# CRITICAL OPERATIONS AND CURTAILMENT PLAN

## KUVLUM PROSPECT

OCS-Y-0866 #1

BLOCK 673

Kuvlum #1

BEAUFORT SEA, ALASKA

SUBMITTED TO:

MINERALS MANAGEMENT SERVICE

ALASKA OCS REGION

ANCHORAGE, AK

SUBMITTED

BY:

ARCO ALASKA, INC.

JULY 10, 1992

# Critical Operations and Curtailment Plan

## Table of Contents

Page

# Critical Operations and Curtailment Plan

Table of Contents | Page



## LIST OF FIGURES

Figure No.



## LIST OF TABLES

Table No.

# CRITICAL OPERATIONS AND CURTAILMENT PLAN

## KUVLUM PROSPECT

## OCS-Y-0866 #1

A. INTRODUCTION:

1. General

ARCO Alaska Inc. (ARCO) is the operator for the drilling of a wildcat well, (OCS-Y-866 #1) on Block 673 located 16 miles northeast of Brownlow Point, Alaska offshore in the Beaufort Sea. (Figures 1-2). The test, named the Kuvlum Well[1] , will be drilled during the 1992 open water drilling season with an anticipated spud date of August 15, 1992.

BeauDril Limited Inc. (Beaudril) has been contracted to drill the well using the Kulluk Drilling System (Kulluk). The Kulluk (Unit) is a mobile, conically shaped, ice strengthened semi-submersible drilling barge designed for use in the ice infested waters of the Arctic ocean. A description of the Unit can be found in Section 3.0.

This Critical Operations and Curtailment Plan (COCP) and the Kulluk Alert Manual (Attachment I) outline the comprehensive effort that ARCO and Beaudril are providing to ensure drilling operations are conducted in a safe and prudent manner in the unique environment of the Beaufort Sea. ARCO assigns the highest priority in conducting its operations to the safety of personnel and protection of the surrounding environment.

The following COCP defines certain standards and guidelines for the conduct of operations at Kuvlum to absolutely minimize any hazard to personnel or the environment. In the Alaskan Beaufort Sea, the two primary factors which can impact curtailment of critical operations while drilling are sea ice and heavy weather. The objective of this COCP is to detail the critical drilling operations and the conditions under which such operations will be curtailed. The availability, capability and response time of oil spill response and containment equipment is detailed in the Kuvlum Oil Spill Contingency Plan (OSCP).

2. Person-In-Charge Of Overall Drilling Operations

The ARCO Drilling Manager, located in Anchorage, Alaska, will be the person who has responsibility as the person-in-charge of overall drilling operations on the Kuvlum Prospect. His name and office address are as follows:

**Mr. Doug J. Ruckel**
**Drilling Manager**
**ARCO Alaska, Inc.**
**P. O. Box 100360**
**Anchorage, AK 99510-0360**

**Office phone: (907) 263-4614**
**Home phone: (907) 345-5331**

---

[1] The APD for the Kuvlum Well will be submitted to the Minerals Management Service (MMS) in July, 1992 with the COCP identified as an attachment to the APD.

## 3. Drilling System Description

The Kulluk was constructed in 1982 by Mitsui Engineering & Shipbuilding Company, Ltd. The floating semi-submersible incorporates a 24-faceted conical shaped hull which has been ice strengthened to meet Arctic Class IV ice classification. The double hull is shaped in the form of an inverted cone which causes the ice to break downward and away from the vessel, thus protecting its anchor lines and drilling riser system from ice movement (See Figure 3). The unit is towed to location where twelve radially deployed 3-1/2" diameter anchor lines are deployed to moor the Unit.

The bottom of the Kulluk hull is equipped with a skirt system. The skirt is designed to protect the mooring lines whose fairleads depart from the center of the Unit below this skirt. Ice is deflected away from the lines allowing the Unit to remain on location during conditions when ice is present. The Kulluk is assisted by icebreaking support vessels which, in BeauDril's case, are also Arctic Class IV ice strengthened. At Kuvlum, the Kalvik, and/or Ikaluk and Miscaroo are planned to assist the operation during certain time periods (See Figures 4,5 and 6). Together with the icebreakers, the Kulluk is referred to as the "Kulluk Drilling System". The Canmar Supplier I is also scheduled to support the operation.

The conical hull design was developed by Earl and Wright - Lavalin to withstand the ice forces encountered during early summer and early winter in the southern Beaufort Sea; thus potentially increasing the drilling season to eight months.

### 3.1 Drilling System Specifications

The principal dimensions of the Kulluk are listed in Table 1 and Table 2, and the specifications of the support vessels are listed in Tables 3,4, and 5 attached.

## 4. Field Operations Schedule

The KULLUK will mobilize to Kuvlum location on or about August 11, 1992. The rig will be in a warm standby mode in June and July, and the well is scheduled to spud around August 15, 1992, or earlier, if possible. Drilling and evaluation operations of the initial Kuvlum Well are estimated to require 40-50 days with the possibility of drilling a second well of similar duration. Upon completion of drilling activities, the Unit will demobilize from location and return to a designated over-wintering point, currently planned to be Summer's Harbor, Canada.

## 5. Wellhead/BOP Configuration

A conventional subsea wellhead/BOP system will be used on the Kuvlum well.

The following provides a description of the wellhead and BOP equipment to be used during the different stages of drilling:

(a) The 30" structural casing will be set at approximately 320' TVD. The 30" structural casing will be "drilled in" to the well using a rock bit and mud motor. The 30" will be installed without the use of a riser if possible. The 26" hole for the 20" will also be drilled riserless if possible.

(b) The 20" conductor casing will be run, and cemented, to approximately 1,000' TVD. The 20" string is equipped with a subsea, high pressure wellhead which will be located just above the guide base positioned at the bottom of the "glory hole" excavated in the ocean floor to protect this equipment from ice scours. Prior to drilling out below the 20" casing the diverter system will be function tested and the subsea BOP stack will be pressure tested.

(c) The diverter system and subsea BOP stack will be used while drilling below 20" casing and for the running of the 13-3/8" surface casing and all further casing strings run in the well. (Figures 7 and 8).

Additional details of the wellhead configuration and BOP arrangement are described in the Kuvlum Application for Permit to Drill.

In summary, the wellhead/BOP configuration satisfies the main objective of well control integrity. The subsea wellhead/BOP system, in conjunction with the wellbore securing procedures discussed in Attachment III, protect the environment from an uncontrolled exposure of the wellbore.

6. Threshold Depth:

The middle interval of the Oligocene age formations, is the primary objective of the Kuvlum Well. Located at an estimated depth of approximately 4000' TVD, the mid-Oligocene is the shallowest objective of the well. Above the top of the mid-Oligocene, major accumulations of hydrocarbons are not likely. This prediction is based on the offset well data obtained from the onshore Point Thompson wells, ARCO's Stinson Well #1, Unocal's Hammerhead Wells (OCS-Y-0849 #1 & #2), SWEPI's Corona Well (OCS-Y-0871 #1), Amoco's Galahad Well (OCS-Y-1092 #1), Amoco's Belcher Well (OCS-Y-0917 #1) and ARCO's geological mapping and interpretation of the Kuvlum structure. Thus, for the Kuvlum Project Well #1 ARCO petitions that the top of the mid-Oligocene Formation should be recognized as the official 'Threshold Depth'. Below the mid-Oligocene is the secondary objective, the lower Oligocene Formation.

B. RESPONSIBILITIES of KEY PERSONNEL:

ARCO, as Operator, has the ultimate responsibility for the well and the overall safety of the lease operations. The Operator and Contractor are jointly responsible for the safety of the Unit itself and all personnel on board. Specific responsibilities of key personnel with respect to this Critical Operations and Curtailment Plan are as listed below. Additional responsibilities are also outlined in the Kulluk Alert System (Attachment I).

1. ARCO Drilling Superintendent

(a) The ARCO Drilling Superintendent has the responsibility as the person-in-charge of overall drilling operations.

(b) In the event of an emergency, he is responsible for directing any emergency response team that may be sent to the drillsite.

(c) Responsible for notifying the MMS District Supervisor in Anchorage, Alaska, whenever the ARCO Drilling Supervisor on the Unit reports curtailment of a critical operation pursuant to this Plan or a deviation from the Plan required by an emergency action.

2. ARCO Drilling Supervisor(s)

(a) The ARCO Drilling Supervisor is the person-in-charge of overall drilling operations at the drillsite. He is responsible for ensuring that key supervisory personnel are aware of regulations and procedures pertinent to their activities with respect to this Plan.

(b) In conjunction with the Contractor Drilling Superintendent and the Contractor Barge Master, he is responsible for ensuring that all safety and emergency procedures outlined in this Plan are observed by all personnel on board the Unit.

(c) Responsible for thoroughly understanding and implementing all aspects of this Plan.

(d) Responsible for minimizing the number of third party personnel and visitors aboard the Unit during expected hazardous operations.

(e) Responsible for obtaining the necessary equipment and personnel needed for the drilling operations.

(f) Responsible for advising the Contractor Offshore Installation Manager of the curtailment actions needed to comply with this Plan.

3. ARCO Drilling Engineer

(a) The ARCO Drilling Engineer is responsible for keeping the ARCO Drilling Supervisor(s) informed of impending ice and weather conditions and how those conditions might effect the planned drilling operations.

(b) Responsible for ensuring that the Kulluk Alert Manual is followed as intended.

(c) In the absence or incapacitation of the ARCO Drilling Supervisor(s), the ARCO Drilling Engineer will assume the Supervisor's responsibilities as specified above.

4. Contractor Offshore Installation Manager

(a) Responsible for executing the drilling program according to directions from, and subject to, the approvals of the ARCO Drilling Supervisor.

(b) Responsible for thoroughly understanding all aspects of this Plan.

(c) Responsible for the maintenance of the rig and associated equipment and training of the drilling crews to ensure sound operations.

(d) In conjunction with the ARCO Drilling Supervisor and the Contractor Marine Superintendent, is responsible for seeing that all safety and emergency procedures outlined in this Plan are observed by all personnel on board the Unit.

(e) In the absence or incapacitation of the ARCO Drilling Supervisor and ARCO Drilling Engineer, the Contractor Offshore Installation Manager will assume all responsibilities designated herein to the ARCO Drilling Supervisor.

(f) Assists the ARCO Drilling Supervisor in determining the necessary levels of personnel and equipment for conducting particular operations.

5. Contractor Rig Superintendent

(a) In the absence or incapacitation of the Contractor Offshore Installation Manager, the Contractor Rig Superintendent will assume the Contractor Offshore Installation Manager's responsibilities as specified above.

6. Contractor Marine Superintendent

(a) As the senior marine operations officer for the Unit he is responsible for the safety of the Unit and all of the personnel on board.

