nature of a waste oil release, potential social impacts are rated as incidental. The probability of this consequence could occur during the lifecycle of this project and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a waste oil spill resulting in potential social and health impacts is therefore rated as low. Therefore, the risk of an accidental waste oil release does not require additional management with respect to potential environmental, social and public health impacts (**Table 5-9**). Regardless, COPCL will implement strict control measures to reduce the potential for an accidental waste oil release to the ocean.

Near Shore Releases –

Crude oil and produced water will not be handled near shore; therefore nearshore spills of crude oil and produced water are unlikely as part of this project. Chemicals will be transported in sealed drums and tanks; therefore an accidental release of chemicals near shore is an extremely unlikely event. The only potential releases nearshore are therefore an accidental release of diesel or waste during a transportation incident. The potential environmental, social and public health impacts are considered minor due to evaporation of the diesel. Waste oil will be transported in tanks and unlikely to be released outside the container. The probability of this consequence could conservatively occur during the lifecycle of this project but only under exceptional circumstances and is therefore rated as seldom (**Table 5-10**). Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of an accidental waste oil release resulting in potential social and health impacts is therefore rated as low. COPCL will implement strict control measures to reduce the potential for an accidental release to the ocean.

A summary of potential impacts from small unplanned accidental releases is provided in **Table 5-34**.

Table 5-34: Potential Impacts from Tier 1 Spills

	Potential Impact	Risk Rating
Offshore Small Release		
Hydrocarbon Release	Water quality, marine biota, the occasional endangered species, fishing, shipping may be impacted within a localized area around the release site. Due to the far distance to shore, the release is unlikely to affect sensitive/protected areas, endangered species tourism and visual aesthetics within these areas. The public is unlikely to be directly exposed to an accidental diesel fuel release	Environment – Low Social – Low Public Health - Low
Chemical Release	Water quality, marine biota, the occasional endangered species, fishing may be impacted within a localized area around the release site. Due to the far distance to shore, the release is unlikely to affect sensitive/protected areas, endangered species, tourism and visual aesthetics within these areas. The public is unlikely to be directly exposed to an accidental chemical release.	Environment – Low Social – Low Public Health - Low
Produced Water Release	Water quality, marine biota, the occasional endangered species, fishing, may be impacted within a localized area around the release site. Due to the far distance to shore, the release is unlikely to affect sensitive/protected areas, endangered species, tourism and visual aesthetics within these areas. The public is unlikely to be directly exposed to an accidental produced water release.	Environment – Low Social – Low Public Health - Low
Waste Release	Water quality, marine biota, the occasional endangered species, fishing, shipping, tourism and visual aesthetics could potentially be impacted within a localised area. Due to the far distance to shore, and the fact that waste oil is transported in tanks which provides additional containment, an accidental releaseis unlikely to affect sensitive/protected areas, endangered species, tourism and visual aesthetics within these areas. The public is unlikely to be directly exposed to an accidental release of waste.	Environment – Low Social – Low Public Health - Low
Near Shore Release		
Diesel Fuel Release Waste Release	An accidental release nearshore of diesel and waste could potentially impact sensitive areas and thus endangered species and marine biota, fishing, tourism, visual aesthetics and public health (either directly or indirectly through contaminated food, loss of aesthetic, tourism and recreational value). However, most diesel will evaporate quickly and waste oil is transported in tanks which provides additional containment. Crude oil and produced water will not be handled near shore therefore is not discussed here. Chemicals will be transported in sealed drums and tanks, therefore an accidental release of chemicals near shore is an extremely unlikely event.	Environment – Low Social – Low Public Health - Low

COPCL will have mitigation measures in place to reduce the potential for small accidental releases. Measures will include:

- Procedures for bulk storage transfer;
- Procedures for fuel handling and transfer;
- Oil spill kits to clean any spills on deck;
- An oil spill response plan will be in place;
- The deck drainage system will be designed to remove oil before water is discharged,
- Lube and hydraulic oil will be stored onboard in tanks or sealed drums;
- A hose maintenance program will be implemented.
- Secondary containment will be provided under vessels.

5.8.3.3 Large Accidental Releases

Large accidental releases associated with events, such as well blowout or loss of FSO crude oil, are very rare events that have the potential to result in significant impacts on the environment.

Well Blow Out

A blowout is defined as an uncontrolled flow of formation fluid from the reservoir due to a loss of control of a well potentially leading to an uncontrolled release of hydrocarbons (oil or gas) at the surface. A well blow out results from formation pressure exceeding the hydrostatic pressure of the mud in the fluid column.

A well blowout can result in the release of hydrocarbons at high pressure into the sea and surrounding environment. This may result in a large release which may have the potential to affect marine biota and the environment such as, seawater, plankton, fish, as discussed above and may affect seabed sediment and benthos. The characteristics and dispersion of hydrocarbons released from a blowout depend on the physical and chemical properties of the hydrocarbons, meteorological and hydrological conditions. Important factors that influence the dispersion of hydrocarbons include current velocity, wind velocity, wave energy, wave breaking-height, and air and water temperatures. A worst case blow out release would be a Tier 3 incident.

The dispersion of crude from a potential blowout was modeled by Asia-Pacific ASA. The approach and results are summarized below. A release of 7,896 m^3 of crude oil released over 21 days was modeled to represent a worst case blow out.

It should be noted that no mitigation measures such as response and clean up operations were considered during the modeling, and the results therefore represent a worst case scenario. The physical and chemical properties of Pimean Akas-4 crude were used for the spill modelling. Dispersion of crude was modeled in two stages:

- Ocean/coastal hydrodynamics were modeled with an extensively validated HYDROMAP model to generate surface tidal currents, and
- Drift, spread and weathering of released crude oil was modeled with the OILMAP model using local winds, modeled tidal currents and crude properties as input.

Because the spread of crude is dependent on tidal currents and winds, dispersion of crude oil was modeled during four distinct seasons: (i) southeast transitional season (February to April); (ii) southwest monsoon (May to September), (iii) northwest transitional season (October), and (iv) northeast monsoon (November to January).

As an accidental release can occur during any set of wind and current conditions, OILMAP's stochastic model (or probability model) was used. A total of one hundred trajectories for the well blowout were simulated for each season. Each release was tracked until 0.1 g/m^2 (~0.1 μm) mass on the water surface or once it reached the shoreline. This mass is equivalent to a silvery sheen appearance, on the water surface, according to the Bonn Agreement Oil Appearance Code (BAOAC) and is below levels that have been found to result in environmental harm.

The combined results of the 100 trajectories for each season indicate that the modelled well blowout has a minimum 30% probability of reaching shore (Poulo Wai island) during the southeast transitional monsoon (February-April) and a maximum 99% probability of reaching shore (Poulo Wai) during the southwest monsoon (May-September). Releases during the southeast transitional season drift mainly in a northwesterly direction further north into the Gulf of Thailand (**Figure 5-6**). Releases during the southwest monsoon drift mainly in an easterly direction towards Cambodia and Vietnam, whereas releases during the northwest transitional season and northeast monsoon drift in a westerly direction towards Thailand (**Figure 5-6**). A release during the southwest monsoon would be the worst case scenario: not only does it have the highest probability of reaching shore, it was also modeled to reach shore (offshore island) in the least amount of time (min 51 hours) with the most amount of oil (max 3,552 m^3) (**Table 5-35**).

A large blowout can affect seawater quality. A blowout could also lead to disturbance of the seabed sediment and can result in sediment being impacted with hydrocarbons. Potential impacts on seabed sediment from a blowout can result in continuous effects on benthos living in and around the area where blowout occurs. Benthos may be deposited by dispersed sediment or might be exposed to sediment impacted with hydrocarbons resulting in toxicity. As seawater quality deteriorates, marine biota (such as phytoplankton, zooplankton, fish, marine mammals, etc) may be affected. In areas where a hydrocarbon plume occurs, the amount of plankton could decrease due to the toxicity of hydrocarbons as discussed above.

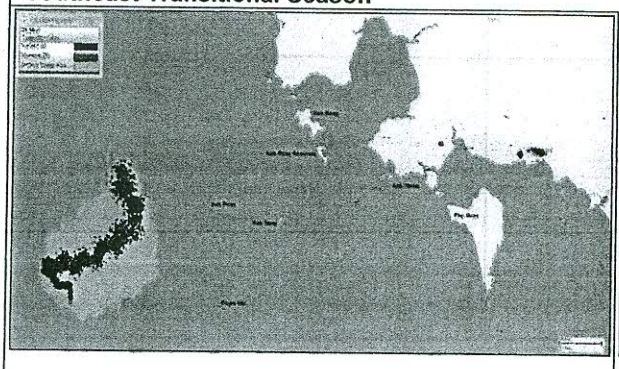
Hydrocarbon plumes (both oil and gas) may be toxic for fish and marine mammals. According to Patin (1999), it was found that natural gas can rapidly disperse to fish tissue by passing through fish gills. Fish may react to natural gas after exposure, moving away from the source to avoid the gas plume. Acute toxicity to fish may occur at a concentration of natural gas of about 1 mg/L. However, toxicity of natural gas to the marine environment is not clearly known (Patin, 1999). EnCana (2006) found that in most cases of natural gas leakage under seawater, fish can avoid the area where the plume occurs. In addition, EnCana found that the overall impact from natural gas leakage does not cause any danger to fish.

Table 5-35: Shoreline Exposure Statistics for Well Blowout

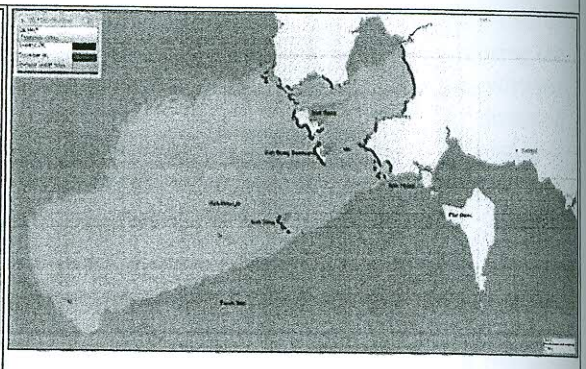
Shoreline Statistics	Minimum (avg) time to shore (hours)	Maximum (avg) oil ashore (m^3)	Probability of any shoreline exposure (%) once the worst case blow out has occurred	Shoreline Exposure
Southeast transitional season (February to April)	224 (520)	3,440 (1,739)	30	**Cambodia**: Mainland (11%), Poulo Wai (15%), Koh Prins (14%), Koh Tang (14%), Koh Ruong Samloem (11%), Koh Rong (10%), Koh Thmei (9%), Koh Kong (6%) **Thailand**: Mainland (6%), Ko Kut (6%) **Vietnam**: Mainland (7%), Phu Quoc (11%)
Southwest monsoon (May to September)	51 (143)	3,552 (2,895)	99	**Cambodia**: Mainland (60%), Poulo Wai (78%), Koh Prins (68%), Koh Tang (93%), Koh Ruong Samloem (49%), Koh Rong (30%), Koh Thmei (72%), Koh Kong (2%) **Thailand**: Mainland (2%), Ko Kut (2%) **Vietnam**: Mainland (19%), Phu Quoc (83%), Nam Du Isle (3%)
Northwest transitional season (October)	86 (436)	2,782 (1,017)	79	**Cambodia**: Poulo Wai (25%), Koh Tang (3%) **Thailand**: Mainland (22%), Ko Samui (41%), Ko Phangan (25%), Ko Tao (7%) **Vietnam**: Mainland (3%), Dao Tho Chu (4%) Phu Quoc (2%), Nam Du Isle (2%)
Northeast monsoon (November to January)	250 (433)	3,062 (1,421)	94	**Cambodia**: - **Thailand**: Mainland (43%), Ko Samui (36%), Ko Phangan (32%), Ko Tao (16%), Ko Kra (3%) **Vietnam**: -

Figure 5-6: Oil Trajectory from Well Blowout

Southeast Transitional Season

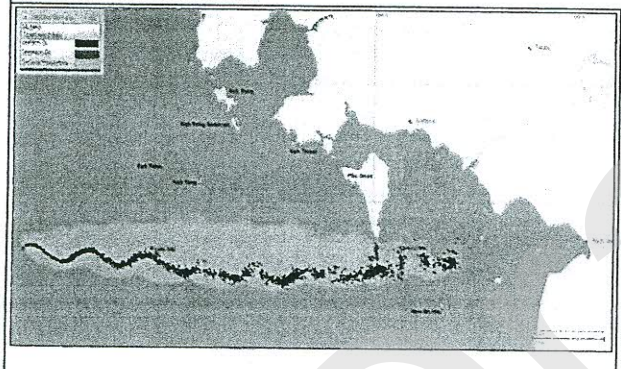


10 days

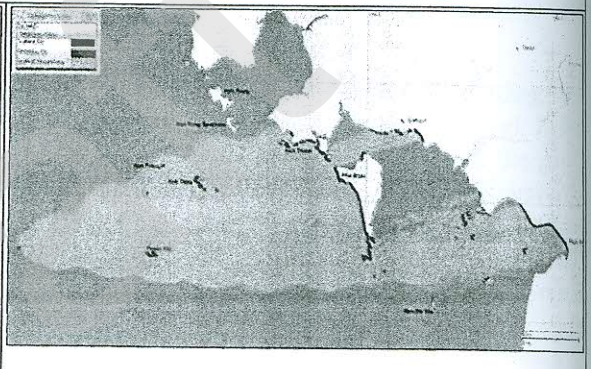


30 days

Southwest Monsoon

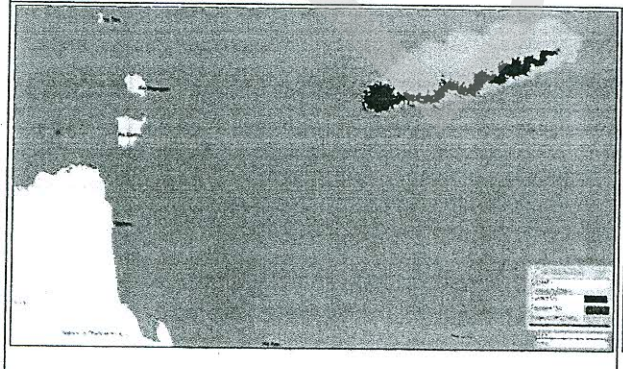


10 days

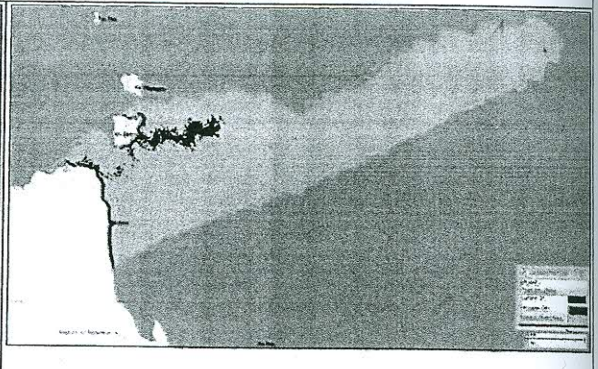


30 days

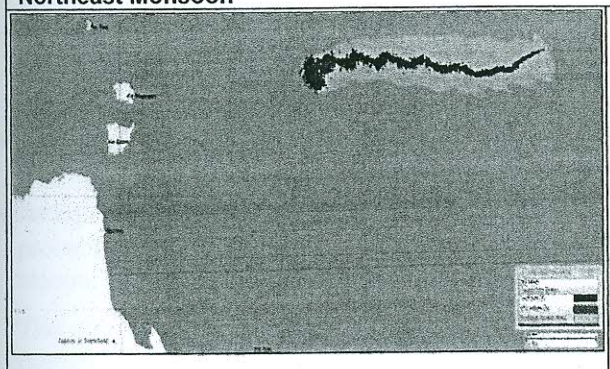
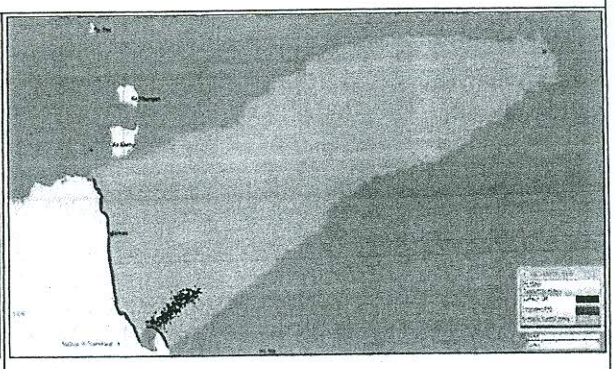
Northwest Transitional Season



10 days



30 days

Northeast Monsoon	
	
10 days	30 days

As seen by modeling results, a worst case blow out could potentially reach coastal areas and impact sensitive environments such as mangroves or coral reefs and social amenities such as fishing grounds, or aquaculture.