(b) Responsible for thoroughly understanding all aspects of this Plan and the attached Kulluk Alert Manual.

(c) In conjunction with the ARCO Drilling Supervisor and Contractor Offshore Installation Manager, he will decide in what manner the Unit would be evacuated and in what order personnel would leave.

## C. CRITICAL OPERATIONS

Listed below are the key critical drilling operations that are typically conducted in the drilling of an exploration well. Depending upon the actual conditions encountered, some of these critical operations may not apply to the Kuvlum Exploration Program as explained in the accompanying paragraphs.

1. Drilling in Close Proximity to Another Well.

No curtailment action, due to drilling in close proximity to another well, will be considered while drilling the subject well since this well is the first to be drilled in the Block 673 (Lease OCS-Y-0866). However, directional surveys will be obtained in accordance with 30 CFR 250.51,(e),(2 ) to avoid future wellbore intersections should a second Kuvlum well be drilled.

2. Drilling Below Threshold Depth

3. Coring

4. Logging or Wireline Operations.

5. Running and Cementing Casing.

6. Cutting and/or Recovering Casing.

7. Drill Stem Testing.

8. Well Completion Operations.

This permit application contemplates an expendable exploratory well and does not consider plans for well completion. In the event a requirement for well completion does occur, ARCO will submit the necessary documentation required by the MMS.

9. Moving the Drilling Vessel Off Location in an Emergency, Repositioning the Vessel on Location, and Re-establishing Entry into the Well.

Detailed procedures for the operations conducted during an emergency to release the Kulluk from the well, repositioning the vessel, and then re-entering the well are contained in Attachment III, "Emergency Well Suspension Procedures".

10. Fuel Transfer.

The KULLUK has a storage capacity of 9,995 barrels of diesel fuel. The KULLUK will be refueled at Tuktoyaktuk during August, 1992. This quantity of fuel will meet drilling and service requirements for operations throughout the 1992 summer season. Therefore, diesel fuel re-supply operations while on site should not be required unless extended operations are conducted, or unusually severe ice conditions are encountered. Detailed procedures for refueling and fuel transfer operations are addressed in the Operations Manual for the KULLUK.

## D. ENVIRONMENTAL MONITORING

A comprehensive Environmental Monitoring Program will be undertaken at the drill-site to support the Critical Operations Curtailment Plan and the Kulluk Ice Alerts System. The following sections describe the monitoring activity that will be under taken and introduces the personnel and equipment that will be used to carry out the program. Additional information on the Environmental Monitoring Program can be found in the Kuvlum Exploration Plan (ARCO, 1992).

During the operating season while drilling activity is underway, the monitoring program will be carried out as specified in this Plan and the Kuvlum Exploration Plan. Prior to and following the conclusion of drilling activity, the program may be scaled down and amended as deemed appropriate by ARCO and as approved by the District Supervisor, MMS.

### 1. General

An essential component of the alert system and a prerequisite to safe and efficient Arctic operations is an environmental monitoring and forecasting system. During BeauDril's operations, a comprehensive environmental monitoring and forecasting system has been established to support KULLUK's drilling activities. This system consists of site specific and regional services provided for or contracted by BeauDril and publicly available regional services acquired from the government. The system is designed to monitor and forecast the weather, wave and ice environment in the drilling area on both regional and local scales for input into strategic and tactical planning for KULLUK operations.

The various components of the environmental monitoring and forecasting system that is recommended for Kuvlum are shown in Table 6. The following sections describe the system in terms of its meteorological, ice and oceanographic components. This system is similar to that used in the Beaufort Sea in previous years and meets the operational requirements of KULLUK. It also adheres to the monitoring guidelines as specified by MMS.

### 2. Meteorological Observations

Weather conditions drive the other offshore environmental conditions and are key inputs to ice and wave forecasting. Weather observations will be made regularly aboard KULLUK by observers who have been certified by the relevant Canadian and American authorities. The weather observations, taken hourly, and the standard reports encoded into the Offshore Weather Observing Station *(OWOS)* format are shown in Table 7. The instruments used to collect this information will conform to government standards.

The meteorological sensors aboard KULLUK are highlighted in Figure 11. In addition to these site specific observations, weather reports from the Alaskan land stations and from public remote weather stations drifting on the pack ice will also be accessed aboard KULLUK in real time.

Observation reports from the offshore drilling site will normally be transmitted to shore and to the Operator's weather forecasting contractor every three hours, except during aviation operations and storms. Aviation operations will receive continuous observation reports from two hours before the planned time of arrival of an aircraft until the flight is complete. When winds exceed 33 knots, a continuous watch will be kept on winds and waves, and weather will be logged at least hourly.

### 3. Onsite Weather Forecasts

Onsite weather forecasts and a continuous weather watch will be provided by Fairweather, Inc. Regular forecasts will be issued for KULLUK's location every 12 hours, with an update[redacted]t each intermediate six hours. The content of regular forecasts will include:

a. A synoptic discussion of relevant pressure patterns and their expected effects on the wind and weather,

b. A table of expected winds, temperatures and, where appropriate, waves each 6 hours to 24 hours, and each 12 hours to 48 hours. A qualitative outlook should be provided for 48 to 120 hours ahead along with a forecast reliability estimate,

c. An outlook for visibility and weather for the first 48 hours.

Storm forecasts will be issued or updated as required. All storm or gale warnings issued by the weather forecast service company will be passed on to both the facilities at sea and operational management ashore. If additional aviation forecasts are necessary, they will be generated by Fairweather, Inc.

4. Oceanographic Observations

The oceanographic component of the forecasting and monitoring system is relatively small because the operational requirements for this information are limited.

KULLUK's oceanographic program will consist of sea surface temperature measurements and visual estimates of waves taken by certified observers aboard KULLUK. The oceanographic observations that will be acquired are shown in Table 8. These observations will be encoded into OWOS format and transmitted with the weather reports every three hours during open water from the operating site.

5. Sea State Forecasts

Sea state forecasts generated by Fairweather, Inc. will be issued with the weather forecasts including wave heights and periods. Clearly, wave conditions will be forecast only during ice free periods for KULLUK.

6. Ice Monitoring

The ice monitoring and forecasting system used to support KULLUK operations includes all weather ice monitoring capability. This system depends heavily on marine radars, aboard KULLUK and support vessels, [redacted]. The marine radars on KULLUK and vessels continuously cover a small local area, while the airborne imagery radar provides regional coverage of the ice conditions as required. A downlink for the imaging radar will also be located onboard KULLUK. To supplement this radar imagery, regional ice information will be acquired from the NOAA satellite and various ice chart products. [redacted]rs will also be [redacted].

Local ice conditions and movements will be observed regularly from KULLUK by trained ice observers and an environmental advisor. During the presence of ice, ice observations will be made at least every three hours and reports will be issued in the OWOS format for ice as shown in Table 9.

7. Ice Forecasting

Tactical and strategic ice forecasting on KULLUK will be conducted by a team of two watchkeepers/ice observers (hereafter referred to as "observers") *(24 hour coverage)* and an environmental advisor using all the local and shore based ice and weather information, plus their own radar and occasional helicopter reconnaissance.

8. Personnel

KULLUK environmental monitoring team consists of three people within KULLUK's marine department, the environmental advisor and two observers. This team monitors the performance of KULLUK and maintains an observational routine for all major weather, ice and oceanographic parameters. These functions are performed on a 24 hour basis.

The team interfaces directly with KULLUK's management personnel, reporting to the Marine Superintendent, to keep them informed of environmental and performance conditions as they are relate to KULLUK's "Alert" status.

9. Reporting

All environmental data recorded at the Kuvlum drilling site will be logged on an IBM PC, using BeauDril's Beaufort Environmental Archive Reporting System *(BEARS)*. This is a custom data base package which allows data entry and retrieval and generates various report products. The reporting of environmental data, meteorological, oceanographic and ice conditions, will be performed on a schedule which meets the Operator's requirements.

For example, clear, legible logs or data printouts containing environmental observations at the site can be submitted on a weekly basis. All summary reports submitted can be accompanied by data in digitized *(disc)* form in an acceptable format.

10. Performance Monitoring System

In addition to the environmental monitoring and forecasting system, real time measurements on KULLUK's performance in ambient conditions is obtained from a performance monitoring system installed onboard. This system provides continuous real time monitoring of KULLUK's responses to ice, wind and wave effects and stores the response information for later assessment, if required. An ongoing knowledge of KULLUK's motions and line tensions is also an important component of the environmental alert procedure.

KULLUK's performance monitoring system includes real time measurements of the vessel's response including translational and rotational motions with respect to the wellhead and tensions in the twelve mooring lines. This information is acquired from sensors deployed around the vessel as shown in Figure 11. The individual anchor line tensions are measured with strain gauges installed on the turndown sheaves for the mooring lines and global environmental loads are calculated by vectorially summing these individual line tensions. KULLUK pitch and roll motions are obtained from inclinometers in a Vertical Reference Unit, yaw responses from the vessel's gyrocompass and marine riser angle from an electronic bullseye mounted on the riser. Surge, sway and heave can be measured with an acoustic position indicator and are also inferred from the marine riser inclination information.

Performance data from these sensors is obtained at frequencies ranging from 10 to 1 Hz by a real time data acquisition system. KULLUK's responses are processed, displayed and recorded by the performance monitoring system highlighted schematically in Figure 12. Key response information is displayed continuously in real time on a computer screen in the KULLUK's Control Room so that the performance status of the vessel is known at all times (Figure 13). Chart recorders also provide time series of primary response parameters such as offset, tensions in the lines and global load so that trends can be identified.

The vessels performance is monitored on an ongoing basis by KULLUK's marine staff. The performance monitoring system is an integral part of KULLUK.

## E. CIRCUMSTANCES OR CONDITIONS UNDER WHICH CRITICAL OPERATIONS SHOULD BE CURTAILED

A descriptive list of the circumstance or conditions under which the identified critical operations should be curtailed is presented below.

1. Availability of Personnel and Equipment for Particular Operations to be Conducted.

A critical operation will be curtailed or not executed if the required number of qualified personnel are not available to properly supervise and perform the given operation. The same will hold true if the necessary support and emergency equipment for that operation are not available. The necessary compliment of personnel and equipment required for the critical operation will be determined based on sound engineering and prudent industry practices. This determination will be made by the ARCO Drilling Supervisor in consultation with the Contractor Offshore Installation Manager and, if applicable, the appropriate service company personnel. The critical operations include, running and cementing casing, cutting and/or recovering casing, coring, drill stem testing and any other operations which increase the exposure with respect to well control or for the prevention of fire, explosion, oil spills, and other discharges or emissions to the surrounding environment.

2. Ice and Weather Conditions

As a floating semi-submersible drilling unit operating in the Arctic ocean, the Kulluk's operation is dictated by ice and weather conditions. As such, the following discussion is provided regarding the circumstances under which critical operations may be curtailed.

a. Environmental Overview

(1) Operating Area

The Alaskan Beaufort Sea, which lies off the North Slope, is a large region stretching for about 450 miles in an east/west direction from the Canadian border to Point Barrow, and an equivalent distance north to the Arctic Ocean. The majority of the drilling prospects in this area are located in a relatively narrow band, typically within 5 to 50 miles of the coastline. As is shown in Figure 1, ARCO's Kuvlum prospect is situated in the eastern sector of the Alaskan Beaufort Sea, roughly 20 miles north of the coast and about 65 miles northeast of Prudhoe Bay.

(2) Bathymetry

The Kuvlum prospect lies on the broad continental shelf of the Alaskan Beaufort Sea, in 110 ft of water. The main bathymetric features of the region are shown in Figure 14 where three main physiographic zones are evident. These are the continental shelf, which slopes gently towards water depths of 300 ft, the continental slope falling steeply from the shelf edge to water depths of about 3000 feet and the more northerly Arctic Ocean. In general, the bathymetric gradients around Kuvlum are quite mild, sloping gently northwards to the shelf break which is approximately 100 miles off the mainland coast. However, seafloor scour is common in the Kuvlum area, resulting in substantial microrelief locally.

(3). Ice Conditions

(a) General

The primary environmental constraint in the Alaskan Beaufort Sea is sea ice since the area is usually ice covered for at least nine months of the year. When considering drilling operations in this area, site specific information on the nature of the ice cover is required. Factors such as ice concentrations, ice type, ice thickness, pressure ridges, multi-year ice and ice dynamics along with their time dependent variability must be known. Various types of sea ice information are available for the general area including systematic ice cover observations collected by the Canadian Atmospheric Service and the U.S. Navy on a weekly and biweekly basis, satellite and airborne remote sensing data and information obtained from ship and ice based investigations. A brief description of the relevant ice conditions in the Alaskan Beaufort Sea is given in the following sections, based upon the information available to BeauDril.

(b) Ice Zonation

With the onset of winter in mid-October, freeze-up in the Beaufort Sea generally begins with the progressive growth of landfast ice seaward from the coastline. During the late fall to late spring period, the ice cover in the offshore region can be subdivided into three basic ice zones. These are:

- The relatively stable *landfast ice zone* which extends from the shoreline to water depths between 50 and 70 feet.

- The sporadically moving *transition or seasonal pack ice zone* which lies between the outer edge of the landfast ice and the more northerly polar pack. This zone may be anywhere from a few tens of miles to a hundred or more miles in width.

- The more northerly *permanent polar pack* which contains primarily multi-year ice and is in constant motion.

During the winter period, the shallower water prospects typically lie within the landfast ice zone while the medium to deeper water locations lie within mobile transition zone area. The Kuvlum drilling prospect, in 110 ft of water, is located in this moving transition ice zone.

(c) Winter Conditions

During the late fall to spring period, the mid to deeper waters of the Alaskan Beaufort Sea are covered by a continuous pack ice cover, comprised of a matrix of first-year ice types and increasing concentrations of multi-year ice towards the polar pack. In the 70 to 200 foot water depth range, where Kuvlum is located, first-year ice usually predominates growing to a maximum thickness of nearly 6 feet by early May (Figure 15). However, because this is an area of moving pack ice, substantial quantities of new, gray and gray-white ice *(less than 1 foot thick)* are present throughout the winter and spring periods. Multi-year ice floes in varying concentrations are also found in this transition zone ice cover and have mean thicknesses of between 10 and 20 feet. This area, although not as rough as the outer edge of landfast ice, contains substantial numbers of first and multi-year pressure ridges which may average 15 to 30 feet in total thickness. Typical pack ice velocities in the transition zone are in the order of 1 to 2 miles per day, although the ice may remain stationary for time periods of a week or more, or experience extreme motions of 10 to 20 miles/day.

(d) Summer Ice Conditions

Break-up in the Beaufort Sea's transition zone, including the Kuvlum location, normally commences in the late July period with significant open water usually occurring earlier in the east than in the west. Throughout early August, the ice regime in the Beaufort's mid to deeper water areas becomes typical of a marginal ice zone. Decreasing concentrations of drifting ice usually occur throughout the month as the ice moves off to the northwest. The summer "open water period" normally commences in mid August and in most years, persists until early to mid October when freeze-up begins again.

During the summer and freeze-up period, ice intrusions are more frequent in the offshore area than nearshore with variable concentrations of thick first-year and old ice often moving into the operating area under the influence of northerly winds. Again, a range of first-year ice thicknesses are expected over this period as shown in Figure 15. At break-up, first-year ice thicknesses of 5 to 6 feet are common, decreasing to several feet in thickness as the summer progresses. Old ice that occurs in the area is between 10 and 20 feet in mean thickness, with floe sizes typically from a few hundred feet to several miles in diameter. Weathered pressure ridges and rough ice fragments from the stamuki zone with thicknesses exceeding 60 feet are also quite frequent within this "summer ice cover". Movements are quite variable in terms of both speed and direction during summer and freeze-up but average about .5 kt with extremes in excess of 1 kt.

As noted earlier, freeze-up typically commences in the early to mid October time frame with thin first-year ice forming across the Alaskan Beaufort Sea. As the ice moves during freeze-up, leads and large areas of open water are common but by mid November, a continuous 9 to 10/10ths concentration ice cover is typical. Areas where old ice was present during freeze-up will have variable concentrations of this ice type contained within the growing ice cover. The predominantly first-year ice cover in the operating area is typically two feet in thickness by mid November and three feet in thickness by mid December with significant ridging.

(4) Meteorological Conditions

Weather conditions in the Arctic are extremely severe and are directly responsible for the formidable environment of the area. In the Alaskan Beaufort Sea, temperatures vary from lows of -50° F in the winter to highs of 80° F during the summer, while mean annual temperatures are roughly 10° F. These temperatures are not as low as those in some of the more southerly inland areas, but the persistence of the Arctic cold, combined with other unfavorable factors, such as remoteness, darkness, winds and poor visibility, make these temperatures a severe operating problem.

The wind climate of the southern Beaufort Sea is relatively calm, although combined with low temperatures, winds present a significant operating constraint. Annual wind speeds in the region average roughly 10 knots, while extremes in the order of 70 knots may be expected.

Annual precipitation in the area is low and usually averages 6 to 12 inches per year. Snowfall is not an important hindrance to operations through its cumulative thickness, but is a more serious operating problem when continually blown by winds into hard packed drifts. Blowing snow also restricts travel by land and air due to reduced visibility.

The most obvious restriction to visibility is the long polar night in winter when the Beaufort Sea region is in darkness. Visibility in the area is also reduced by fog, white-outs and blowing snow. Fog is usually the result of warm, moist air passing over cold water, snow or ice, and is worst during the break-up and early freeze-up periods. White-outs are most common during low overcast, in freshly fallen or blowing snow, or with fog. In general, visibility is best in the late winter, although the continuous daylight during the summer months is obviously a great advantage to operations.

(5) Oceanographic Conditions

In a relative sense, waves in the Beaufort Sea are quite small since the presence of pack ice limits the wind fetch, and thus wave heights, during the open water period. Generally, significant wave heights in the area are in the order of several feet, although extremes during storms may be as great as 20 feet. Although little information on currents exists, they are expected to be typically less than 0.5 kts and thus, are not a significant factor.

b. Kulluk System

(1) Design Capabilities

KULLUK is a second generation Arctic drilling unit that is purpose built to operate in the ice and wave conditions characterizing the Beaufort Sea's break-up, summer, freeze-up and early winter periods. The vessel has a unique twenty-four faceted circular hull which, combined with its radially symmetrical mooring, provides an omni-directional capability to resist ice and storm forces (Figure 3). KULLUK's inverted conical hull form fails the oncoming ice in flexure at low force levels while the outward flare near the bottom of the hull ensures that broken ice pieces clear around it and do not enter the moonpool or become entangled in the mooring lines. This efficient ice breaking and clearing of KULLUK's hull minimizes the tensions in the unit's mooring lines along with the vessel's response motions in ice.

KULLUK's mooring system provides resistance to environmental forces and is comprised of twelve radially deployed anchor wires. An important feature is the through hull path of the mooring lines and the underwater fairleads which, combined with the unit's hull form, minimizes the threat of ice fouling the lines.

KULLUK is designed for continued drilling operations in the wind and waves associated with one-year return period Beaufort Sea storms and to maintain location and survive 100 year return period events (Table 10). In terms of ice, KULLUK is designed to operate with no icebreaker support in level, unbroken first-year ice up to four feet in thickness. The vessel is built to Arctic Class[2] IV specifications and as such, has a normal design operating season from June 1st until January 31st.

The operating and survival capabilities of KULLUK in ice are enhanced by the ice management support provided by BeauDril's Class IV ice-breaking vessels. These icebreakers fragment thicker ice within the general ice cover along with more extreme features such as pressure ridges and old ice floes.

This ice management support reduces the ice forces on KULLUK's mooring system and allows drilling operations to proceed in more severe ice environments. In level ice, 4 feet thick, BeauDril's 24,000 and 14,900 HP icebreakers proceed continuously at speeds of

2 Arctic Class - is a Canadian Coast Guard classification system which rates icebreakers for use in the Canadian Arctic. The normal design operating season from June 1st until January 31st is established by the Canadian Coast Guard for Class IV vessels.

seven knots and four knots respectively (Figures 4,5, and 6). In addition to ice management, these support vessels carry out supply, anchor handling and towing operations.

(2) Operating Experience

The capabilities of KULLUK are particularly well suited to safe and efficient drilling operations in the Alaskan Beaufort Sea where late break-up, early freeze-up and frequent ice intrusions limit the operating season available to more conventional drilling systems.

Since entering the Beaufort Sea in August 1983, the KULLUK system has successfully drilled nine wells in water depths ranging from 80 to 180 feet. During drilling operations, KULLUK has been exposed to a wide range of ice and wave conditions and has developed ice management techniques and procedures for safe and efficient operations within its performance limits. Ice management has been a key element to the success of KULLUK's station-keeping in thick first-year ice, large pressure ridges and old ice intrusions.

The conditions in which KULLUK has operated can be subdivided into three characteristic ice scenarios: spring break-up with thick moving first-year ice and some old ice; summer open water with first and multi-year ice intrusions; and freeze-up/early winter with a growing first-year ice cover and some old ice. KULLUK has experienced very little downtime in these conditions and has commenced drilling operations as early as June 1st and continued working as late as December 11th. KULLUK has also operated through a number of Beaufort Sea storms with maximum wave heights in the 20 foot range, performing in accordance with design expectations.