The potential environmental and social and public health impacts of a worst case blow out, without any mitigation measures would be major and potential public health impacts would be moderate.

Blowout frequencies have been compiled by International Association of Oil & Gas Producers (OGP, 2010a). The relevant results are summarized in **Table 5-36**. Chevron has drilled more than 4000 wells for the various exploration and petroleum production projects in the Gulf of Thailand; there has not been a blowout leading to a release of reservoir hydrocarbons. With the standard procedures and mitigation measures that COPCL will implement, the probability of a blowout during the project is remote.

Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of a blowout resulting in potential environmental, social and public health impacts is rated as low.

Table 5-36: Blowout Frequency and Probability Rates

Event	Historical Frequency	Probability
BLOWOUTS		
Development drilling blowout – oil (normal wells)	4.8×10^{-5}/drilled well	1 in 20,833
Workover blowout – oil	1.0×10^{-4}/operation	1 in 10,000
Producing wells blowout – oil (excluding external causes)	2.6×10^{-6}/well-year	1 in 384,615
Producing wells blowout – oil (external causes)	3.9×10^{-5}/well-year	1 in 25,641
Water injection wells blowout – avg	2.4×10^{-6}/well-year	1 in 416,667
WELL RELEASES		
Development drilling well release – oil (normal wells)	3.9×10^{-4}/drilled well	1 in 2,564
Workover well release – oil	3.2×10^{-4}/operation	1 in 3,125
Producing wells well release – oil (excluding external causes)	2.9×10^{-6}/well-year	1 in 344,828

Notes: Frequencies are for offshore operations of North Sea Standard. Those not of North Sea standard have higher frequencies of accident
Source: OGP. 2010a. Risk Assessment Data Directory. Report No. 434-2.

The following mitigation measures will be implemented by COPCL to reduce the potential for a blowout to occur:

- The well has been designed to reduce the probability of blow outs;
- The mud program has been selected to reduce the probability of blow outs,
- Seafloor surveys will be conducted prior to drilling in order to identify survey shallow gas pockets.
- Blowout preventer (BOP) will be installed to prevent a blowout of hydrocarbons to the environment.
- An experienced and skilled drilling contractor will be selected.
- A blowout prevention plan will be prepared.
- Down hole pressure and mud circulating system will be continuously monitored and adjusted during drilling operations.
- Employees and contractors will be trained in the emergency response plan in case of oil/gas release.
- In addition, COPCL empowers all its employees and contractors to use the 'Stop Work Authority' without fear of recrimination in the event that an unsafe condition or act is identified in the course of the operations.

In addition, to reduce the potential consequences of an accidental release, COPCL will have a comprehensive oil spill response plan in place. The plan will be designed for small and large releases (From Tier 1 to Tier 3 spills). Response equipment will be available both offshore and onshore. COPCL can mobilize additional equipment from the response centres COPCL is a member of Oil Spill Response Limited (OSRL). Equipment can be mobilised from Thailand, Singapore or the UK in the very unlikely case of a large release.

5.8.3.4 FSO Rupture

Rupture of the FSO has been identified as another worst case scenario that could result in a large release of hydrocarbons (oil or gas) into the sea and surrounding environment.

This situation has the potential for impacts on marine biota and the environment such as seabed sediment, seawater, benthos, plankton, fish, etc. The dispersion of crude from a potential rupture of the FSO was modeled by Asia-Pacific ASA. The approach and results are summarized below. A release of 7,200 m^3 of crude oil released over 24 hours was modeled to represent a loss equivalent to the entire loss of one tank on the FSO. Such a release would also be classified as a Tier 3 release.

Note: As with well blowout modeling, no mitigation measures were considered during the FSO rupture modeling, and the results therefore represent a worst case scenario. The physical and chemical properties of Pimean Akas-4 crude were used for the release modelling. Dispersion of crude was modeled as outlined above in *Section 5.8.3*.

Because the spread of crude is dependent on tidal currents and winds, dispersion of crude oil was modeled during four distinct seasons: (i) southeast transitional season (February to April); (ii) southwest monsoon (May to September), (iii) northwest transitional season (October), and (iv) northeast monsoon (November to January). As spills can occur during any set of wind and current conditions, OILMAP's stochastic model (or probability model) was used. A total of one hundred trajectories for the well blowout were simulated for each season. Each spill was tracked until 0.1 g/m^2 (~0.1 µm) mass on the water surface or once it reached the shoreline. This mass is equivalent to a silvery sheen appearance, on the water surface, according to the Bonn Agreement Oil Appearance Code (BAOAC) and is below levels that have been found to result in environmental harm.

The combined results of the 100 trajectories for each season indicate that the modelled FSO rupture has a minimum 17% probability of reaching shore during the southeast transitional season (February-April) and a maximum 95% probability of reaching shore during the southwest monsoon (May-September). Releases during the southeast transitional season drift mainly in a northwesterly direction further north into the Gulf of Thailand (**Figure 5-7**). Releases during the southwest monsoon drift mainly in an easterly direction towards Cambodia and Vietnam, whereas releases during the northwest transitional and northeast monsoon drift in a westerly direction towards Thailand. A release during the southwest monsoon would be the worst case scenario: not only does it have the highest probability of reaching shore, it also reaches shore (island) the fastest (min 57 hours) with the most amount of oil (max 3,122 m^3) (**Table 5-37**).

The effects of an accidental release of oil on sediment, seawater and biota from a potential FSO rupture are the same as those described for a well blowout (discussed above). The potential consequences are major for environmental and social and moderate for public health.

Out of 460 major releases from tankers during 1970-2010, accidental groundings account for 160 major spills, collisions for 132, hull failures for 55, fire and explosion for 34 and equipment failure for 4. During 1964-2010, there were 15 oil spills greater than 50 bbl from vessels during oil and gas exploration/production activities in the Gulf of Mexico. Three of these involved a collision with subsequent tank rupture on the workboat/drill ship; none of these were associated with an FSO.

The FSO will be anchored. Therefore an accidental release from a grounding event is not possible.

The most probable cause of a rupture of an FSO tank would be a collision. Collision statistics for floating storage units (FSU, similar to the FSO) and floating production storage units (FPSO) are provided by OGP (2010b). The frequency of a significant collision was calculated as in OGP (2010b). No specific collisions statistics were available for FSOs; instead FPSO statistics were used.

Factors were used to adjust the collision statistics for the Asian region and for collisions resulting in significant damage (0.009 {worldwide FPSO collision frequency} * 0.17 {fraction of collisions in Asia} * 0.25 {fraction of collisions with significant damage} = 0.00038 or 1 in 2,630).

With the standard procedures and mitigation measures that COPCL will implement, the probability of an FSO rupture during the project is remote.

Table 5-37: Shoreline Exposure Statistics for FSO Rupture

Shoreline Statistics	Minimum (avg) time to shore (hours)	Maximum (avg) oil ashore (m^3)	Probability of any shoreline exposure (%)	Shoreline Exposed
Southeast transitional (February to April)	153 (430)	2,858 (2,160)	17	**Cambodia**: Mainland (3%), Poulo Wai (1%), Koh Tang (2%), Koh Ruong Samloem (2%), Koh Rong (3%), Koh Thmei (2%), Koh Kong (1%) **Thailand**: Mainland (2%), Ko Tao (1%), Ko Pha Ngan (1%) **Vietnam**: Phu Quoc (2%)
Southwest monsoon (May to September)	57 (168)	3,122 (2,614)	95	**Cambodia**: Mainland (22%), Poulo Wai (27%), Koh Prins (14%), Koh Tang (33%), Koh Ruong Samloem (13%), Koh Rong (4%), Koh Thmei (22%), Koh Kong (1%) **Thailand**: - **Vietnam**: Mainland (8%), Phu Quoc (17%), Nam Du Isle (2%)

Shoreline Statistics	Minimum (avg) time to shore (hours)	Maximum (avg) oil ashore (m^3)	Probability of any shoreline exposure (%)	Shoreline Exposed
Northwest transitional (October)	100 (368)	2,889 (1,814)	58	**Cambodia**: Poulo Wai (14%) **Thailand**: Mainland (14%), Ko Samui (21%), Ko Phangan (5%), Ko Tao (3%) **Vietnam**: Mainland (3%), Dao Tho Chu (2%) Phu Quoc (2%)
Northeast monsoon (November to January)	246 (412)	2,799 (2,368)	88	**Cambodia**: - **Thailand**: Mainland (17%), Ko Samui (12%), Ko Phangan (14%), Ko Tao (3%) **Vietnam**: -

Based on these ratings and the risk assessment matrix of **Table 5-10**, the risk of an FSO rupture release resulting in potential environmental, social and public health impacts is therefore rated as low.

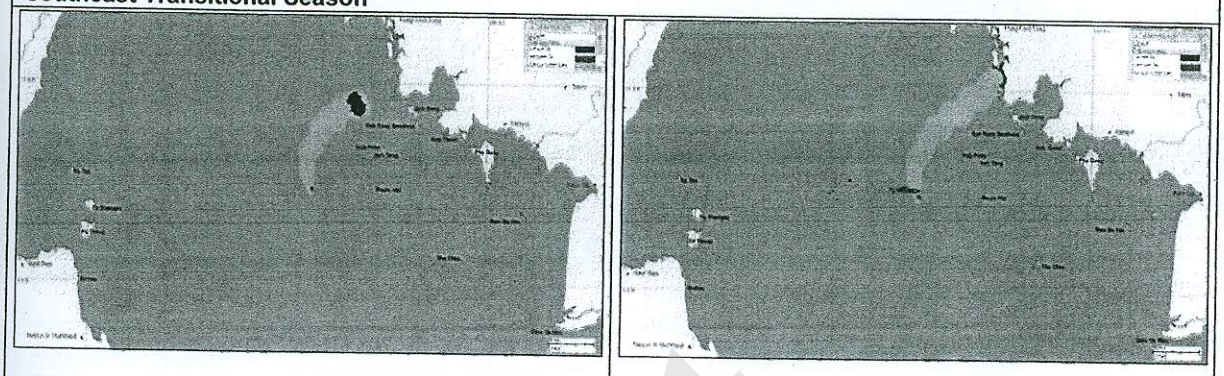
COPCL will implement specific mitigation measures to reduce the potential for a significant collision occurring during the project.

- The FSO will have safety lights to be visible from passing traffic;
- The FSO will be marked on nautical charts;
- An exclusion zone will be implemented around the vessel. No traffic will be allowed within the exclusion zone;
- A traffic monitoring system will be in place to detect presence of vessels near the FSO.

In addition, COPCL will have a comprehensive oil spill response plan in place to further reduce the potential consequences should a large accidental release occur.

Figure 5-7: Oil Trajectory from FSO Rupture

Southeast Transitional Season

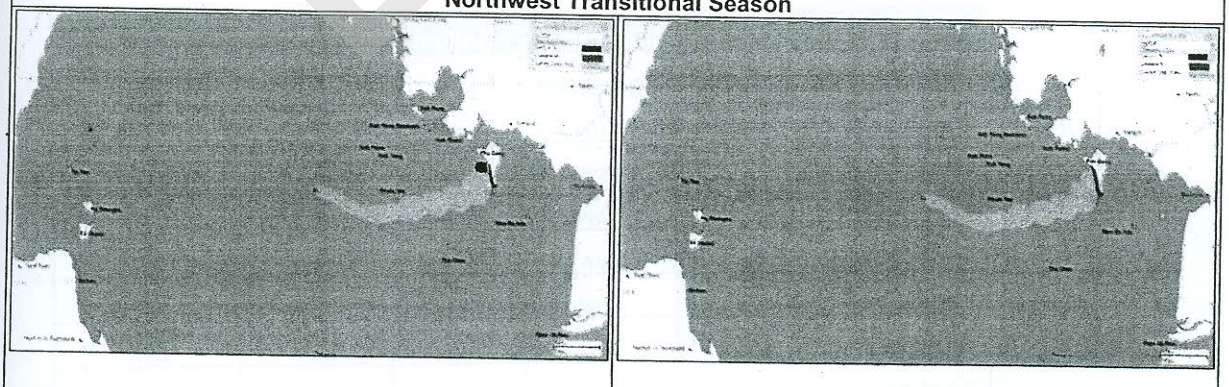


10 days | 25 days

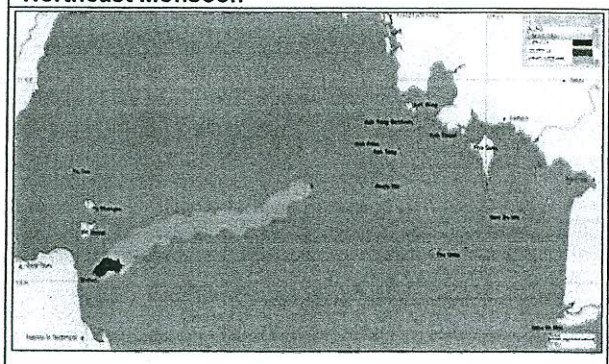
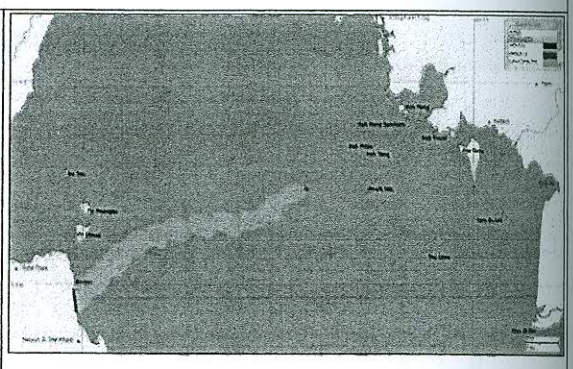
Southwest Monsoon

10 days | 25 days

Northwest Transitional Season



10 days | 25 days

Northeast Monsoon	
	
10 days	25 days

Accidental releases of volumes between a few barrels and a worst case type of volumes may also occur and have the potential for impacts on the environment, social values and / or public health. For any releases that could have the potential to have negative impacts (e.g.: if the release drifts towards the shore), COPCL will activate its Oil Spill Response Plan and deploy equipment to reduce the potential impacts. Such releases are rare events. Additional resources will be deployed for any Tier 2 and Tier 3 releases for which on site equipment is not deemed sufficient.