3. Abnormal or Unusual Conditions Encountered During Drilling Operations

a. Logging or Wireline Operations

(1) Logging will not be attempted until the hole is stable, which means the following conditions exist: no mud flow; no lost circulation; mud is not being gas cut; and the hole is clean as indicated by the returns at the shale shaker.

(2) Conditions that are considered unfavorable for successful logging and require consideration for correction are as follows:

(a) high solids content in the drilling mud;

(b) tight hole sections in wellbore on first logging run;

(c) excessive time since circulating the well.

(3) Logging operations which will not be allowed are:

(a excessive spudding of logging tools to get downhole; or

(b) repeat runs in a hole that gives evidence of being in bad condition. Instead, a conditioning trip will be considered before the logging program is resumed.

b. Running and Cementing Casing

(1) Casing should not be run or cemented unless hole conditions are stable which means the following conditions exist:

(a) mud is not gas cut and rheological properties are in order;

(b) fluid level in wellbore is stable, not flowing or taking fluid;

(c) wellbore is free of obstructions.

(2) If fluid is lost or the well begins to flow while running casing, remedial measures will be considered. This could include, but not limited to, rigging up to circulate through casing, the use of loss circulation materials and the application of conventional well control procedures, etc.

(3) Casing will not be run and cemented under conditions deemed unsafe due to weather, ice, equipment problems, or personnel availability.

c. Cutting and/or Recovering Casing

(1) During the abandonment of the well, each casing string may be cut and/or recovered in such a manner that additional cement plugs are set if open hole is exposed by the removal of the casing string.

(2) The casing cutting and/or recovering operation would not be commenced until the ARCO Drilling Supervisor is confident that the well is properly plugged in accordance with all existing regulations.

d. Drill Stem Testing

(1) Drill stem testing will not be conducted:

(a) in open hole; or

(b) using the drill pipe as a test string unless it can be tested to a pressure in excess of the anticipated reservoir pressure.

(c) without first pressure testing all circulating lines and manifolds, testing head, manifold and other associated surface testing equipment to at least the maximum anticipated surface pressure.

(2) The ARCO Drilling Supervisor will be prepared to cease any testing operations if:

(a) surface pressure exceeds the design or tested rating of the surface equipment;

(b) the surface facilities, burner, or storage become overloaded by the producing rate (This applies to both liquid and gas capacities);

(b) the annulus-pressure behavior is erratic, after taking into account that some variation in pressure is normal from the effect of temperature and tubing pressure; or

(d) at any time there is concern about safety because of weather, ice, integrity of any equipment, abnormal presence of hydrocarbon vapors or hydrogen sulfide, or any other reason deemed unsafe for the personnel onboard.

(3) During drill stem testing, the following will be prohibited in the testing area: smoking, welding, open flames, and exposed lights.

(4) Before commencing any testing operations, a meeting of key ARCO, Contractor, and service company personnel will be held to review the procedures and equipment to be utilized during the test. All flowlines will be tested to the maximum anticipated surface pressure upstream of the test choke. All personnel will be alerted to the possible hazards of the testing operations to be conducted.

4. Availability of Oil Spill Containment and Cleanup Equipment

The KULLUK and Canmar Supplier I have initial oil spill response equipment onboard at all times. This equipment is listed in ARCO's Oil Spill Contingency Plan (ARCO, 1992). In addition to the oil spill response equipment and materials located on board the KULLUK, the CANMAR SUPPLIER I shallow draft support vessel will maintain an extensive inventory of spill response supplies onsite as identified in the Oil Spill Contingency Plan. In case of an emergency, ARCO would obtain additional oil spill response equipment through Alaska Clean Seas (ACS), and other sources both in Alaska and out-of-state as identified in of the Oil Spill Contingency Plan.

If an uncontrolled well emergency on a different Beaufort Sea well occurs while the Kuvlum well is being drilled, ARCO will track the ACS equipment dedicated to that cleanup operation. ARCO will make an assessment of its planned drilling activities and the availability of off-site cleanup equipment. If drilling operations or other downhole activities are being conducted, ARCO will consult with the District Office of the MMS on what safeguards may be necessary to continue or commence such operations.

5. Lease Stipulations Affecting Drilling Operations.

Two Lease Stipulations for OCS-Y-0866 directly impact the operations scheduled for drilling the Kuvlum Prospect.

a. The first stipulation requires a seasonal drilling restriction for protection of bowhead whales from potential effects of oil spills. This stipulation has been waived by the MMS because the operator is performing a "whale monitoring program".

   ARCO has contracted an outside firm to conduct such a program on the Kuvlum project. A whale monitoring program has been prepared and submitted to all appropriate governmental agencies for approval and implementation.

b. The second stipulation prohibits Drilling Below Threshold Depth in Broken Ice Conditions.

   With regard to oil spill cleanup capability (Lease Sale 87, Stipulation No. 6), the MMS has approved the Oil Spill Contingency Plan (OSCP) for broken ice conditions (reference August 30, 1990 correspondence).

   This approval is conditional based upon the operator (ARCO) performing an oil spill response exercise prior to the commencement of drilling operations. This exercise will be conducted by ARCO to fulfill this requirement.

   In addition, a table top/communications oil spill response exercise will be conducted to demonstrate ARCO's ability to respond to simulated major oil spill. This exercise will also be conducted to fulfill this obligation.

   As previously mentioned, ARCO will provide immediate response capability at Kuvlum by stationing the Canmar Supplier I at the location, fully equipped with oil spill equipment and materials as specified in the OSCP.

   Also, ARCO has arranged for a spill response barge and tug to be located on standby, at West Dock in Prudhoe Bay, in the event a major response is required.

## 6. Seasonal Considerations

This COCP is primarily intended to detail the responsibilities, circumstances, and procedures to safely and securely curtail critical operations if necessary. All procedures contained herein specify a temporary well suspension as the desired course of action.

In the later part of the normal design operating season, environmental conditions may dictate that a permanent well abandonment be implemented. All curtailment opportunities and decisions will account for the need for a permanent well abandonment to be undertaken if necessary. As an example, in late season, careful consideration will be given to the decision as to whether or not to drill out of a previously set casing string.

Under all circumstances, ARCO intends to follow the guidelines set forth in this COCP with careful consideration given to the particular environmental conditions as they relate to the seasonal window for drilling operations.

## F. LIST OF REFERENCES:

ARCO, 1992, *Kuvlum Exploration Plan*, July, 1992

ARCO, 1992, *Kuvlum Oil Spill Contingency Plan*, July, 1992

Hinkel, R.M. and S.L. Thibodeau. *Experience With Drillship Operations in the U.S. Beaufort Sea.* OTC 5685, May 2-5, 1988

Regg, J.B. and R.Y. Kuranel. *Minerals Management Service Regulation of Floating Drilling Unit Operations in the Beaufort and Chukchi Outer Continental Shelf.* ADC/SPE 23922, February 18-21, 1992

Pilkington, G.R., B.D. Wright, B.C. Dixit, K.S. Wooner, and B.D. O'Del. *A Review of Kulluk's Performance After Three Years' Operations in the Beaufort Sea.* Iowa City, Iowa: International Association of Hydraulic Research Conference, 1986

Hnatiuk, John and Brian D. Wright. *Ice Management in Support of BeauDril's Beaufort Sea Drilling Operations.* Bambridge, USA: International Conference on Ice Technology, MIT, 1986

Jones, Capt. Keith and Capt. Peter Kimmerly. *Ice Management Procedures for Specialized Drilling Structures.* Vancouver: International Polar Transportation Conference, 1986

Mitton, Frank . *Environmental Monitoring and Forecasting in Support of Operations in the Arctic Offshore.* Miami, Florida: Second International Conference on Offshore Safety, 1986

Mitton, Frank . *The Alert System - Planned Location Abandonment for Safe, Extended-season Operations in the Arctic Offshore.* Miami, Florida: Second International Conference on Offshore Safety, 1986

Dixit, B.C. , C.R. Pilkington, F.J. Eley. *Environmental and Performance Monitoring for Offshore Arctic Exploration Structures.* Calgary, AB: Arctic Offshore Technology Conference, 1984

Hnatiuk, J. and B.D. Wright. *Ice Management to Support the Kulluk Drilling Vessel.* Calgary, AB: 35th Technical Meeting of the Petroleum Society of CIM held jointly with the Canadian Association of Drilling Engineers, 1984

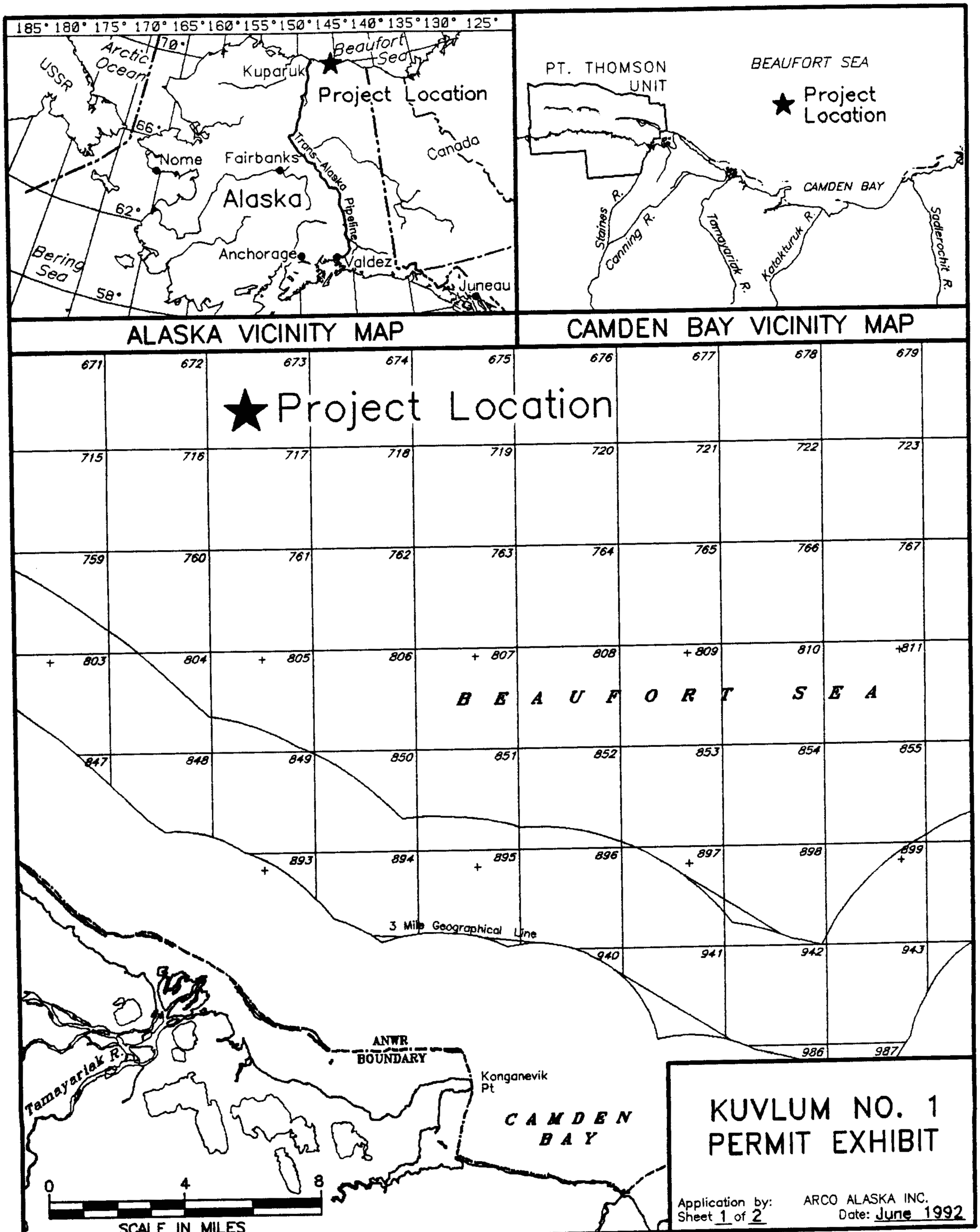



FIGURE 1 AK92 060804A01

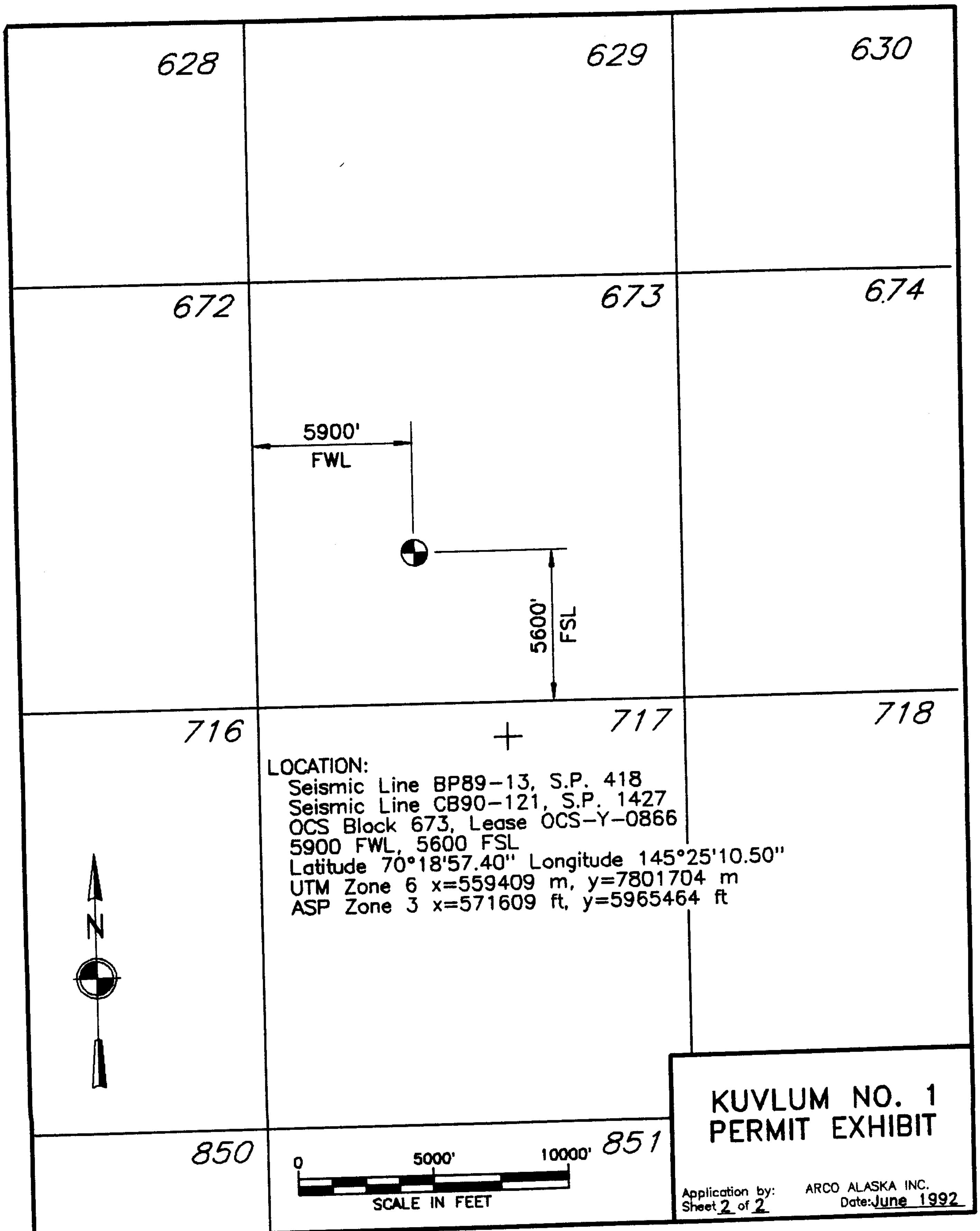
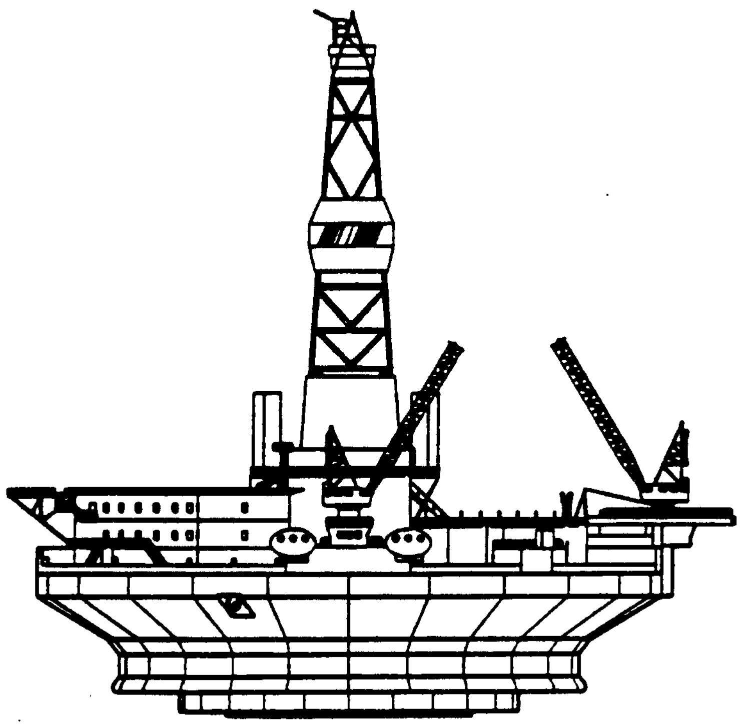



FIGURE 2

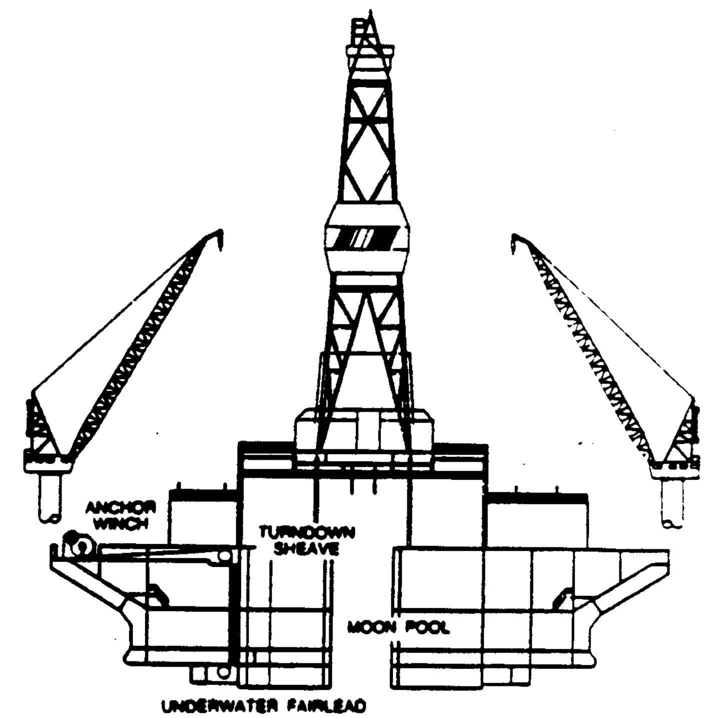
AK92 060604B01

# Kulluk

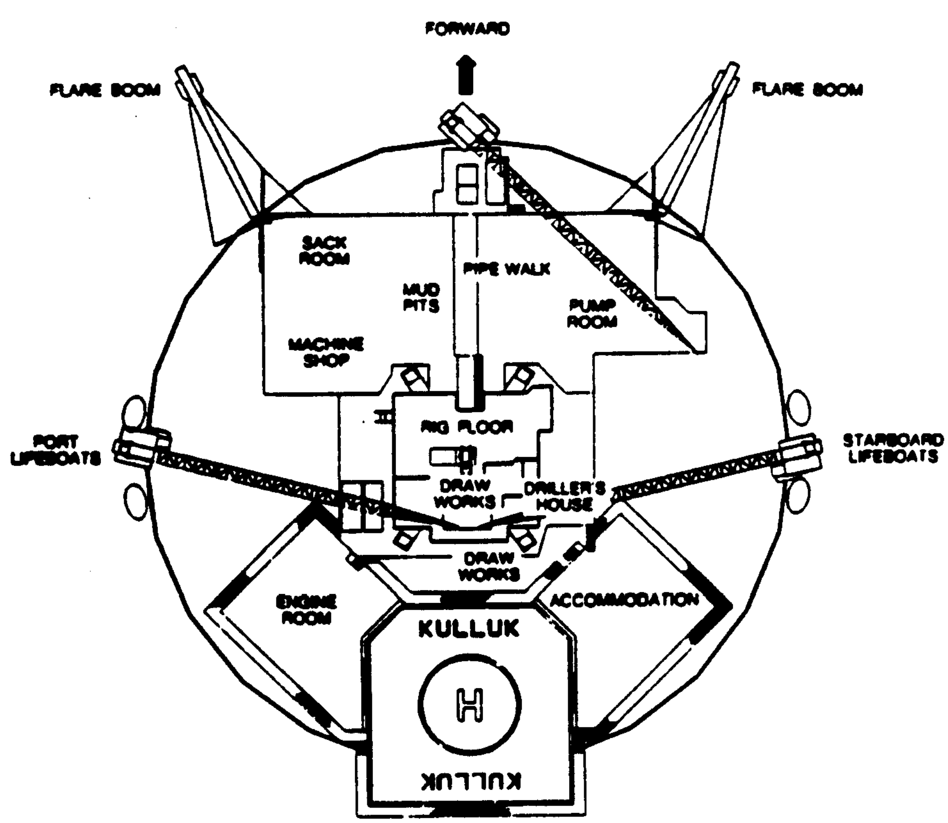
## Principal schematic drawings and layouts.