5.9 Summary of the Impact Assessment

The results of the impact assessment of normal project operations with the implementation of mitigation measures are summarized in **Table 5-38**. Given the mitigation measures in place, all potential impacts are deemed to be negligible or low significance.

Table 5-38: Summary of Potential Impacts from Normal Operations after Implementation of Chevron's Environmental Management Plans

	Installation	Drilling	Production	Abandonment
Air Quality/GHG emissions	Insignificant	Low	Low	Low
Seawater Quality	Low	Low	Low	Low
Ocean Sediment	Low	Low	Insignificant	Low
Marine Biota	Low	Low	Low	Low
Endangered Species	Low	Low	Low	Low
Fishing	Low	Low	Low	Low
Shipping	Low	Low	Low	Low
Tourism	Low	Low	Low	Low
Socio-Economy	Beneficial	Beneficial	Beneficial	Beneficial
Visual Aesthetics	Negligible	Negligible	Negligible	Negligible
Public Health	Low	Low	Low	Low

The results of the impact assessment of unplanned events are summarized in **Table 5-39**. All potential impacts are deemed to be of low significance. Emergency response plans are developed for unplanned events to reduce the potential impact from unplanned events. Further details of these plans are outlined in the next section.

Table 5-39: Summary of Potential Risk from Unplanned Events

Unplanned Event	Risk
Collision	Low (Potentially severe consequences for social and public health but likelihood rare)
Fire or Explosion	Low (Incidental potential for social and public health and likelihood remote)
Accidental Releases	
Minor releases (diesel, chemical, produced water, waste, crude)– offshore	Low (Incidental potential consequences for environment, social and public health and likelihood seldom)
Minor releases (diesel and waste) –nearshore	Low (Minor potential consequences for environment, social and public health and likelihood seldom)
Blowout (large accidental release)	Low (Major potential consequences for environment and social, moderate for public health but likelihood remote)
FSO Rupture (large accidental release)	Low (Major potential consequences for environment and social but likelihood remote)

6. MITIGATION AND MONITORING

6.1 Introduction

This section summarizes mitigation measures that will be employed to reduce the potential forimpacts and/or to limit the extent (consequence) of potential impacts. In addition, environmental monitoring measures will be undertaken to assess whether performance meets EIA commitments. Environmental monitoring measures are also listed in this section.

6.1.1 Operational Excellence

Operational Excellence (OE) encompasses the Health, Environment, Safety, Reliability and Efficiency aspects of COPCL's business.

COPCL has a formal Management System (MS) designed to facilitate the systematic management of activities and to drive progress toward world class performance.The OEMS formalises the responsibilities of managers and the workforce in complying with COPCL's expectations. It also provides the basis for planning performance improvement, and monitoring the results from the planning process. Responsibilities are assigned for initiating, executing and checking execution of commitments. COPCL's management system is shown in **Figure 6-1**.

Figure 6-1: COPCL's Management System Process

The project's EIA is integrated into the OEMS at different stages:

- Assessment: with identification of the appropriate mitigation/monitoring measures;

- Implementation: with implementation of the measures;
- Review: when effectiveness is reviewed and mitigation and monitoring measures revised when necessary.

6.1.2 Contractors HES Performance Management

A number of activities will be undertaken by contractors[1]. COPCL has a process to integrate OE criteria into the selection of the contractors, establish clear accountability, provide active engagement of contractors, and provide a consistent program to reduce the potential for health, environment, and safety incidents and injuries among contractors.

Applicable requirements are communicated in writing to all contractors. Routine monitoringtakesplace to verify contractors' HES performance throughout the duration of the project. Monitoring includes review, inspection and audit activities by COPCL's personnel.

6.2 Environmental Management Plan

In the context of the project, the main vehicle for converting the OEMS and principles into specific action will be the Project Environmental Management Plan. The plan will contain all identified mitigation measures as well as the monitoring measures and the responsibilities for implementation. As responsibilities for some of the actions fall to the contractors, they will be communicated appropriately.

Mitigation measures (**Table 6-1**) for potentially significant environmental, social, or health impacts from project activities or events consist of designed mitigation measures, specific additional mitigation measures and a series of management plans. They are summarized in **Table 6-1**.

[1]Contractors are third parties employed by COPCL to provide services. For instance, FSO personnel will be contractor's personnel.

Cambodia Block A Development
Environmental Impact Assessment

Table 6-1: Mitigation Measures

Environmental Aspects	Potential Impact	Mitigation Measures
Project Planning		
Seawater and Sediment	Degradation of water quality in case of upset of produced water reinjection (PWRI) system	Design PWRI with 100% availability by having one stand by pump available for immediate start up should an operating pump fail.
	Degradation of water quality	• Prepare Waste Management Plan • Prepare Emergency Response Plan, Typhoon evacuation plan andOil Spill ResponsePlan (OSRP) • Provide FSO with MARPOL approved sewage treatment system • Provide Oil Discharge Monitoring Equipment on FSO for machinery drainage • Develop Mercury Waste Standard Operating Procedure
	Sediment disturbance	• Prepare an anchoring plan to reduce dragging of anchors if non Dynamically Positioned (DP) barges are used during facility and pipeline installation
Fishing	Fishing disturbance	• Develop complaints handling procedure • Include pipeline and facilities on nautical charts prior to their respective operations
Tourism	Tourism disturbance	Develop a Community Engagement Plan.
Site Survey, Transportation and Installation of facilities and pipelines Activities		
Air Quality	Deterioration of air quality	Conduct routine inspection and preventive maintenance as per schedule recommended by manufacturers to increaseefficiency of combustion
Seawater & Sediment	Degradation of water quality from discharges	Comply with Waste Management Plan
	Degradation of water quality through accidental releases	• Implement 500m exclusion zone around facilities • Comply with all Cambodian and International Maritime Organization (IMO) regulations regarding vessel seaworthiness and maritime safety • Comply with all fuel storage, waste treatment and disposal regulations/procedures (the Petroleum Regulation, MARPOL73/78, COPCL procedures) • Implement Hazardous Materials Management Tracking System and manifests system for transportation • Segregate hazardous waste and non hazardous waste as per Waste Management Plan • Use COPCL approved contractors to transport and dispose of waste at COPCL approved facilities

Environmental Aspects	Potential Impact	Mitigation Measures
		• Follow COPCL/installation contractor's Emergency Response Plan, Typhoon EvacuationPlan and OSRP when required for Block A Operations
Rare and Endangered Species	Noise from piling operations	• Monitor a 500m zone visually by Marine Mammal Observers for 30 minutes prior to the commencement of piling. • Delay start of piling operations if marine mammals are detected within the mitigation zone (500 m radius around piling site) or until 20 minutes after the last visual detection. • Use soft-start (gradual ramping up of piling power), incrementally over a set time period, until full operational power is achieved. The soft-start duration will be a period of 20 minutes. • Keep log of marine mammals observed during piling activities
Fishing	▪ Restriction on fishing areas ▪ Ruptures and discharges ▪ Collisions	• Implement maintenance program on lighting and navigation signal system of the FSO and all structures • Communicate as required about restricted zone, project activities and schedules • Implement complaints handling procedure
Tourism / Recreation	Reduce attractiveness of area due to increased noise, increased traffic, and/or reduced visual aesthetics	Implement a Community Engagement Plan.
Drilling		
Air Quality/Greenhouse Gas Emissions	Deterioration due to combustion and fugitive emissions	Conduct routine inspection and preventive maintenance as per schedule recommended by manufacturers to increaseefficiency of combustion
Seawater & Sediment	Sediment disturbance	• Use slim hole well design to reduce mud and cutting quantities. • Discharge all the cuttings overboard through a caisson at a depth of approximately 1 m below the sea surface
Seawater & Sediment	Degradation of water quality from discharges	• Implement and comply with Waste Management Plan • Control the Cutting Base Fluid Retention (CBFR) to less than or equal to 9% • Use seawater and water based mud (WBM) in surface and intermediate drilling section and use Synthetic oil based drilling mud (SBM) in production drilling

		• Use seawater and water based mud (WBM) in surface and intermediate drilling section and use Synthetic oil based drilling mud (SBM) in production drilling

Environmental Aspects	Potential Impact	Mitigation Measures
		sections • Separate SBM and cuttings by solid control equipment • Do not discharge whole SBM to sea. • Do not dispose of solid waste overboardas per Waste Management Plan
	Degradation of water quality through accidental releases	• Implement 500m exclusion zone around facilities • Use helicopter flights for staff transfer to check for accidental releases • Comply with all Cambodian and International Maritime Organization (IMO) regulations regarding vessel seaworthiness and maritime safety • Comply with all fuel storage, waste treatment and disposal regulations/procedures (the Petroleum Regulation, MARPOL73/78, and COPCL procedures) • Implement Hazardous Materials Management Tracking System and manifests system for transport • Provide training on Waste Management Plan • Keep records of hazardous and non hazardous waste quantities • Segregate hazardous waste and non hazardous waste as per Waste Management Plan and store in appropriate containers • Provide spill containment facilities (e.g.: drip trays) in all process equipment areas (over grating) where hydrocarbons or chemical accidental releases can occur • Install spill kits on rig deck • Verify that spill response equipment is on support vessel • Clean accidental releases on deck • Use COPCL approved contractors to transport and dispose of waste at COPCL approved facilities • Use "overbalanced drilling" technique to prevent a blowout by controlling the formation pressure using mud hydrostatic pressure • Require all drilling supervisors to be Well Control certified • Use Blowout Preventer-BOP to control blowout • Conduct regular training on oil spill response. This includes communication about potential public health concerns. • Follow COPCL's Emergency Response Plan for Block A operations, Typhoon Evacuation Plan and OSRP when required
Fishing	• Restriction on fishing areas • Tainting or contamination of fish from spills, leaks, ruptures and discharges • Collisions	• Communicate as required about restricted zone, project activities and schedules • Implement complaints handling procedure • Develop communication briefs on tainting

Environmental Aspects	Potential Impact	Mitigation Measures
Operation		
Air Quality/Greenhouse Gas Emissions	Deterioration due to combustion and fugitive emissions	• Conduct routine inspection and preventive maintenance as per agreed schedule recommended by manufacturers to increaseefficiency of combustion
	GHG emissions	• Test gas detection system quarterly
Seawater & Sediment	Degradation of water quality in case of upset of produced water reinjection (PWRI) system	• Conduct maintenance on PWRI system as per schedule recommended by manufacturers • In case of upset of the PWRI system, store produced water on FSO and reinject when system is working again
	Degradation of water quality from discharges	• Implement and comply with Waste Management Plan • Direct platform deck drainage from potentially contaminated areas to open drain system prior to discharge • Macerate FSO food waste in the food macerator in accordance with MARPOL Annex V requirements prior to discharge • Do not dispose of solid waste overboard as per Waste Management Plan
	Degradation of water quality through accidental releases	• Implement 500m exclusion zone around facilities • Use helicopter flights for staff transfer to check for accidental releases • Comply with all Cambodian and International Maritime Organization (IMO) regulations regarding vessel seaworthiness and maritime safety • Comply with all fuel storage, waste treatment and disposal regulations/procedures (the Petroleum Regulation, MARPOL73/78, and COPCL procedures • Provide training on Waste Management Plan • Implement Hazardous Materials Management Tracking System and manifests for transport • Keep records of hazardous and non hazardous waste quantities • Segregate hazardous waste and non hazardous waste as per Waste Management Plan and store in appropriate containers • Use COPCL approved contractors to transport and dispose of waste at COPCL approved facilities • Provide spill containment facilities (e.g.: drip trays) in all process equipment areas (over grating) where hydrocarbons or chemical accidental releases can occur • Conduct regular training for handling oil spill incidents. This includes communication about potential public health concerns. • Install spill kits on deck

		communication about potential public health concerns. • Install spill kits on deck

Environmental Aspects	Potential Impact	Mitigation Measures
		• Verify that spill response equipment is on support vessel • Follow COPCL's Emergency Response Plan for Block A Operations, Typhoon EvacuationPlan and OSRP when required. • Clean accidental releases on deck • Follow Mercury Waste Standard Operating Procedure • Conduct periodic reviews on feasibility of using chemicals with improved environmental performance.
Fishing	▪ Restriction on fishing areas ▪ Tainting or contamination of fish from spills, leaks, ruptures and discharges ▪ Collisions	• Implement maintenance program on lighting and navigation signal system of the FSO and all structures • Communicate as required about restricted zone, project activities and schedules • Implement complaints handling procedure • Conduct regular training for handling oil spill incident. This includes communication about potential public health concerns. • Develop communication briefs on tainting.
Tourism/ Recreation	Reduced attractiveness of area due to increased noise, increased traffic, and/or reduced visual aesthetics	• Implement Community Engagement Plan

6.2.1 Emergency Response Plan

While incident prevention measures take priority over mitigation measures, COPCL takes due care of emergency response to mitigate the potential impacts and prevent escalation of any incident which may occur during operationsin Block A.

COPCLwill prepare an Emergency Response Plan (ERP) for Block A operations. The ERP will be designed to provide the members of the Chevron Cambodia Emergency Response Organization (ERO) with the appropriate information to respond to incidents in a safe, rapid and effective manner.

In addition, Chevron will develop Site Specific ERPs to address credible and significant risks identified from site-specific risk and impact assessments. These will include an Oil Spill ResponsePlan, Medevac, and Typhoon Evacuation.

Chevron will implement emergency response training and exercise programs to maintain competency of the COPCL ERO members.

The COPCL Emergency Response Organization (ERO) consists of Onsite Response Teams (ORTs) and Installation Emergency Management Team (IEMT) and Asset Emergency Management Teams (AEMTs). The mobilization of each team depends on the severity of the incident. The system is designed so that the response can escalate as required.

These teams are manned by Chevron personnel and contractors based in Cambodia and Thailand. If needed, these teams can be supplemented by personnel available from Chevron's worldwide emergency response resources and international contractor resources.

These teams are charged with responding to any types of incidents that occur in facilities and operations under Block A Project.

Table 6-2provides guidance on the relationship that exists between the severity of an incident and the elements of the ERO that are most likely to respond to the incident.

Table 6-2: Elements of ERO Susceptible to be mobilised

Severity of Incident	ORT	Installation EMT	COPCL AEMT	CMT
Level 1: Minor	✓	✓		
Level 2: Moderate	✓	✓	✓	
Level 3: Major	✓	✓	✓	✓

Note: Crisis Management Team (CMT)

The objectives of the ERP are to:

- Define the overall organisation and responsibilities;
- Define the actions to be taken by the Crisis and Emergency Management Team;
- Define the actions to be taken to support that team.

COPCL will adopt the Incident Management System for its Emergency response organization. It will be comprised of the following departments:

- Command
- Operations
- Planning (includes the Environmental discipline)
- Logistics
- Finance
- Public Affairs
- Safety
- Legal

COPCL will also review Emergency Plans of Installation and Drilling contractors.