PROFILE




SECTION VIEW

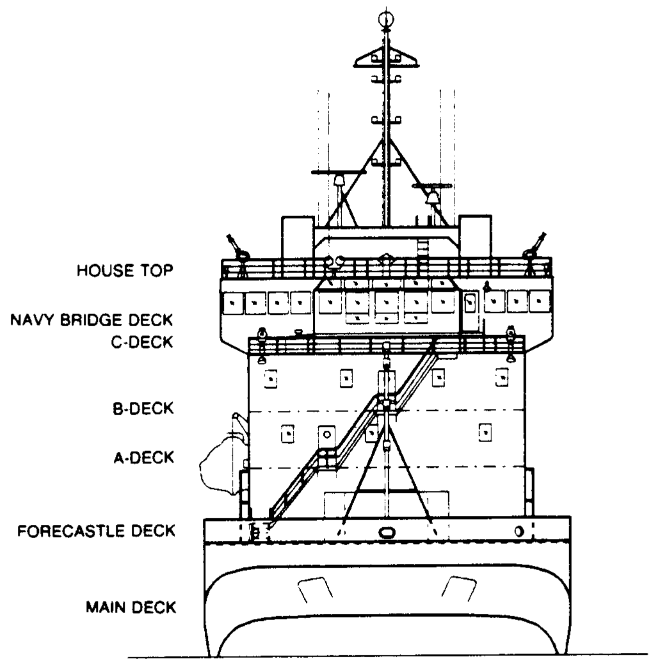



PLAN VIEW

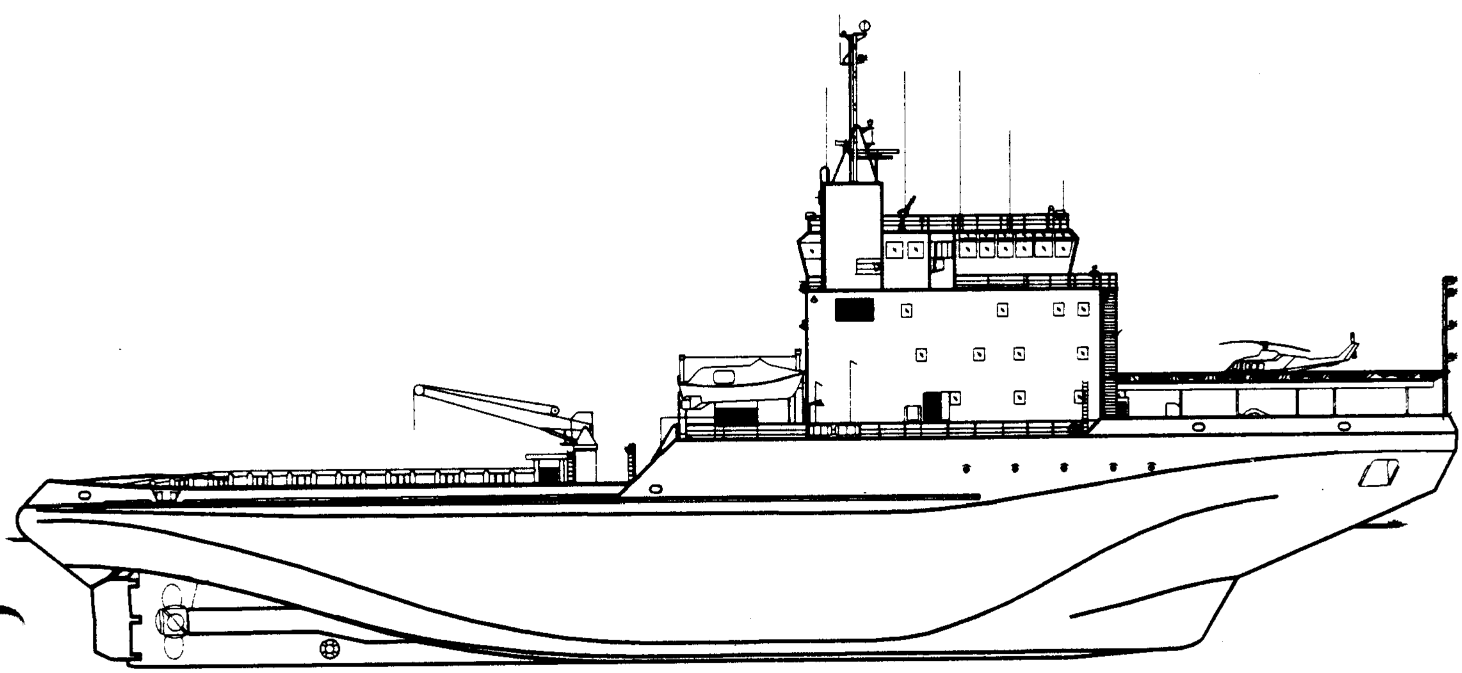
FIGURE 3

# Kalvik

## Principal schematic drawings and layouts




BOW ELEVATION

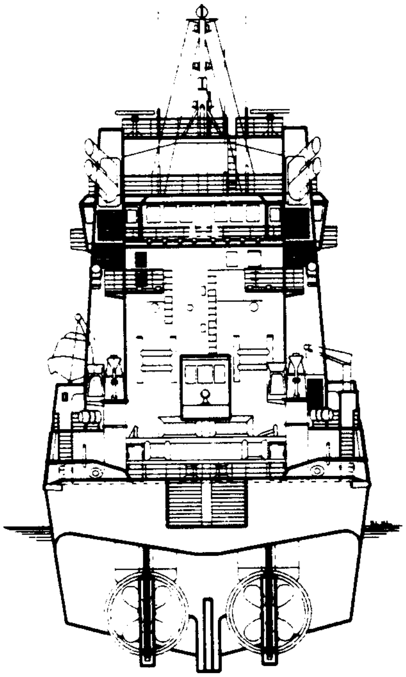


PROFILE ELEVATION

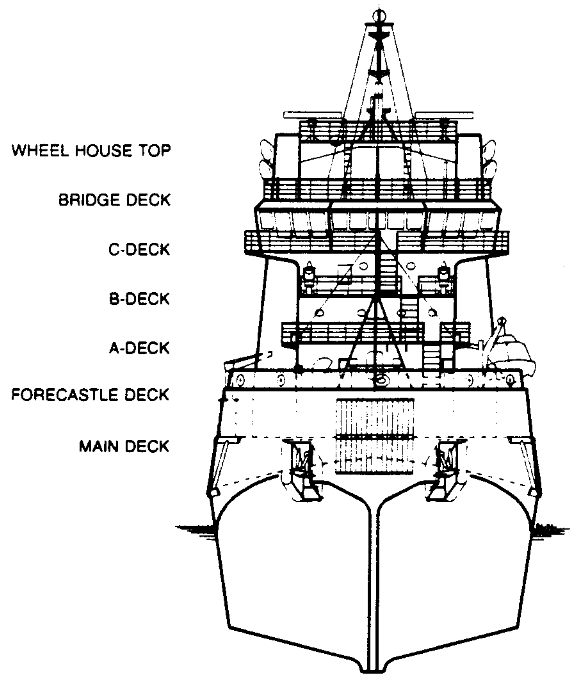
FIGURE 4

# Ikaluk

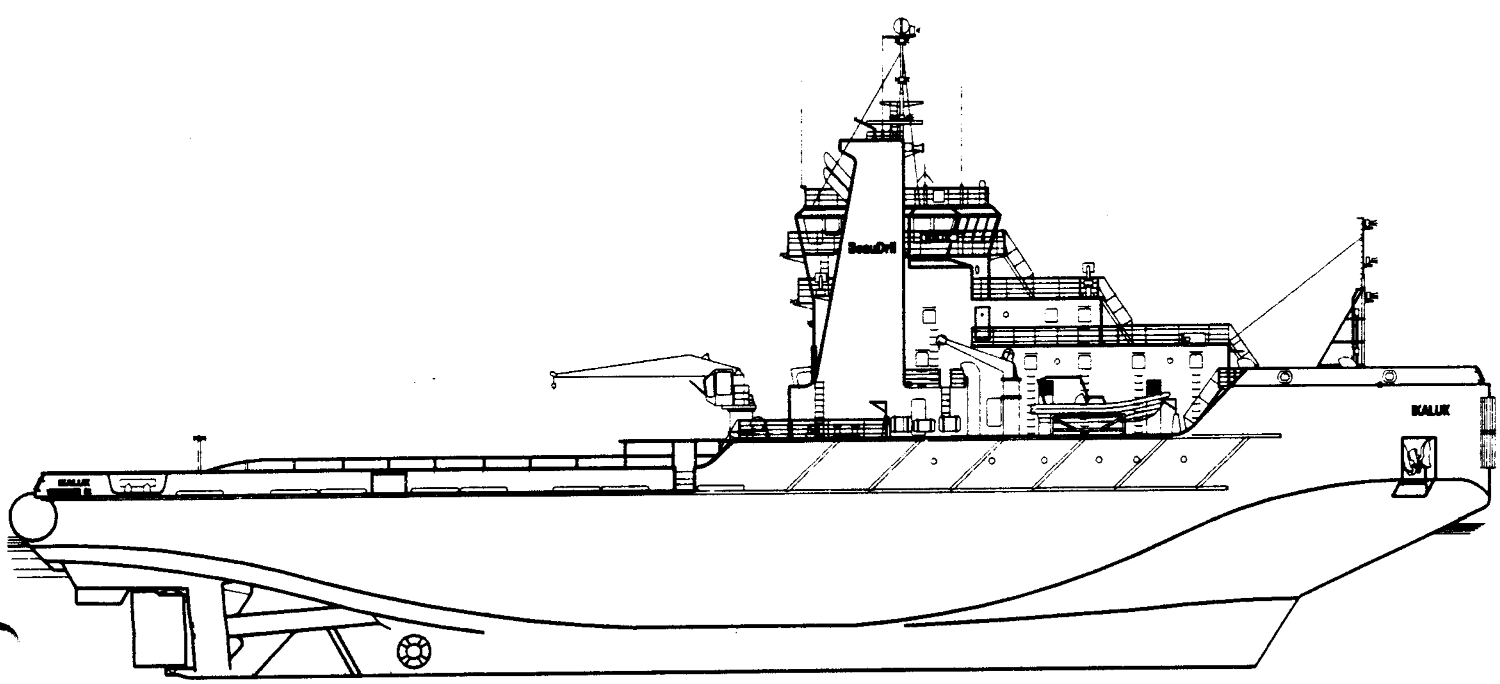
## Principal schematic drawings and layouts



STERN ELEVATION




BOW ELEVATION

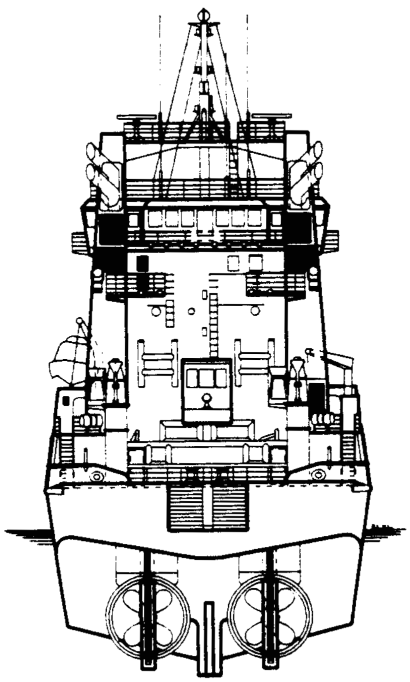



PROFILE ELEVATION

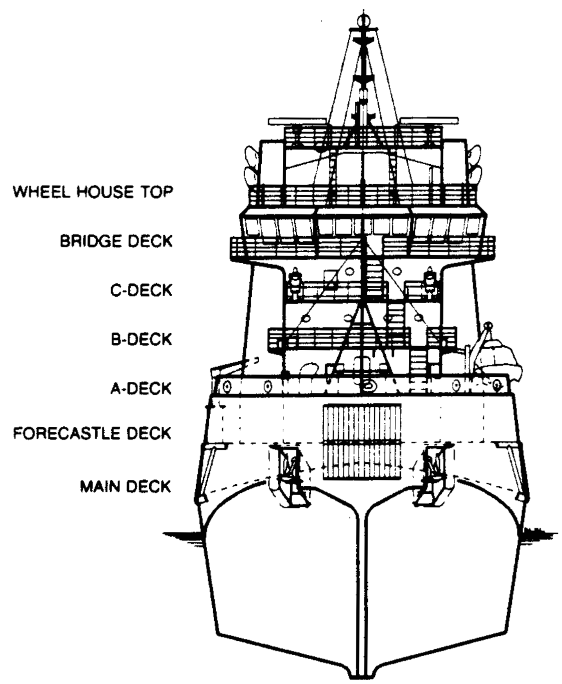
FIGURE 5

# Miscaroo

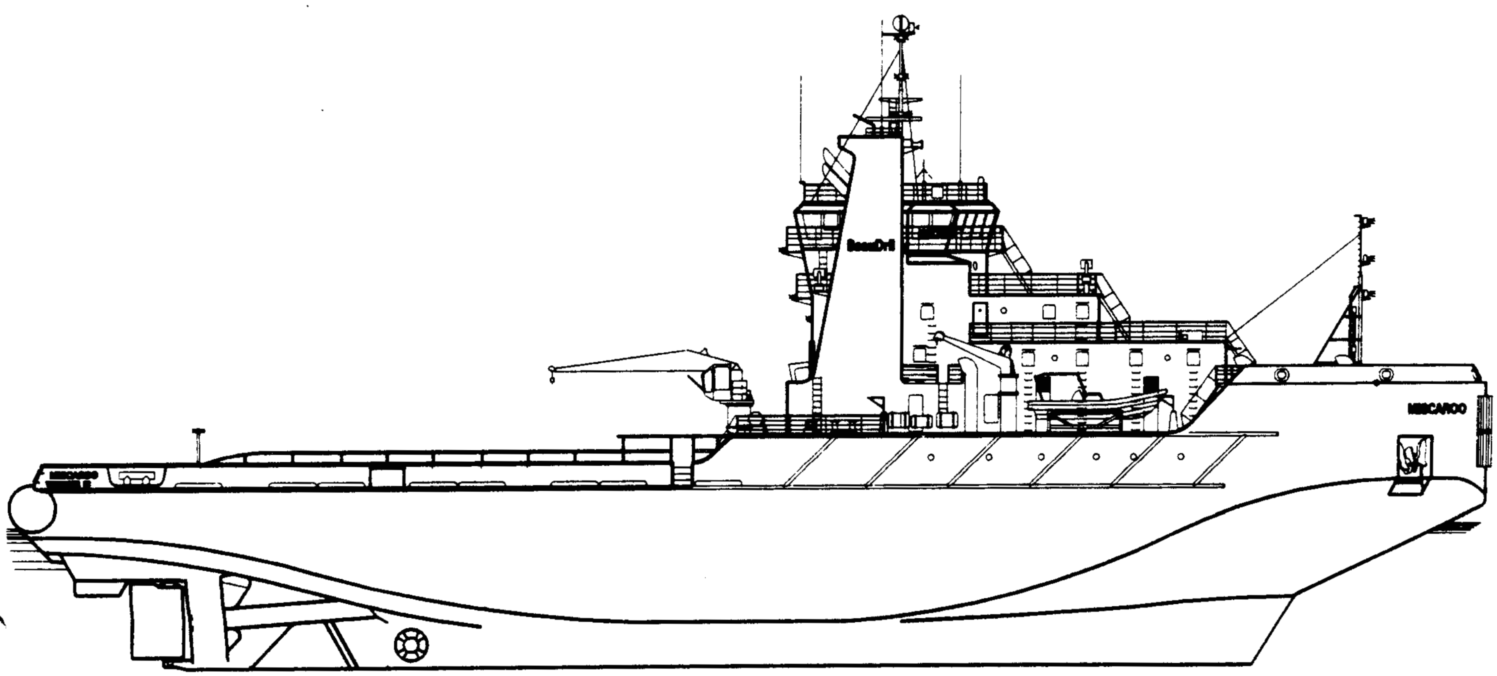
## Principal schematic drawings and layouts