6.2.2 Oil Spill ResponsePlan

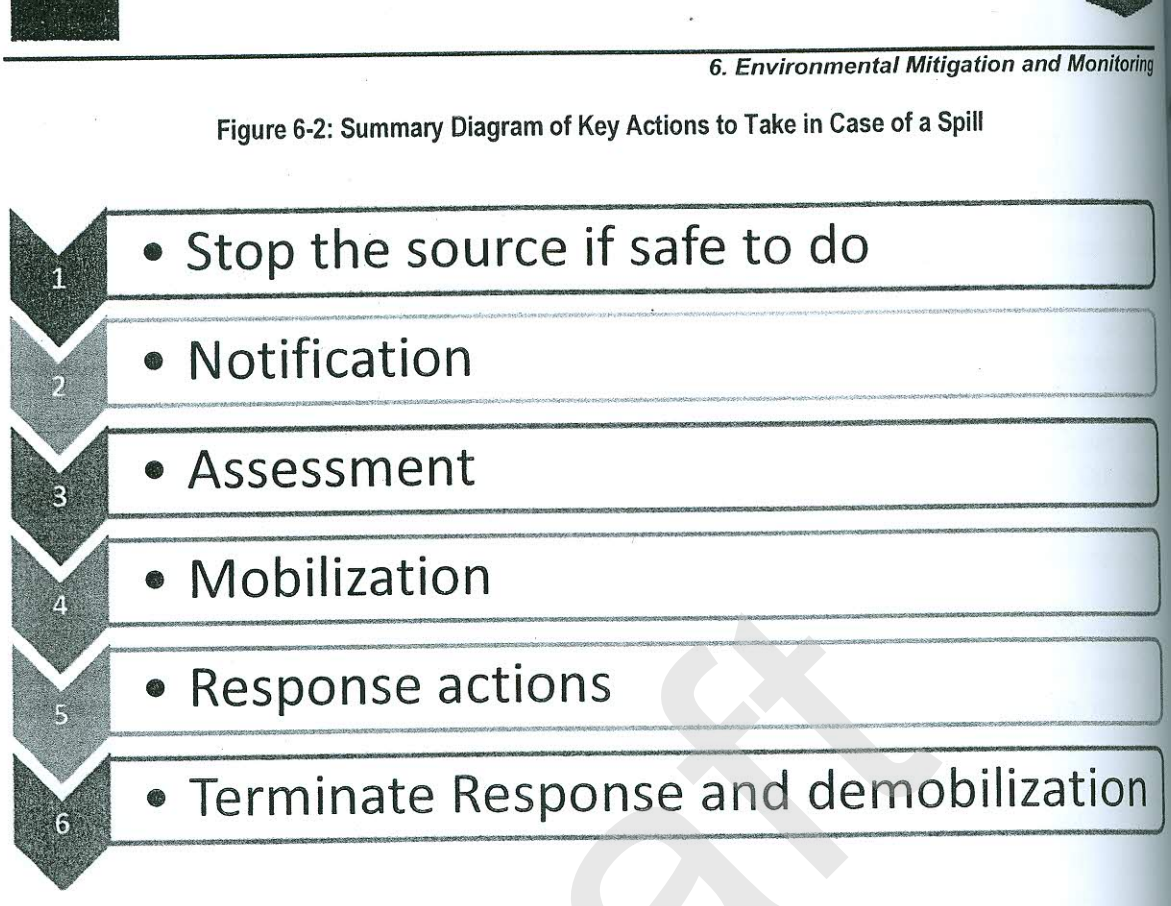
COPCL has developed an Oil Spill Response Plan (OSRP) for their offshore operations. The OSRP is one of the site specific emergency plans listed above.

The OSRP indicates what actions must be taken in the event of anaccidental release. In addition, because each incident is unique, the OSRP has built-in flexibility to adapt to each incidentresponse as it is occurring.

The OSRP guides decisions on the level of response effort. The Oil Spill Response Plan provides personneland responders with the information needed to avoid or reduce the potential impacts of an oil spill. It identifies the procedures and resources necessary to implement the plan, specify priorities for implementing response strategies and clean up and contain the information needed to respond to anaccidental release.

Key actions to be taken during an accidental release are summarized in **Figure 6-2**.

Figure 6-2: Summary Diagram of Key Actions to Take in Case of a Spill



The OSRP is based on the Tiered response system (**Table 6-3**). The tiered system allows incidents to be handled at the lowest operational level. Additional resources are identified and available. Plans to cascade in these resources are in place should the incident escalate.

The Tiered system gives a structured approach to both establishing oil spill preparedness and undertaking a response. Conventionally, the concept has been considered as a function of size and location of a potential oil spill, with three tiers defined (IPIECA, 2007). Spills tiers have been classified as per Industry best practices.

Table 6-3: Oil Spill Response Tiers (adapted from IPIECA)

Tier	Definition	Support
1	Operational in nature Occurring at or near an operator's facilities as a consequence of its own activities. On-site equipment and resources and sufficient to respond to the spill	On site Tier 1 equipment and trained response teams
2	Are more likely to extend outside the remit of Tier 1 response area and possibly be larger in size, where additional resources are needed from several potential sources. Above the capabilities of the Tier 1 resources, requiring regional assistance	On-site T1 resources, assistance and access to regionalT2 resources
3	When on-site and local resources and inadequate to deal with the response. Due to its scale a large oil spill which requires external response contractors and Tier 3 Global oil spill response equipment.	Tier 3 oil spill response equipment, along with resources available from Tier 1 and 2 stocks

Tier I Spill

Small volumes of diesel fuel, crude oil,and lubricating oilcaused from minor incidents that do not represent a safety hazard, and are unlikely to impact environmentally sensitive areas. This level of potential impact is within the capabilities of COPCL's on site resources to control.

Tier II Spill

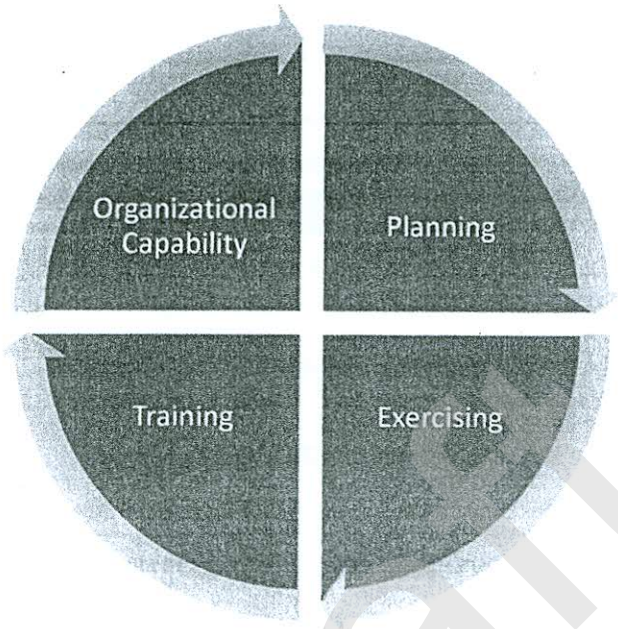
Larger volumes of oil spillage which cannot be readily controlled using on site resources. Such a spill may necessitate mobilization of regional equipment

Tier III Spill

Large spills as large uncontrolled well blowout is beyond the combined capability of COPCLand regional capabilities to respond to. In this situation COPCL will mobilize worldwide equipment and resources.

To reach a state of readiness, a continuous cycle of planning, organizing, training and exercising is required (**Figure 6-3**). The plan is regularly updated. Training is also carried out on a regular basis supported by drills and exercises.

Figure 6-3: Oil Spill Response Planning and Readiness



6.2.3 Mercury (Hg) Management

Mercury contaminated material will be safely stored onsite offshore until it is shipped to licensed facilities that have been approved for use by COPCL.

Mercury-contaminated process consumables (filter cartridges, membrane cartridges, activated carbon, etc.) will be firsttransferred to suitable containers (sealable drums). Containers will be safely stored until such inventory warrants shipment to 3rd party disposal contractor.

Mercury-contaminated sand arising from the desander package (if installed in the future), will be discharged to sealable storage containers. Filled containers willbe stored until such inventory warrants shipment to COPCL approved third party disposal contractor.

COPCLwill develop Standard Operating Procedures outlining how mercury contaminated sludge will be removed and handled and how mercury contaminated material will be handled and decontaminated to manage the effects of Hg on personnel and the plant for the Block A development project.

6.2.4 Waste Management

6.2.4.1 Waste Classifications

To facilitate proper management of project waste materials, a designation of either "hazardous" or "non-hazardous" has been applied to each waste stream.

The basis for assigning a designation of "hazardous" was the Basel Convention Annex I, II, III, VIII, and IX lists, http://www.basel.int/text/con-e-rev.pdf, which is believed to be consistent with the intent of Cambodia Sub Decree on Waste Management, 1999.

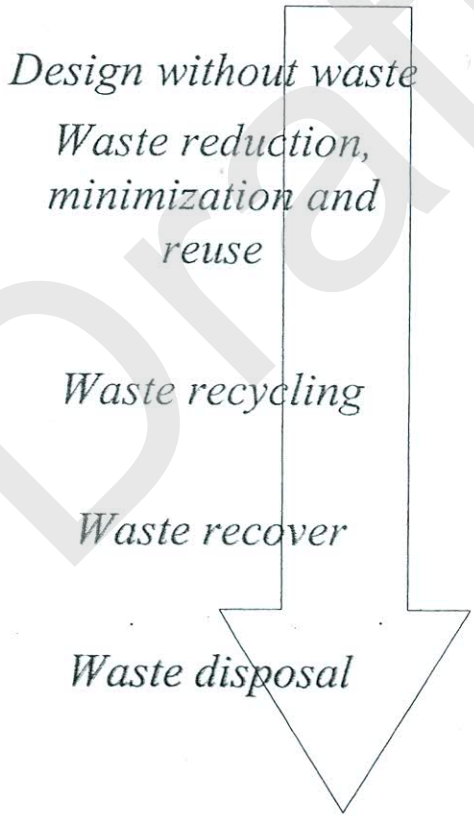
Where a waste stream is discharged overboard, it was considered to be non-hazardous if pretreated according to applicable permit standards, or COPCL standards, whichever is more rigorous.

6.2.4.2 Waste Management Philosophy

The waste management practices to be implemented by this project have been developed to address the specific types of wastes that are generated, local regulations and COPCL policy regarding management of waste, and the availability of COPCL approved 3rd party waste management facilities.

The preferred hierarchy of waste management begins with designing without waste. Waste disposal is the least preferred option (**Figure 6-4**).

Figure 6-4:Waste Management Hierarchy



6.2.4.3 Waste Minimization

COPCL will adopt a practice of waste minimization and will encourage contractors to build that philosophy into their activities. Waste minimization not only reduces potential impacts on the environment, but also reduces the risk of improper management and noncompliance. There are several ways to minimize waste generation. Examples of waste minimization actions include:

- Reuse when possible.
- Do not be wasteful with a product; use up all product.

• Prevent spills; spills of hazardous materials yield clean-up materials that must be managed as hazardous waste.

6.2.4.4 Waste Recycling

Scrap metal, plastic bottles, aluminum cans, and possibly other reusable materials will be sorted at the shorebase and packaged for transport to Chevron approved local recycling facilities in Cambodia when available.

6.2.4.5 Waste Disposal

Where waste materials cannot be recycled, they will be disposed.

Produced water will be reinjected in wells. Selected waste streams (water based drilling mud, drilled cuttings, food waste, oily drainage, sewage and hydrotest water) will be disposed of offshore in accordance with applicable regulatory requirements as described in Chapter 2. Other waste that cannot be disposed of will be sent to COPCL approved 3rd party facilities.

The disposal options are as follows:

Reinject Produced Water

Produced water will be injected into the formation via disposal wells.

Discharge Macerated Food Waste

In accordance with MARPOL 73/78 requirements, food waste that is generated offshore will be discharged overboard after having passed through a macerator so that only particles of less than 25mm are discharged.

Discharge Treated Sewage

Sewage generated onboard the FSO will be treated on the FSO before being discharged

Discharge Cleaned Drilled Cuttings

Cuttings will be passed through the rig's cuttings treatment system and discharged overboard.

Discharge Cleaned Oily Drainage

Contaminated deck drainage will be treated for oil removal and treated water will be discharged.

Discharge Water Based Mud

Whole water based mud will be discharged overboard. This is not applicable to synthetic based mud.

Discharge Hydrotest Water

Hydrotest water will be discharged to sea upon completion of pipeline commissioning. Chemicals will be carefully selected to reduce the potential for environmental impacts.

Incinerate Combustible Waste

Incineration of combustible waste in COPCL approved incinerators was identified as an was identified as a disposal option that would not have a significant impact on theenvironment.

The following waste streams have been identified as non-hazardous combustible wastes or non-combustible raw materials:

- Combustible trash / office waste
- Empty chemical sacks
- Plastic scrap / bottles
- Spent hose
- Used cooking oil
- Shredded plastic drums (cleaned)
- Wood scraps / crates
- Sandblast grit
- Spent silica beads

In addition, the following combustible waste streams, classified as hazardous, may be incinerated as well:

- Oily rags
- Spent solvents
- Used lube oil, hydraulic oil

Dispose in Specialized and COPCL Approved Treatment Facilities and COPCL Approved Sanitary and Engineered Landfills

Waste materials that require specialized treatment facilities include various solid wastes that contain mercury, fluorescent light tubes, lead acid batteries, and expired or unused chemicals.

All other waste materials that cannot be incinerated or that do not require specialized treatment shall be disposed in COPCL approved sanitary and engineered landfills. If suitable COPCL approved third party facilities cannot be identified in Cambodia to handle all of the COPCL waste materials, waste materials will be exported to a COPCL's approved suitable waste management facility in another country. The waste export process will be conducted in accordance with Cambodia Ministry of Environment requirements, the Basel Convention, and COPCL policies.

6.2.4.6 Waste Management Procedures

Waste Segregation and Storage

Waste materials awaiting transport to shore or to a COPCL approved 3rd party disposal facility will be stored in a manner that prevents releases, potential impacts to the environment, and exposure of workers or local residents.

Waste Preparation

Solid waste materials may need to be prepared before being sent for disposal. The project is evaluating projects' needs in terms of auxiliary equipment. Examples of waste preparation units include: compactor, shredder, food waste macerator, and sewage treatment unit.

Recordkeeping / Waste Tracking

Accurate records of all wastes generated, by waste type,will be kept onsite (shore base) or at a location having continuous control by Chevronpersonnel or designated contractors. The records will be used to track the amount of waste generated and the disposal methods used. It will also provide documentation that wastes are being managed appropriately when sent to COPCL approved 3rd party waste management facilities.

6.2.5 Community Engagement Plan

The purpose of Community Engagement Program is to foster understanding and dialogue between COPCL and the communities that may be affected by the Block A DevelopmentProject. The program promotes the open communication of relevant, useful information that is responsive to the public's questions and concerns about environment, health and safety.

Community awareness started with the Public Participation meetings that were organized in preparation of the EIA. The plan will be updated regularly as the Project progresses.

6.3 Environmental Monitoring

Monitoring measures are proposed to verify that mitigation measures are implemented and to verify that they are effective in mitigating the potential impact.

They specifically cover:

1. The monitoring of discharges and emissions from the project in order to comply with regulations or company standards; and
2. The measurement of the environment to assess the potential impact, if any, of the project on its surroundings.

Environmental monitoring during and after the project will provide information on:

- Potential environmental impact;
- Trends in parameters which may result inan environmental impact; and
- Whether the potential impact is attributable to the project (comparison to control site).

Interpretation of the results will provide information on:

- The accuracy of the assessmentmade in the EIA;
- Provide early warning of any possible unforeseen potential impacts;
- Assist in the identification of alternative mitigation measures that may have to be taken;

Evaluate effectiveness of the mitigation measures. As seen at the beginning of the chapter, environmental monitoring is an integral part of the OEMS.

6.3.1 Scope

6.3.1.1 *Facility and Pipeline Installation and Commissioning Activities*

Production Platforms, Wellhead platforms, and FSO will be fabricated at onshore facilities before transported by barge to proposed installation locations. Similarly, pipeline will be transported to proposed routes and laid on the seabed without trenching. Potential impacts from these activities are short-term and intermittent in nature, and are considered to be insignificant. As a result, an environmental monitoring program is not proposed for this phase. It should be noted however thatimplementation of mitigation measures that are applicable to this phase will be monitored.

6.3.1.2 *Drilling Activities*

The environmental monitoring program for the drilling phase is designed to monitor the efficiency of environmental mitigation measures following best practice of Chevron operation in GoT. The monitoring program include measuring the quantity of drill cuttings and mud, heavy metal contents in drill cuttings, cutting base fluid retention (CBFR), and tracking of waste generated from drilling activities.

6.3.1.3 *Production Activities*

Environmental monitoring programs during this phase are designed to monitor potential environmental impact that may occur at production platforms, FSO, and wellhead platforms. Environmental quality at reference station will be monitor as representative of environmental quality in an area not directly impacted by project activities every time that the monitoring activities are conducted.

6.3.2 Environmental Monitoring Measures

Proposed environmental monitoring measures including parameter, frequency, stations, and number of samples are presented in **Table 6-4**and **Figure 6-5 to 6-8**.

A total of 33 stations for sediment sampling, three stations forwater analysis and 17stations for benthic community sampling are proposed. Proposed sampling plan is deemed representative of Block A activities.

Figure 6-5: Location of Proposed Production Platforms, Wellhead Platforms, and FSO to be Monitored for Block A Development Monitoring Program

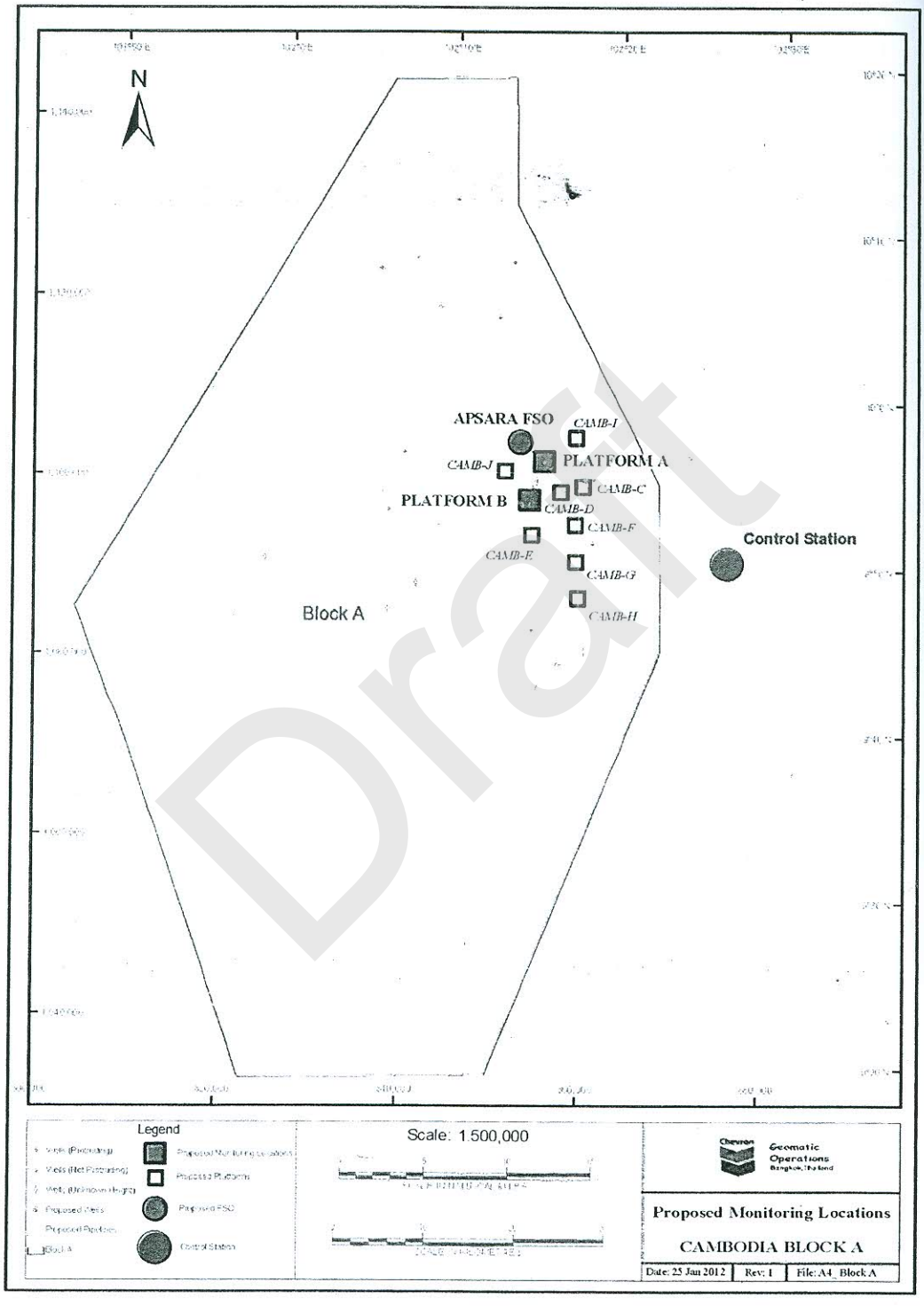


Figure 6-6: Proposed Sampling Stationsfor Sediment and Benthos Samplings at Production and Wellhead Platforms

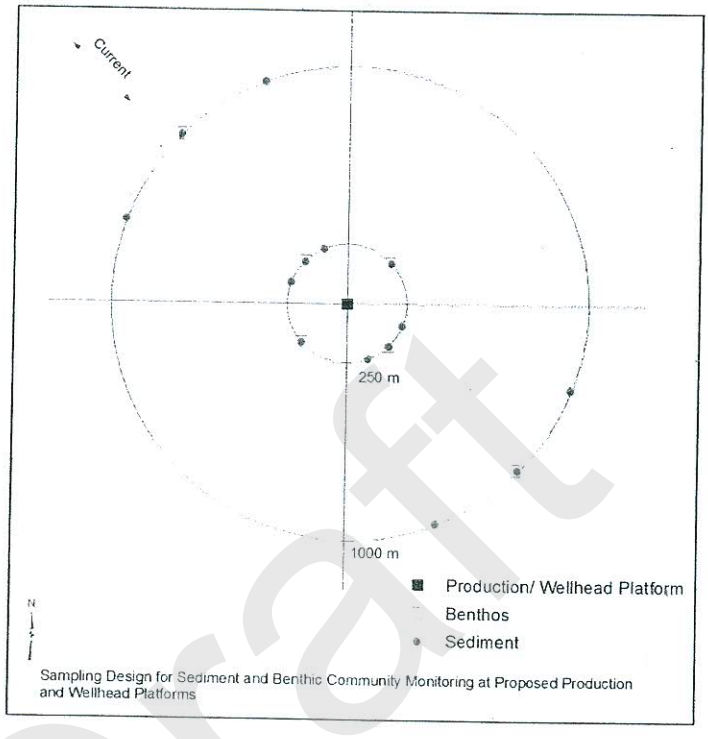


Figure 6-7: Proposed Sampling Stationsfor Seawater Sampling at FSO

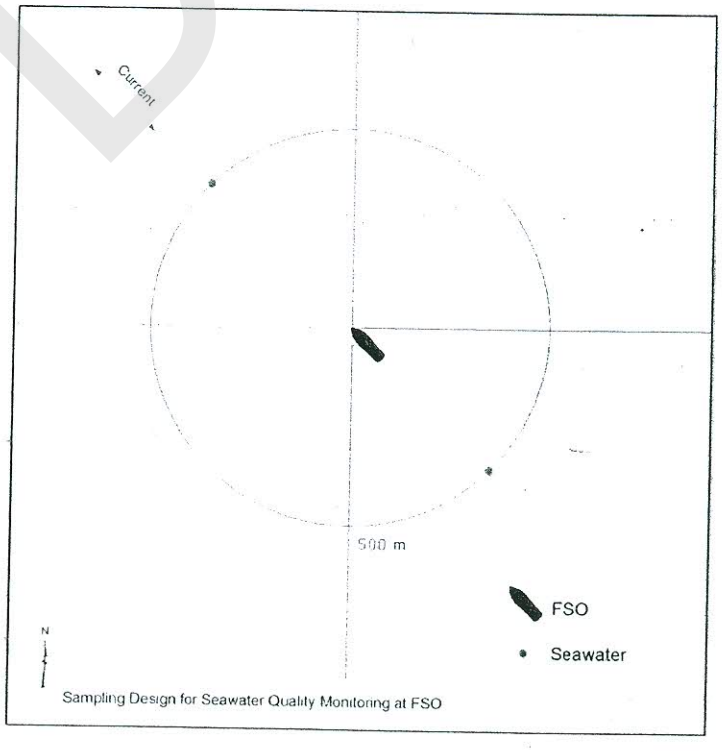


Figure 6-8: Proposed Sampling Stationsfor Sediment and Benthos at FSO

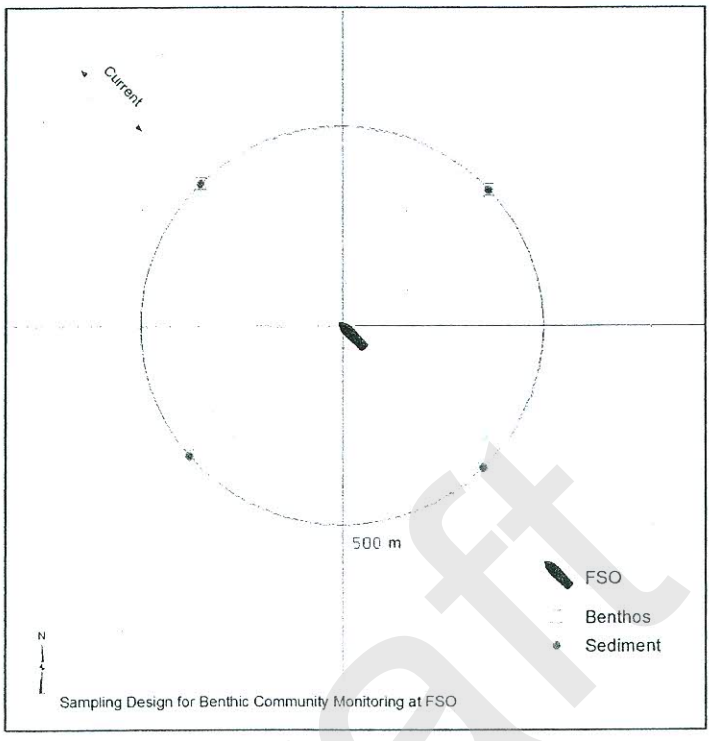


Table 6-4:Parameters to be Monitored, Location, Number of Stations

Location	Seawater	Sediment	Benthos	Monitoring frequency
FSO	2 stations	4 stations	4 stations	Every 3 years
Production Platform (Platform A)	N/A	14 stations	6 stations	Every 3 years
Wellhead Platform (Platform B – to be installed in future)	N/A	14 stations	6 stations	Every 3 years
Control Point	1stations	1 stations	1 stations	Every 3 years
Total	3 stations	33 stations	17 stations	

6.3.3 Compliance Monitoring

COPCL will monitor compliance with all relevant local and international agreements and regulations. In addition, specific objectives and targets will be reviewed as a result of follow-up to an incident/accident or a finding from monitoring. Monitoring measures for all project activities are shown in **Table 6-5**.

Table 6-5:Monitoring Measures

Activities/Environmental Factors	Monitoring Measures	Duration or Frequency of Monitoring	Monitoring Areas	Reporting	Responsibility
Site Survey, Installation of Platforms, Pipelines, and FSO					
Pile Driving/ Under water noise	Marine Mammals.observation report	Once for each platform	Project Area	One report per platform	COPCL
Drilling Activities					
Drill Cuttings and Mud	**End of Well Report**, which provides information on mud composition and concentration (both WBM and NAF), quantity of mud used, discharged and loss to formation, and properties and estimated volume of cuttings discharged including Cutting Base Fluid Retention (CBFR)	Once for each platform	Project area	One report per platform	COPCL
Waste Generation	**Waste Inventory Report**, including quantity and type of wastes generated offshore from drilling, transportation and wastes disposal	Monthly during the entire drilling period	Project area	Annual report	COPCL
Drill Cuttings Properties	**Report of drill cuttings analysis** of the following parameters: • Total Petroleum Hydrocarbons (TPH) • Heavy Metals (As, Ba, Cd, Cr, Cu, Fe, Ni, Pb, and Hg))	Once for each project phase (1a, 1b, and 1c) during the entire drilling period. Cuttings to be sampled from 3 wells per platform	Project area	One report per platform	COPCL
Production Activities					
Seawater Quality	Report of seawater analysis of the following parameters:	• FSO: once within 12 months after	• FSO: 2 stations (**Figure 6-7**and	One combined report per	COPCL

Activities/Environmental Factors	Monitoring Measures	Duration or Frequency of Monitoring	Monitoring Areas	Reporting	Responsibility
	• *In situ* measurements of temperature, salinity, dissolved oxygen, pH, turbidity, and conductivity • Total Suspended Solid (TSS) • Chemical Oxygen Demand (COD) • Total Organic Carbon (TOC) • Petroleum Hydrocarbons (TPH) • Oil and Grease • Heavy metals (As, Ba, Cd, Cr, Cu, Fe, Ni, Pb, and Hg)	start of production, then every 3 years • Control Point: every time seawater sampling is conducted in the Block A Operating Areas.	**Table 6-4**) • Control Point: 1station	monitoring program	
Sediment Quality	Report of sediment analysis of the following parameters: • Particle Size Distribution • Total Organic Carbon (TOC) • Total Petroleum Hydrocarbons (TPH) • Oil and Grease • Heavy metals (As, Ba, Cd, Cr, Cu, Fe, Ni, Pb, and Hg)	• Production platform A and wellhead platform B: once within 12 months after start of production at platform A and platform B, then every 3 years. • FSO: once within 12 months after start of production	• Production platform A and wellhead platform B (Figure 6-6): Total 14 stations at the distances of 250m and 1000 m around platforms • Block A FSO (**Figure 6-8):**Total 4 stations at the	One combined report per monitoring program	COPCL

Activities/Environmental Factors	Monitoring Measures	Duration or Frequency of Monitoring	Monitoring Areas	Reporting	Responsibility
		start of production at platform A and platform B, then every 3 years. • Control Point: every time sediment sampling is conducted in the Block A Operating Areas.	4 stations at the distance of 500 m from CALM BOUY • Control Point: 1 station		
Benthos	Report of benthic community analysis of the following parameters: • Species identification • Density • Shannon diversity index	Same as the sediment sampling frequency	• Production platform and wellhead platform (**Figure 6-6**):Total 6 stations at the distances of 250m and 1000 m around platforms • Block A FSO (**Figure 6-8**): Total 4 stations at the distance of 500 m from CALM BOUY • Control Location: 1 station	One combined report per monitoring program	COPCL

6.4 Conclusion

The EIA for the Block A Development Project has systematically identified potential environmental, social and public health aspects associated with the proposed project. For aspects identified as potentially significant, appropriate mitigation and monitoring measures have been developed to reduce the significance of the potential impact and monitor effectiveness of the proposed mitigation measures.

IEM believes that the prevention and mitigation measures outlined in this EIA are suitable to provide the appropriate management measures to verify that potentially significant environmental, social and public health impacts are prevented ormitigated.

7. CONCLUSION AND RECOMMENDATIONS

Chevron Overseas Petroleum (Cambodia) Limited (COPCL) plans to develop the Apsara Field (Phase 1) in the Block A Concession. The Phase 1 development of Block A will consist of up to ten platforms, one Floating Storage and Offloading vessel (FSO) and a network of infield flowlines ("the Project").

A formal screening/scoping exercise was conducted and identified potentially significant impacts. These potential impacts were evaluated in detail and proposed mitigation assessed. This EIA report summarizes the conclusions of the impact assessment and meets the intent of *the Sub Decree on Environmental Impact Assessment Process, 1999.*

7.1 Block A Development Project EIA

The EIA for the Block A Development Project was conducted in compliance with the guidance in Annex 1 of the 2009 Prakas on General Guideline for Preparing IEIA and EIA Report (2009). As required according to the general guideline:

- EIA objectives indentified, methodology and scope of the study determined, applicable laws and regulations reviewed (Chapter 1).
- The Project was reviewed to gain a full understanding of the project and to compile information on project activities (Chapter 2).
- Environmental data and information was collected and evaluated using Cambodian regulations/guidelines and, where necessary, regulations from other jurisdictions as a guideline to determine the current baseline environmental conditions (Chapter 3).
- Public Involvement consisted of public meetings with local regulators, communities, and NGOs to provide information, and to obtain information on local sensitivities/attitudes to assist in determining potential project impacts and develop suitable mitigation measures (Chapter 4).
- Impact assessment including screening, scoping and assessment of potentially significant impacts and a risk assessment of unplanned events using Cambodian regulations/guidelines and, where necessary, regulations from other jurisdictions as a guideline to evaluate the significance of the potential impact (Chapter 5).
- An Environmental Management Plan (EMP) including all prevention and mitigation measures to reduce the significance of potential impacts. The EMP also includes monitoring measures (Chapter 6).

7.2 EIA Findings

Baseline environmental conditions at the project area indicated that:

- Seawater quality is typical of uncontaminated offshore waters and comparable to data collected in the central Gulf.
- Sediment quality is generally typical of uncontaminated offshore sediments and comparable to data collected in the central Gulf. Higher levels of barium were found in one sediment sample, likely from drilling mud associated with a previous exploration well; however, barite is not considered a toxic pollutant.

- Sensitive ecosystems (such as seagrass, mangrove, fish refugia, sea turtle nesting areas, wetlands, corals and other protected areas) are located on or in the near proximity to the coast, at least 140 km from the project area.
- Most fishing is conducted nearshore.
- Tourist attractions are located along the coast, at least 140km from the project area.

The outcomes of the public involvement at four coastal provinces (Preah Sihanouk, Kampot, Kep and Koh Kong) indicated that:

- The public has general concerns about potential impacts on fishing, transportation activities, subsurface geology, risk of earthquakes and accidental releases.
- The public showed interest in:
  - General mitigation plans;
  - Specific management measures for risks of accidental oil releases and typhoons;
  - Management of gas, cuttings and waste;
  - Benefits for local communities i.e. job opportunities, revenue;
- Regulators and participating communities fully supported the project.

The impact assessment and the risk assessment indicated that:

- All potential impacts during normal operations are deemed to be of insignificant or low significance;
- Risks associated with unplanned events are deemed to be of low significance. While some unplanned events could potentially have severe environmental, public health and social consequences, the likelihood of these events happening is very low, and therefore the associated risk is not considered significant. Events that are potentially more frequent such as very small accidental releases are unlikely to have significant potential consequences.

7.3 Management Plan and Operational Excellence Management

Mitigation measures will be employed to reduce the likelihood of an impact and/or to limit the extent of an impact if one does occur. In addition, environmental monitoring measures will be undertaken to verify the effectiveness of the mitigation measures.

Measures for management of potential impacts and risks include:

- OE selection criteria for contractors;
- Environmental Management Plan with comprehensive mitigation and monitoring measures;
- Emergency Response Plan;
- Oil Spill Response Plan;
- Waste Management Plan;
- Community Engagement Plan.

COPCL has adopted a formal Operational Excellence Management System which is designed to drive progress toward world class performance.

Environmental management of the project and in particular the EIA are integrated into the OEMS at different stages:

- Assessment: with identification of the appropriate mitigation/monitoring measures;
- Implementation: with implementation of the measures;
- Review: when effectiveness is periodically reviewed and mitigation and monitoring measures revised when necessary.

7.4 General Conclusion and Recommendation

The EIA for the Block A development Project has systematically identified potential environmental, social and public health impacts associated with the proposed project.

For impacts identified as potentially significant, appropriate mitigation and monitoring measures have been developed to reduce the significance of the potential impact and monitor effectiveness of the proposed mitigation measures.

Implementation of COPCL's formal OEMS is designed to facilitate the systematic management of activities and to drive progress toward world class performance. Its implementation for the Block A development Project allows identification of responsibilities and accountability, management review and implementation of corrective action when necessary, resulting in continual improvement.

IEM believes that the prevention and mitigation measures outlined in this EIA and COPCL's management systems are suitable to provide the appropriate management measures to verify that potentially significant environmental, social and public health impacts are prevented or mitigated. No modifications of the proposed project are required in the light of the assessed extent of potential impacts.

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APPENDIX 1: EIA LICENSE

ព្រះរាជាណាចក្រកម្ពុជា

ជាតិ សាសនា ព្រះមហាក្សត្រ

គណៈរដ្ឋមន្ត្រី

ក្រសួងបរិស្ថាន

លេខ:...[illegible]...បស្ថ

រាជធានីភ្នំពេញ, ថ្ងៃទី...១៣...ខែ មីនា...ឆ្នាំ២០០៧

ជំរាបមក

លោកនាយកក្រុមហ៊ុន International Environmental Management Co., Ltd.

កម្មវត្ថុ : ការលើកផ្តល់លិខិតអនុញ្ញាតដល់ក្រុមហ៊ុន **International Environmental Management Co., Ltd.** ក្នុងការសិក្សាស្រាវជ្រាវរៀបចំ និងចងក្រងរបាយការណ៍វាយតំលៃហេតុប៉ះពាល់បរិស្ថាន ។

យោង : - ព្រះរាជក្រមលេខ នស.រកម ១២៩៦/៣៦ ចុះថ្ងៃទី២៤ ខែធ្នូ ឆ្នាំ១៩៩៦ ដែលប្រកាសអោយប្រើច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និង ការគ្រប់គ្រងធនធានធម្មជាតិ

- អនុក្រឹត្យលេខ៧២ អនក្រ.បក ចុះថ្ងៃទី១១ ខែសីហា ឆ្នាំ១៩៩៩ ស្តីពីកិច្ចដំណើរការវាយតំលៃហេតុប៉ះពាល់បរិស្ថាន
- លិខិតលេខ ០៧៣៥ ពណ.នគក ចុះថ្ងៃទី ១៤ ខែ កុម្ភៈ ឆ្នាំ ២០០៧ របស់ក្រសួងពាណិជ្ជកម្ម
- ពាក្យស្នើសុំ ចុះថ្ងៃទី ១៤ ខែ កុម្ភៈ ឆ្នាំ ២០០៧ របស់ក្រុមហ៊ុន ។

តបតាមកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមជំរាបលោកនាយកជ្រាបថា ក្រសួងបរិស្ថានឯកភាពឱ្យក្រុមហ៊ុន **International Environmental Management Co., Ltd.** តំណាងដោយលោក ZORAN VUCICEVIC សញ្ជាតិ កាណាដា កាន់លិខិតឆ្លងដែនលេខ BA២៩៦៤២៤ ចុះថ្ងៃទី០៥ ខែកញ្ញា ឆ្នាំ២០០៦ ដើម្បីបង្កើតក្រុមហ៊ុនឯកជនមួយសិក្សាស្រាវជ្រាវ រៀបចំ និងចងក្រងរបាយការណ៍វាយតំលៃហេតុប៉ះពាល់បរិស្ថាន ដែលមានទីស្នាក់ការស្ថិតនៅផ្ទះលេខ ១៣-១៤ មហាវិថីសហព័ន្ធរុស្ស៊ី សង្កាត់កាកាប ខណ្ឌដង្កោ រាជធានីភ្នំពេញ ដោយម្ចាស់ក្រុមហ៊ុនត្រូវគោរពច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ អនុក្រឹត្យស្តីពីកិច្ចដំណើរការវាយតំលៃហេតុប៉ះពាល់បរិស្ថាន និងលិខិតបទដ្ឋាននានាដែលពាក់ព័ន្ធនឹងកិច្ចដំណើរការវាយតំលៃហេតុប៉ះពាល់បរិស្ថាន ។

អាស្រ័យហេតុនេះ សូមលោកនាយកទទួលអនុវត្តឱ្យបានត្រឹមត្រូវតាមខ្លឹមសារខាងលើនេះឱ្យមានប្រសិទ្ធិភាព ។

សូមលោកនាយកទទួលនូវការរាប់អានដ៏ស្មោះអំពីខ្ញុំ ។

ទេសរដ្ឋមន្ត្រី រដ្ឋមន្ត្រីក្រសួងបរិស្ថាន

ម៉ុក ម៉ារ៉េត

ចម្លងជូន :
- ទីស្តីការគណៈរដ្ឋមន្ត្រី
- ក្រុមប្រឹក្សាអភិវឌ្ឍន៍កម្ពុជា
- ក្រសួងឧស្សាហកម្មរ៉ែ និងថាមពល
- ក្រសួងពាណិជ្ជកម្ម
- [illegible]
- ឯកសារ-កាលប្បវត្តិ

APPENDIX 2: TECHNICAL CODES & STANDARDS

Technical Codes & Standards

The following is a list of the main international codes and standards that are to be utilized in the detailed facilities design.

General

- API American Petroleum Institute.
- API RP 14E Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems.
- API RP 14C Recommended Practice for Analysis, Design, Installation and Testing of Basic Surface Safety Systems for Offshore Production Platforms.
- API RP 14G Fire Prevention and Control on Open Type Offshore Platforms.
- API RP 500 Recommended Practice for Classification of Locations for Electrical Installation at Petroleum Facilities Classified as Class 1, Division 1 and Division 2.
- API RP 520 Recommended Practice for the Design and Installation of Pressure-Relieving Devices in Refineries:
  - Part I Sizing and Selection
  - Part II Installation
- API RP 521 Recommended Practice Guide for Pressure-Relieving and De-pressuring Systems.
- API RP 14J Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities.
- AGA #3.
- Flow Metering.

Mechanical & Piping:

- API American Petroleum Institute.
- API 610 Centrifugal Pumps for General Refinery Service.
- API Spec 2C Specification for Platform Cranes.
- API RP 2G Recommended Practice for Production Facilities on Offshore Platforms.
- ASME American Society Mechanical Engineers.
- ASME B31.3 Process Piping.
- ASME B31.4 Liquid Petroleum Transportation Piping Systems.
- ASME B31.8 Gas Transmission and Distribution Piping Systems.
- ASME B16.5 Pipe Flanges and Flanged Fittings.
- ASME Section II Materials.
- ASME Section VIII Boiler and Pressure Vessel Code Div 1 and Div 2.
- ASME Section V Non-Destructive Examination.
- ASME Section IX Welding and Brazing Qualifications.
- ASHRAE Std. 62 Ventilation for Acceptable Indoor Air Quality.
- TEMA Tubular Exchanger Manufacturers Association.

- DEMA Diesel Engine Manufacturers Association.
- NACE MR-01-75 Sulphide Stress Cracking Resistant Metallic Material for Oil Field Equipment.

Electrical:

- NEC - National Electrical Code (NFPA 70).
- NEMA - National Electrical Manufacturers Association.
- NFPA - National Fire Protection Association.
- IEEE - Institute of Electrical & Electronic Engineers.
- IES - Illuminating Engineering Society.
- API - American Petroleum Institute (RP-14F & RP-500B).
- IPCEA - Insulated Power Cable Engineers Association.
- NETA - National Electrical Testing Association.
- NESC - National Electrical Safety Code (ANSI C2).
- UL - Underwriters Laboratories.
- ANSI - American National Standards Institute.
- FM - Factory Mutual.

Instruments and Controls:

- NEMA ICS-1 General Requirements for Industrial Control.
- NEMA ICS-2 Industrial Control Devices, Controllers and Assemblies.
- NEMA ICS-6 Enclosures for Industrial Control Systems.
- IEC 61508 - Functional Safety: Safety Related Systems.
- Electronic Industries Association (EIA).
- RS-232-C - Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
- RS-422-A - Electrical Characteristics of Balanced Voltage Digital Interface Circuits.
- 488 IEEE Standard Digital Interface for Programmable Instrumentation.
- Instrument Society of American (ISA).
- ISA S84-01 Safety Instrumented Systems for Process Industries.
- ISA S84.02 Application of Safety Instrumented Systems for the Process Industries.
- ISA S5.1 Instrument Symbols and Identification.
- S5.2 Binary Logic Diagrams for Process Operations.
- American Petroleum Institute (API).
- API RP 550 Section 12, Manual on Installation of Refinery Instruments and Control Systems, Part I - Process Instrumentation and Control, Section 12 - Control Centers.
- API RP 550 Manual on Installation of Refinery Instruments and Control Systems, Part 1 - Process Instrumentation and Control, Section 6 - Control Valves and Accessories.

- API RP 14F Recommended Practice for Design and Installation for Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Division 1 and Division 2 Locations.
- API RP5.1 - Instrumentation Symbols and Identification.

Structural:

- API - American Petroleum Institute.
- API RP2A – WSD Recommended Practice for Planning, Designing, and Constructing Fixed Offshore Platforms. Working Stress Design, 21st Edition.
- API Bul. 2V Bulletin on the Design of Flat Plate Structures, 1st Edition, May 1987
- API SPEC 2H Specification for carbon Manganese Steel Plate for Offshore Platform Tubular Joints.
- API SPEC 2W Specification for Steel Plates for Offshore Structures, Produced by Thermo mechanical Control Processing (TMCP).
- API SPEC 2Y Specification for Steel Plates, Quenched and Tempered, for Offshore Structures.
- API SPEC 5L Specification for Line Pipe.
- AISC American Institute of Steel Construction.
- Specification for the Design, Fabrication and Erection of Structural Steel for Buildings." (9th Edition) WSD
- Code of Standard Practice for Steel Buildings and Booms
- ASTM American Society for the Testing of Materials.
- ASTM A36 Standard Specification for Carbon Structural Steel.
- ASTM A572 Standard Specification for High-Strength, Low Alloy Columbium-Vanadium Steel of Structural Quality.
- ASTM A6 /A6M Standard Specification for General Requirements for Rolled Steel, plates, Shapes, Sheet Piling and Bars for Structural Use.
- ASTM A307 Standard Specification for Carbon Steel Bolts and Nuts.
- ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength.
- ASTM A490 Standard Specification for Heat Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength.
- AWS American Welding Society
- ANSI / D1.1 Structural Welding Steel Code.
- DnV, Det Norske Veritas, Part 2, Chapter 5, Lifting.
- British Standard, BS2853 The Design and Testing of Steel Overhead Runway Beams.

Miscellaneous:

- IMO International Maritime Organization
- OSHA Occupational Safety and Health Administration
- SOLAS International Convention for the Safety of Life at Sea

- CAP 437 Offshore Helicopter Landing Areas – Guidance on Standards

APPENDIX 3: MSDS FOR CHEMICALS USED IN PROJECT

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **ADAPTA™**

Revision Date: 29-Jun-2009

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: ADAPTA™
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
Methylstyrene/Acrylate copolymer		60 - 100%	Not applicable	Not applicable
Silica gel	112926-00-8	1 - 5%	10 mg/m^3	6 mg/m^3

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 Rinse mouth with water many times.

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 1, Reactivity 0
HMIS Ratings: Health 1, Flammability 1, 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. Avoid dust accumulations. Ground and bond containers when transferring from one container to another.

Storage Information Store away from oxidizers. Keep away from friction, impact, and heat. Store in a well ventilated area. Product has a shelf life of 36 months.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls Use in a well ventilated area. Trace amounts of monomers may be released during use of this material.

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 Neoprene gloves. 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:	Powder
Color:	Off white
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.03
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	33
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	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	Irritation of the mouth, throat, and stomach.
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	If not contaminated, reuse product. 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	One or more components listed.
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

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: **ALDACIDE® G ANTIMICROBIAL**

Revision Date: 07-Apr-2010

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: ALDACIDE® G ANTIMICROBIAL
Synonyms: None
Chemical Family: Aldehyde
Application: Biocide

Manufacturer/Supplier
Halliburton Energy Services, Inc.
P.O. Box 1431
Duncan, Oklahoma 73536-0431
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
Glutaraldehyde	111-30-8	10 - 30%	0.05 ppm	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview
Keep out of reach of children. May cause eye burns. May cause irreversible eye damage. May cause severe skin irritation. May be harmful if swallowed. May be harmful if inhaled. May cause allergic skin reaction.

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.

Eyes
Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.

Ingestion
Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Notes to Physician
Probable mucosal damage may contraindicate the use of gastric lavage. No specific antidote. Treat symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point/Range (F):	Not Determined
Flash Point/Range (C):	Not Determined
Flash Point Method:	Not Determined
Autoignition Temperature (F):	> 527
Autoignition Temperature (C):	> 275
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.

Special Protective Equipment for Fire-Fighters Full protective clothing and approved self-contained breathing apparatus required fire fighting personnel.

NFPA Ratings: Health 3, Flammability 1, Reactivity 0
HMIS Ratings: Health 3, Flammability 1, Physical Hazard 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures Use appropriate protective equipment. Use only competent persons for cleanup

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 mate Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Do not swall Wash hands after use. Launder contaminated clothing before reuse.

Storage Information Store away from acids. Store away from alkalis. Keep container closed when no 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. If vapors are strong enough to be irritating to the nose or eyes, the TLV is probably being exceeded and special ventilation or respiratory protection maybe required.

Respiratory Protection Full Facepiece Respirator with Organic vapor cartridge with particulate prefilter.

Hand Protection Nitrile gloves. Butyl rubber gloves.

Skin Protection Butyl coated apron or clothing.

Eye Protection Splashproof chemical monogoggles or safety glasses with side shields in conjun with a face shield. Do NOT wear contact lenses.

Other Precautions Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	Clear light yellow
Odor:	Sharp
pH:	3.1-4.5
Specific Gravity @ 20 C (Water=1):	1.064
Density @ 20 C (lbs./gallon):	8.87
Bulk Density @ 20 C (lbs/ft3):	Not Determined
Boiling Point/Range (F):	213
Boiling Point/Range (C):	100.5
Freezing Point/Range (F):	14 to 23
Freezing Point/Range (C):	-5 to -10
Vapor Pressure @ 20 C (mmHg):	0.2
Vapor Density (Air=1):	0.8
Percent Volatiles:	100
Evaporation Rate (Butyl Acetate=1):	0.9
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:	-0.333
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 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	Harmful if inhaled. Causes severe respiratory irritation. Vapors given off by heated product may be harmful. May cause allergic respiratory reaction. Inhalation of vapors may result in skin sensitization.
Skin Contact	May cause skin irritation. May cause skin burns on prolonged contact. Harmful if absorbed through the skin. Prolonged or widespread contact may result in the absorption of potentially harmful amounts of material. This product contains ingredients which may produce an allergic skin reaction. It should be treated as a skin sensitizer.
Eye Contact	May cause eye burns. May cause permanent eye damage. High vapor concentration will cause irritation.
Ingestion	Causes burns of the mouth, throat and stomach. Harmful if swallowed. 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. Lung disorders. Liver disorders.

Chronic Effects/Carcinogenicity	No data available to indicate product or components present at greater than 1% as chronic health hazards.
Other Information	None known.

Toxicity Tests

Oral Toxicity:	LD50: 320 mg/kg (Rat)
Dermal Toxicity:	LD50: > 2000 mg/kg (Rabbit)
Inhalation Toxicity:	LC50: 0.28-0.39 mg/l/4 hr (Rat)
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 expected to bioaccumulate.

Ecotoxicological Information

Acute Fish Toxicity:	May be highly toxic to aquatic life. LC50: (96 hour) 13 mg/l (Lepomis macrochirus)
Acute Crustaceans Toxicity:	TLM48: 0.11 mg/l (Acartia tonsa) TLM48: 29.73 mg/l (Daphnia magna)
Acute Algae Toxicity:	EC50: 8.1 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

DOT
Not restricted by surface modes.

Canadian TDG
Not restricted by surface modes.

ADR
Not restricted by surface modes.

Air Transportation

ICAO/IATA
Not restricted by surface modes.
UN3334, Aviation Regulated Liquid, N.O.S (Contains Glutaraldehyde), 9

Sea Transportation

IMDG
Not restricted by surface modes.

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	Acute Health Hazard Chronic Health 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 NOT meet the criteria of a hazardous waste as defined by the US EPA.
Federal Insecticide, Fungicide and Rodenticide Act:	Label in accordance with Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.
California Proposition 65	All components listed do not apply to the California Proposition 65 Regulation.
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	D1B Toxic Materials D2B Toxic Materials E Corrosive Material

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

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BARABLOK® 400**

Revision Date: 03-Jan-2008

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BARABLOK® 400
Synonyms: None
Chemical Family: Asphalt
Application: Fluid Loss 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
Natural asphalt	12002-43-6	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 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

Flash Point/Range (F):	599
Flash Point/Range (C):	315
Flash Point Method:	COC
Autoignition Temperature (F):	Not Determined
Autoignition Temperature (C):	Not Determined
Flammability Limits in Air - Lower (%):	Not Determined
Flammability Limits in Air - Lower (oz./ft3):	0.02
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: Flammability 1, Reactivity 1, Health 0

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 oxidizers. 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 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:	Black to Dark brown
Odor:	Asphalt
pH:	5.8
Specific Gravity @ 20 C (Water=1):	1.06
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	30
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:	2
Evaporation Rate (Butyl Acetate=1):	Not Determined
Solubility in Water (g/100ml):	Insoluble
Solubiiity in Solvents (g/100ml):	Soluble in petroleum solvents
VOCs (lbs./gallon):	Not Determined
Viscosity, Dynamic @ 20 C (centipoise):	2800
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 anticipated
Incompatibility (Materials to Avoid)	Strong oxidizers.
Hazardous Decomposition Products	Carbon monoxide and carbon dioxide. 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 mild skin irritation.
Eye Contact	May cause mechanical irritation to eye.
Ingestion	Not determined
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:	TLM96: 717,000 ppm (Mysidopsis bahia) SPP @ 20 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.
EPA SARA Title III Extremely Hazardous Substances	Not applicable
EPA SARA (311,312) Hazard Class	Acute Health 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 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	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

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END OF MSDS

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BARAZAN® D PLUS**

Revision Date: 03-Jan-2008

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BARAZAN® D PLUS
Synonyms: None
Chemical Family: Polysaccharide
Application: Viscosifier

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
Xanthan gum	11138-66-2	60 - 100%	10 mg/m^3	15 mg/m^3

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye 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):	400
Autoignition Temperature (C):	204
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 0, Flammability 1, Reactivity 0
HMIS Ratings: Flammability 1, Reactivity 0, Health 0

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

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	White to yellow
Odor:	Slight
pH:	5.5-8.5 (1%)
Specific Gravity @ 20 C (Water=1):	1.6
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	35-55
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):	1,000,000

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	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

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	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

MATERIAL SAFETY DATA SHEET

Product Trade Name: **BDF-513**

Revision Date: 20-Oct-2009

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: BDF-513
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
Styrene acrylate copolymer		60 - 100%	10 mg/m^3	15 mg/m^3

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 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

Flash Point/Range (F):	Not Determined**Min:** > 200
Flash Point/Range (C):	Not Determined**Min:** > 93
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	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 1, Flammability 1, Reactivity 0
HMIS Ratings:	Health 1, Flammability 1, Physical Hazard 0 , PPE: E.

6. ACCIDENTAL RELEASE MEASURES

Personal Precautionary Measures	Use appropriate protective equipment.
Environmental Precautionary Measures	None known.
Procedure for Cleaning / Absorption	Remove ignition sources and work with non-sparking tools. Scoop up and remove.

7. HANDLING AND STORAGE

Handling Precautions	Avoid contact with eyes, skin, or clothing. Avoid creating or inhaling dust. Ground and bond containers when transferring from one container to another.
Storage Information	Store away from oxidizers. Keep from excessive heat. Use good housekeeping in storage and work areas to prevent accumulation of dust. Close container when not in use. Store in a dry location. Store in a well ventilated area. Keep from heat, sparks, and open flames. Product has a shelf life of 36 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	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 masks.
Hand Protection	Neoprene 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:	Off white
Odor:	Odorless
pH:	Not Determined
Specific Gravity @ 20 C (Water=1):	1.03
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. Reducing agents.
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 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:	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 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	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
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

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: **CALCIUM CHLORIDE - POWDER**

Revision Date: 16-Nov-2009

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: CALCIUM CHLORIDE - POWDER
Synonyms: None
Chemical Family: Inorganic Salt
Application: Accelerator

Manufacturer/Supplier
Halliburton Energy Services
P.O. Box 1431
Duncan, Oklahoma 73536-0431
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
Calcium chloride, dihydrate	10035-04-8	60 - 100%	Not applicable	Not applicable

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. May be harmful if swallowed.

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

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	All standard firefighting media.
Special Exposure Hazards	Not applicable.
Special Protective Equipment for Fire-Fighters	Not applicable.
NFPA Ratings:	Health 1, Flammability 0, Reactivity 0
HMIS Ratings:	Health 1, Flammability 0, Reactivity 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 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	Normal work gloves.
Skin Protection	Normal work coveralls.
Eye Protection	Dust proof goggles.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State:	Solid
Color:	White
Odor:	Odorless
pH:	10
Specific Gravity @ 20 C (Water=1):	2.1 -.2.5
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	51

9. PHYSICAL AND CHEMICAL PROPERTIES

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):	42
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):	147.02

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. May cause skin burns on prolonged contact.
Eye Contact	May cause severe eye irritation. May cause corneal injury.
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: 1000 mg/kg (Rat)
Dermal Toxicity:	LD50: > 5000 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:	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	Acute Health 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 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	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

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

Chrome Free Desco® Deflocculant

Product Use: Drilling Mud Additive
Product Number(s): 0001016808, 0001017884
Synonyms: Drilling Mud Deflocculant
Product CAS No.: Mixture

Company Identification:
Chevron Phillips Chemical Company LP
Drilling Specialties Company
10001Six Pines Drive
The Woodlands,TX 77380

Chevron Phillips Chemicals International N.V.
Brusselsesteenweg 355
B-3090 Overijse
Belgium

Product Information:
MSDS Requests: (800) 852-5530
Technical Information: (800) 221-1956
Responsible Party: Product Safety Group
Email:msds@cpchem.com

24-Hour Emergency Telephone Numbers
HEALTH:Chevron Phillips Emergency Information Center-866.442.9628 (North America) and 1.832.813.4984 (International)
TRANSPORTATION: North America: CHEMTREC 800.424.9300 or 703.527.3887
ASIA: +1.703.527.3887
EUROPE: BIG .32.14.584545 (phone) or .32.14.583516 (telefax)
SOUTH AMERICA SOS-Cotec Inside Brazil: 0800.111.767
Outside Brazil: 55.19.3467.1600

SECTION 2 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW
Fine reddish-brown powder with small white specks, odorless.

- MAY CAUSE RESPIRATORY TRACT IRRITATION IF INHALED
- MAY CAUSE SKIN IRRITATION
- DUST MAY PRODUCE MECHANICAL IRRITATION TO THE MUCOUS MEMBRANES OF THE EYES, NOSE, THROAT AND UPPER RESPIRATORY TRACT

- MAY CAUSE EYE IRRITATION
- CANCER HAZARD - CONTAINS MATERIAL THAT CAN CAUSE CANCER
- MAY CAUSE DAMAGE TO:
- - - - - - LUNGS
- - - - - - LIVER
- - - - - - BLOOD/BLOOD FORMING ORGANS
- - - - - - GASTROINTESTINAL SYSTEM

****

IMMEDIATE HEALTH EFFECTS:

Eye: This material may be irritating to the eyes and could cause prolonged (days) impairment of your vision. The degree of the injury will depend on the amount of material that gets into the eye and the speed and thoroughness of the first aid treatment. Not expected to cause prolonged or significant eye irritation. Material is dusty and may scratch the surface of the eye.

Skin: This material may be irritating to the skin. The degree of the injury will depend on the amount of material that gets onto the skin and the speed and thoroughness of the first aid treatment. Symptoms may include pain, itching, discoloration, swelling, and blistering. Not expected to be harmful to internal organs if absorbed through the skin.

Ingestion: May be irritating to mouth, throat, and stomach. Symptoms may include nausea, vomiting, and diarrhea.

Inhalation: The dust from this material may cause respiratory irritation. Symptoms of respiratory irritation may include coughing and difficulty in breathing.

DELAYED OR OTHER HEALTH EFFECTS:

Cancer: Prolonged or repeated exposure to this material can cause cancer.

Target Organs: - Liver - Blood/Blood Forming Organs - Lung Gastrointestinal System

See Section 11 for additional information. Risk depends on duration and level of exposure.

SECTION 3 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENT	CAS NUMBER	AMOUNT	EINECS	SYM	R-PHRASES
Proprietary	Proprietary	> 89 % weight	NA	NA	NA
Ferrous Sulfate	17375-41-6	< 10 % weight	NA	NA	NA
Crystalline Silica	14808-60-7	< 1 % weight	238-878-4	NA	NA

Occupational Exposure Limits:

Component	Limit	TWA	STEL	Ceiling / Peak	Notation
Crystalline Silica	ACGIH	.025 mg/m3	NA	NA	NA
Crystalline Silica	CPCHEM	.05 mg/m3	NA	NA	Respirable Dust
Crystalline Silica	German MAK	.15 mg/m3	NA	NA	NA
Ferrous Sulfate	ACGIH	1 mg/m3	NA	NA	as Fe
Proprietary	ACGIH	Not Established	NA	NA	NA

SECTION 4 FIRST AID MEASURES

Eye: Flush eyes with running water immediately while holding the eyelids open. Remove contact lenses, if worn, after initial flushing, and continue flushing for at least 15 minutes. Get immediate medical attention.

Skin: To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse. Get medical attention if any symptoms develop.

Ingestion: If swallowed, do not induce vomiting. Give the person a glass of water or milk to drink and get immediate medical attention. Never give anything by mouth to an unconscious person.

Inhalation: Move the exposed person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if breathing difficulties continue.

SECTION 5 FIRE FIGHTING MEASURES

Explosive dust clouds may be produced.
FIRE CLASSIFICATION:
Classification (29 CFR 1910.1200): Not flammable or combustible.This material will burn although it is not easily ignited.

NFPA RATINGS: **Health:** 1 **Flammability:** 0 **Reactivity:** 0
FLAMMABLE PROPERTIES:
Flashpoint: NA
Autoignition: NDA
Flammability (Explosive) Limits (% by volume in air): **Lower:** NA **Upper:** NA

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: Material will not burn unless preheated. Clear fire area of all non-emergency personnel. Only enter confined fire space with full gear, including a positive pressure, NIOSH-approved, self-contained breathing apparatus. Cool surrounding equipment, fire-exposed containers and structures with water. Container areas exposed to direct flame contact should be cooled with large quantities of water (500 gallons water per minute flame impingement exposure) to prevent weakening of container structure.
Combustion Products: Combustion may form: Sulfur Oxides, Carbon Oxides, Iron Oxides

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Wear appropriate personal protective equipment when cleaning up spills. Refer to Section 8.
Spill Management: Avoid creating dust clouds. Shovel, sweep up or use industrial vacuum cleaner to pick up. Place in container for proper disposal. Reduce airborne dust and prevent scattering by moistening with water.
Reporting: U.S.A. regulations may require reporting spills of this material that could reach any surface waters. Report spills to local authorities and/or the National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL . REFER TO PRODUCT LABEL OR MANUFACTURERS TECHNICAL BULLETINS FOR THE PROPER USE AND HANDLING OF THIS MATERIAL .

Precautionary Measures: Use caution to avoid creation of dusts and to prevent inhalation of product dust (fines). Avoid contact with product dust. Airborne dust concentrations above 20 mg/L may create a dust explosion hazard. Avoid breathing vapors or fumes which may be released during thermal processing. Do not breathe dust at levels above the recommended exposure limits. Avoid breathing material. Keep container closed. Use only with adequate ventilation. Avoid contact with eyes, skin and clothing. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations, which have the potential of generating an accumulation of electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids, National Fire Protection Association (NFPA 77), 'Recommended Practice on Static Electricity' (liquids, powders and dusts), and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents' (liquids).
General Storage Information: Treat as a solid that can burn. Store away from oxidizing materials, in a cool, dry place with adequate ventilation. Bond and ground transfer equipment. DO NOT USE OR STORE near heat, sparks or open flames. USE AND STORE ONLY IN WELL VENTILATED AREA. Keep container closed when not in use.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous.

Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly. Containers, even those that have been emptied, can contain residues of dusts or solid particulates which may create both health and fire/explosion hazards.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:
Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:
If heated material generates vapor or fumes, use process enclosures, local exhaust ventilation, or other engineering controls to control exposure.

PERSONAL PROTECTIVE EQUIPMENT:
Eye/Face Protection: Wear eye protection such as safety glasses, chemical goggles, or faceshields if engineering controls or work practices are not adequate to prevent eye contact.
Skin Protection: Wear impervious protective clothing to prevent skin contact. Selection of protective clothing may include gloves, apron, boots, and complete facial protection depending on operations conducted. Users should determine acceptable performance characteristics of protective clothing. Consider physical requirements and other substances present when selecting protective clothing. Suggested materials for protective gloves include: Neoprene
Respiratory Protection: If user operations generate harmful levels of airborne material that is not adequately controlled by ventilation, wear a NIOSH approved respirator that provides adequate protection. Use the following elements for air-purifying respirators: Air-Purifying Respirator for Organic Vapors, Dusts and Mists

Occupational Exposure Limits:

Component	Limit	TWA	STEL	Ceiling / Peak	Notation
Crystalline Silica	ACGIH	.025 mg/m3	NA	NA	NA
Crystalline Silica	CPCHEM	.05 mg/m3	NA	NA	Respirable Dust
Crystalline Silica	German MAK	.15 mg/m3	NA	NA	NA
Ferrous Sulfate	ACGIH	1 mg/m3	NA	NA	as Fe
Proprietary	ACGIH	Not Established	NA	NA	NA

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AND ODOR: Fine reddish-brown powder with small white specks, odorless.
pH: NA
Flashpoint: NA
VAPOR PRESSURE: NA
VAPOR DENSITY (AIR=1): NA
BOILING POINT: NA
SOLUBILITY (in water): Appreciable
SPECIFIC GRAVITY: 1.5 - 1.7

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Conditions to Avoid: No Data Available

Incompatibility With Other Materials: May react with oxygen and strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: Sulfur Oxides. Iron Oxides. Carbon Oxides.
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS:

Acute Oral Toxicity: LD50 / not known
Acute Dermal Toxicity: LD50 / not known
Acute Inhalation Toxicity: LC50 / not known

Eye Irritation: May cause eye irritation.
Skin Irritation: May cause skin irritation.
Respiratory Tract Irritation: This material maybe irritating to the respiratory tract.

ADDITIONAL TOXICOLOGY INFORMATION:
The toxicological properties of this product have not been tested or have not been tested completely and its handling or use may be hazardous. EXERCISE DUE CARE.

This product contains CRYSTALLINE SILICA:
Repeated Dose Toxicity: Up to 420 days / inhalation / rat / Doses: 30,000 particles/ml 18 hrs/day 5days/wk / Silicotic nodules
Genetic Toxicity: AMES test = Negative / Recombination Assay = Negative
Carcinogenicity: 2 yrs / inhalation / rat / Dose: 1 mg/m3 / primary lung tumors in control (3) and treated (18); 150, 300 or 570 days / inhalation / mouse / Doses: 1475 ug/m3 for 150 days, 1800 ug/m3 for 300 days or 1950 ug/m3 for 570 days 8 hrs/day 5days/wk / pulmonary adenomas found in both control (7) and treated (9)
Other: International Agency for Research on Cancer (IARC) classifies crystalline silica as a human carcinogen

Long-term exposure to high dust concentrations may cause non-debilitating lung changes.

This material contains IRON DUSTS.
Target organs: inhalation: lung (siderosis); ingestion: liver (periportal necrosis), gastrointestinal tract (hemorrhagic necrosis), blood (decrease coagulation)

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY:

Proprietary - 96 hour(s) / LC50 / Flatfish, Flounder (*Scophthalmus maximus*) / >1800 mg/l
Proprietary - 48 hour(s) / EC50 / Marine Copepod (*Acartia tonsa*) / 73.2 mg/l
Proprietary - 168 hour(s) / NOEC / Freshwater Plant (*Lemna minor*) / 1000 mg/l
Proprietary - 168 hour(s) / EC50 / Freshwater Plant (*Lemna minor*) / > 1000 mg/l

ENVIRONMENTAL FATE:
Biodegradability: 28 day(s) / 38 %

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

Shipping Descriptions per regulatory authority.

US DOT

NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION

ICAO / IATA

NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION

IMO / IMDG

NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION

RID / ADR

NOT REGULATED AS A HAZARDOUS MATERIAL OR DANGEROUS GOODS FOR TRANSPORTATION

SECTION 15 REGULATORY INFORMATION

SARA 311/312 CATEGORIES:

1. Immediate (Acute) Health Effects: YES
2. Delayed (Chronic) Health Effects: YES
3. Fire Hazard: NO
4. Sudden Release of Pressure Hazard: NO
5. Reactivity Hazard: NO

REGULATORY LISTS SEARCHED:

01= CA Prop 65
02 = LA RTK
03 = MA RTK
04 =MN Hazardous Substance
05 =NJ RTK
06 = PA RTK
07 = CAA Section 112 HAPs
08 = CWA Section 307
09 = CWA Section 311
10 =DOT Marine Pollutant
11 = FDA 172
12 = FDA 173
13 = FDA 174
14 = FDA 175
15 = FDA 176
16 = FDA 177
17 = FDA 178
18 = FDA 179
19 = FDA 180
20 = FDA 181
21 = FDA 182
22 = FDA 184
23 = FDA 186
24 = FDA 189
25 = IARC Group 1
26 = IARC Group 2A
27 = IARC Group 2B
28 = IARC Group 3
29 = IARC Group 4
30 = NTP Carcinogen
31 = OSHA Carcinogen
32 = OSHA Highly Hazardous
33 = RCRA Waste Appendix VIII
34 = RCRA Waste D-List
35 = RCRA Waste P-List
36 = RCRA Waste U-List
37 = SARA Section 302
38 = SARA Section 313
39 = TSCA 12 (b)
40 = TSCA Section 4
41 = TSCA Section 5(a)
42 = TSCA Section 8(a) CAIR
43 = TSCA Section 8(a) PAIR
44 = TSCA Section 8(d)
45 = WHIMS - IDL
46 = Germany D TAL
47 = Germany WKG
48 = DEA List 1
49 = DEA List 2

The following components of this material are found on the regulatory lists indicated.

Ferrous Sulfate	3, 4, 5, 6, 9, 45
Crystalline Silica	1, 3, 4, 5, 6, 25, 30, 45

CERCLA REPORTABLE QUANTITIES(RQ)/SARA 302 THRESHOLD PLANNING QUANTITIES(TPQ):

Component	Component RQ	Component TPQ	Product RQ
Ferrous Sulfate	1000 lbs	None	11111 lbs

WHMIS CLASSIFICATION:

Class D, Division 2, Subdivision A: Very Toxic Material
Carcinogenicity

CHEMICAL INVENTORY LISTINGS:

AUSTRALIA: This material contains components that require notification before sale or importation into Australia.
CANADA: All the components of this material are on the Canadian Domestic Substances List (DSL) or are exempt from notification.
PEOPLE'S REPUBLIC OF CHINA: All the components of this product are listed on the Inventory of Existing Chemical Substances in China.
EUROPEAN UNION: All the components of this material are in compliance with the EU Seventh Amendment Directive 92/32/EEC.
JAPAN: This material contains components that require notification before sale or importation into Japan.
KOREA: All the components of this product are on the Existing Chemicals List (ECL) in Korea.
PHILIPPINES: This material contains components that require notification before sale or importation into the Philippines.
UNITED STATES: All of the components of this material are on the Toxic Substances Control Act (TSCA) Chemical Inventory.

EU RISK AND SAFETY PHRASES:

R40: Possible risks of irreversible effects.
R45: May cause cancer.
S22: Do not breathe dust.
S53: Avoid exposure - obtain special instructions before use.

EU Symbols: T - Toxic

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 1 Flammability: 0 Reactivity: 0 Special: NA

(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA).

REVISION STATEMENT: *The following sections have been updated: 1,12*

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV	- Threshold Limit Value	TWA	- Time Weighted Average
STEL	- Short-term Exposure Limit	PEL	- Permissible Exposure Limit
ACGIH	- American Conference of Government Industrial Hygienists	OSHA	- Occupational Safety & Health Administration
NIOSH	- National Institute for Occupational	NFPA	- National Fire Protection Agency

	Safety & Health		
WHMIS	- Workplace Hazardous Materials Information System	IARC	- Intl. Agency for Research on Cancer
EINECS	- European Inventory of existing Commercial Chemical Substances	RCRA	- Resource Conservation Recovery Act
SARA	- Superfund Amendments and Reauthorization Act.	TSCA	- Toxic Substance Control Act
EC50	- Effective Concentration	LC50	- Lethal Concentration
LD50	- Lethal Dose	CAS	- Chemical Abstract Service
NDA	- No Data Available	NA	- Not Applicable
<=	- Less Than or Equal To	>=	- Greater Than or Equal To
CNS	- Central Nervous System	MAK	- Germany Maximum Concentration Values

This data sheet is prepared according to the latest adaptation of the EEC Guideline 67/548.
This data sheet is prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200).
This data sheet is prepared according to the ANSI MSDS Standard (Z400.1).
This data sheet was prepared by EHS Product Stewardship Group, Chevron Phillips Chemical Company LP, 10001 Six Pines Drive, The Woodlands, TX 77380.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

HALLIBURTON

MATERIAL SAFETY DATA SHEET

Product Trade Name: **DEXTRID® LTE**

Revision Date: 03-Jan-2008

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Trade Name: DEXTRID® LTE
Synonyms: None
Chemical Family: Modified Starch
Application: Fluid Loss 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
Complex carbohydrate		60 - 100%	10 mg/m^3	15 mg/m^3

3. HAZARDS IDENTIFICATION

Hazard Overview May cause eye, skin, and respiratory irritation. May be harmful if swallowed. 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 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

Flash Point/Range (F):	Not Determined**Min:** > 260
Flash Point/Range (C):	Not Determined**Min:** > 125
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. 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 1, Flammability 1, Reactivity 0
HMIS Ratings:	Flammability 1, Reactivity 0, Health 1

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. Avoid dust accumulations. Wash hands after use.
Storage Information	Store away from oxidizers. Store in a cool, dry location. Product has a shelf life of 12 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	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:	Powder

9. PHYSICAL AND CHEMICAL PROPERTIES

Color:	White to off white
Odor:	Musty
pH:	10
Specific Gravity @ 20 C (Water=1):	1.5
Density @ 20 C (lbs./gallon):	Not Determined
Bulk Density @ 20 C (lbs/ft3):	30-45
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):	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	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 allergic respiratory reaction. May cause respiratory irritation.
Skin Contact	May cause skin irritation.
Eye Contact	May cause eye irritation.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea.
Aggravated Medical Conditions	None known.
Chronic Effects/Carcinogenicity	Repeated excessive ingestion may cause central nervous system effects. Repeated overexposure may cause liver and kidney effects.
Other Information	None known.
Toxicity Tests	
Oral Toxicity:	LD50: 363 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

DOT
Not restricted

Canadian TDG
Not restricted

ADR Not restricted

Air Transportation

ICAO/IATA Not restricted

Sea Transportation

IMDG Not restricted