STERN ELEVATION

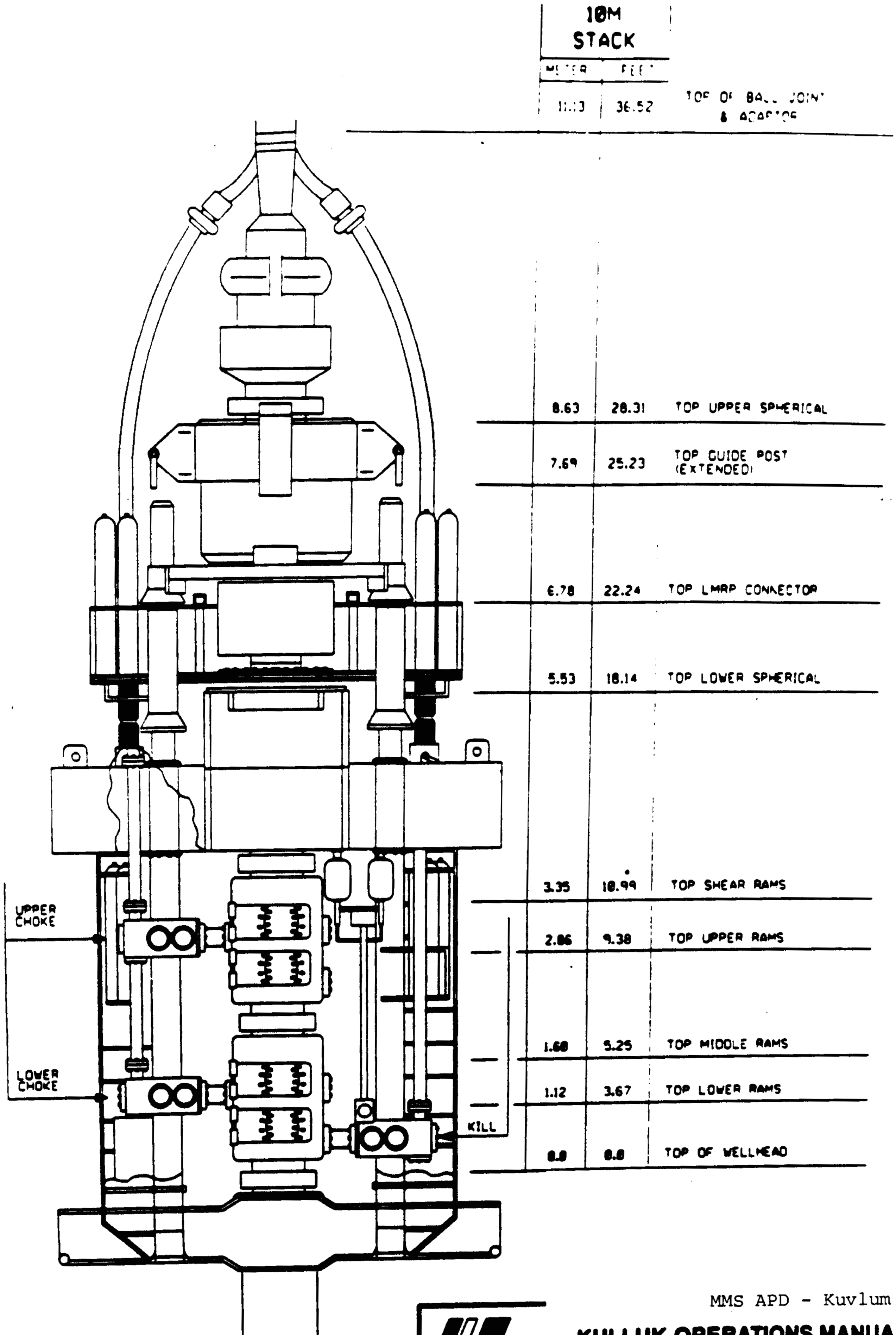



BOW ELEVATION




PROFILE ELEVATION

FIGURE 6



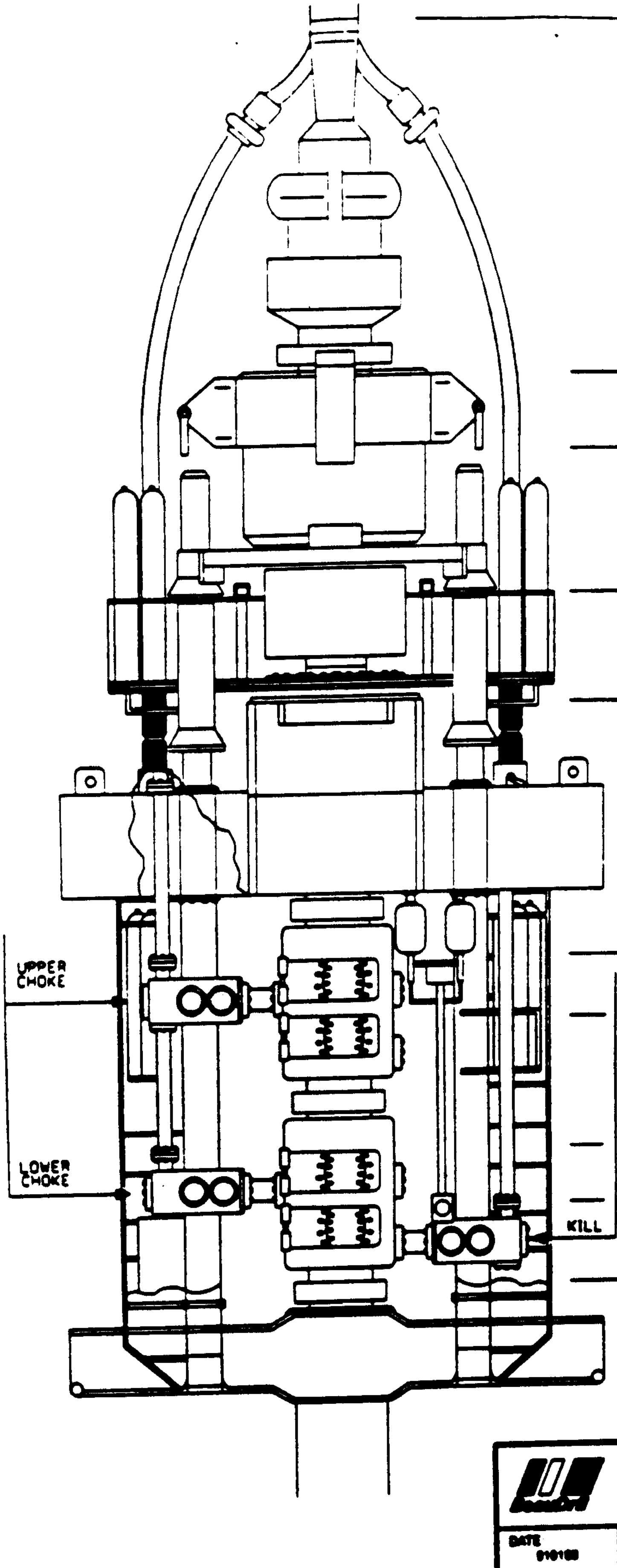

MMS APD - Kuvlum

**KULLUK OPERATIONS MANUAL**

DATE: 910108

FIGURE 7

Name of facility: Kulluk (CDU)




| 15M STACK | | |
|---|---|---|
| METERS | FEET | |
| 11.25 | 36.91 | TOP OF BALL JOINT & ADAPTOR |
| 8.75 | 28.71 | TOP UPPER SPHERICAL |
| 7.86 | 25.79 | TOP GUIDE POST (EXTENDED) |
| 6.95 | 22.80 | TOP LMRP CONNECTOR |
| 5.70 | 18.70 | TOP LOWER SPHERICAL |
| 3.70 | 12.14 | TOP SHEAR RAMS |
| 3.19 | 10.47 | TOP UPPER RAMS |
| 1.77 | 5.80 | TOP MIDDLE RAMS |
| 1.26 | 4.13 | TOP LOWER RAMS |
| 0.0 | 0.0 | TOP OF WELLHEAD |

MMS APD - Kuvlum

**KULLUK OPERATIONS MANUAL**

DATE [illegible]

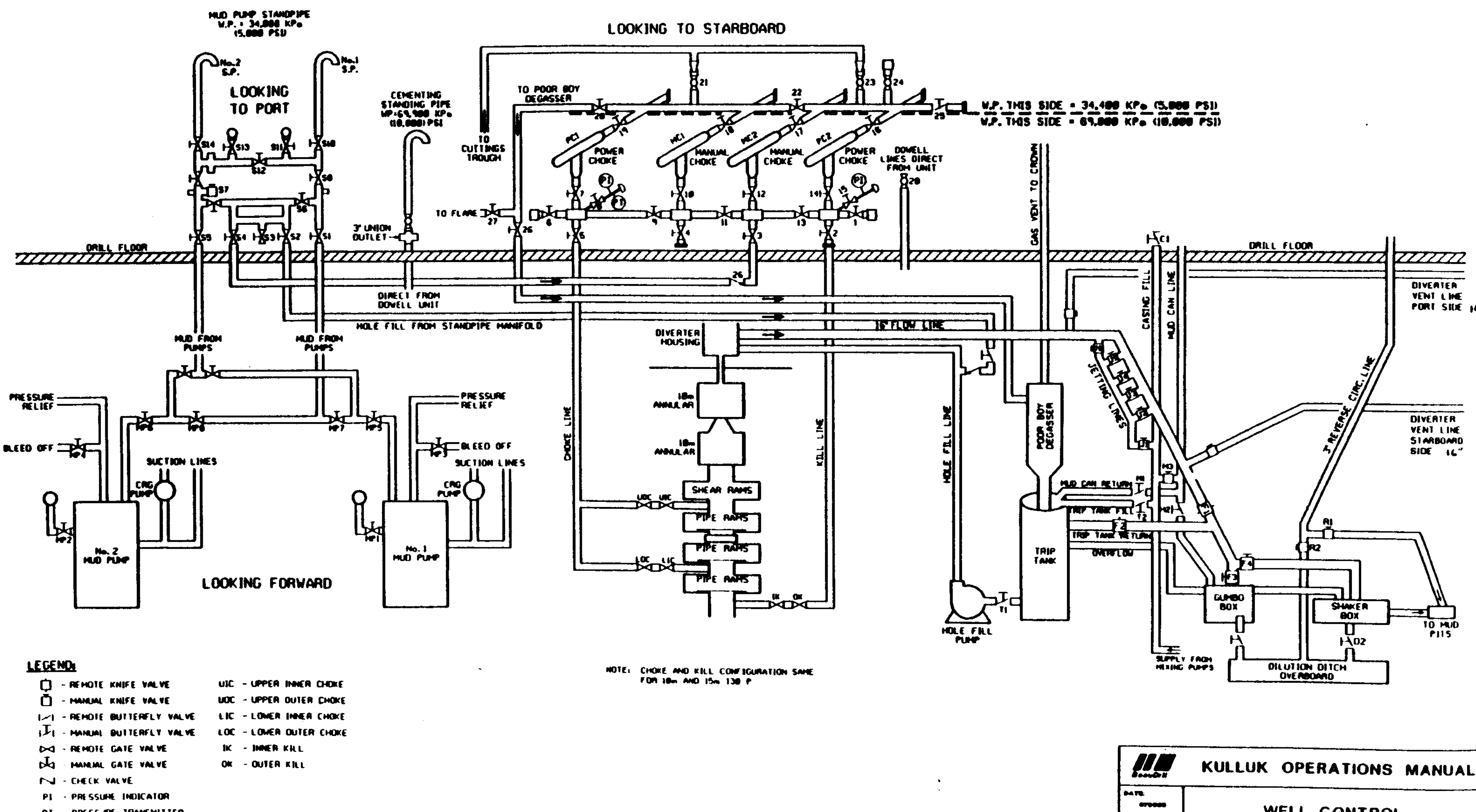
PROJECT No [illegible]

FIGURE 8

**15m BOP**

Name of facility: Kulluk (CDU)

Operator: ARCO Alaska, Inc.

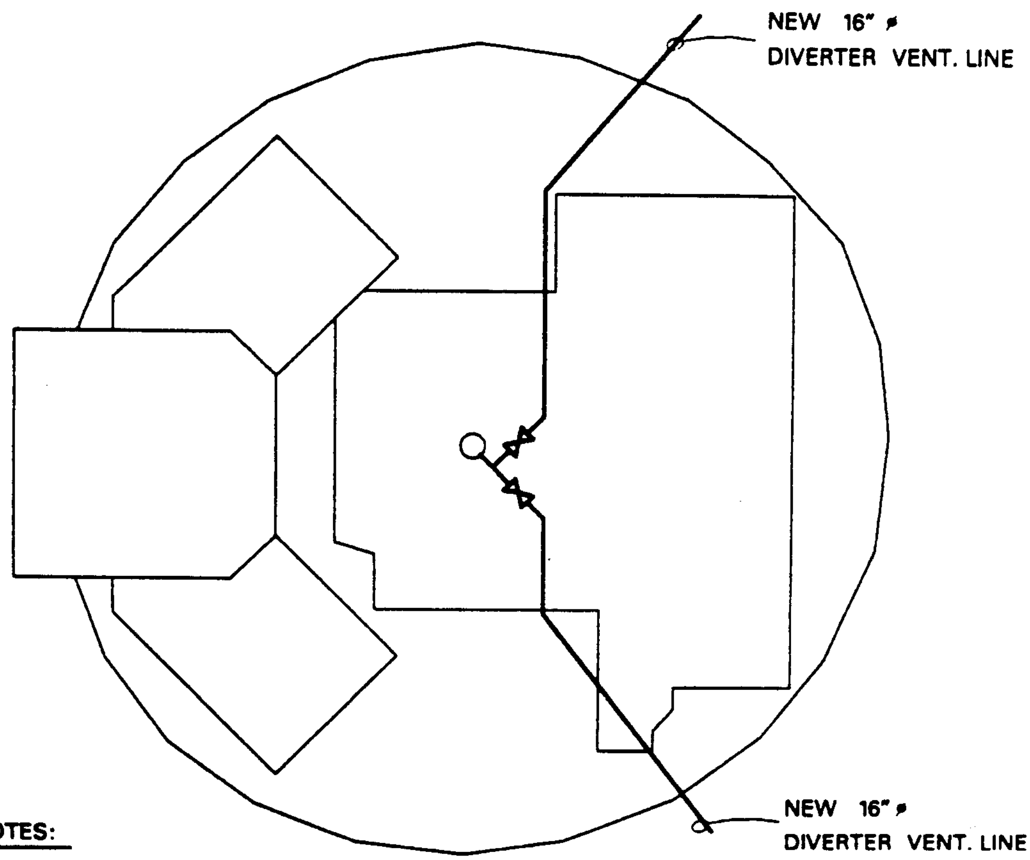



KULLUK OPERATIONS MANUAL

WELL CONTROL FLOW DIAGRAM

FIGURE 9

# BEAUDRIL KULLUK DIVERTER SYSTEM PLAN VIEW




NOTES:

1) 16" DIAMETER SYSTEM
2) VALVES C/W HYDRAULIC ACTUATORS.
3) 45° & 90° ELBOWS SHALL BE, VORTICE-ELL OR TARGETED TEES.
4) ALL OTHER ELBOWS SHALL BE, R=3 DIA. ELBOWS

ZHO:[200,12]KULLUK.DGN'FONT

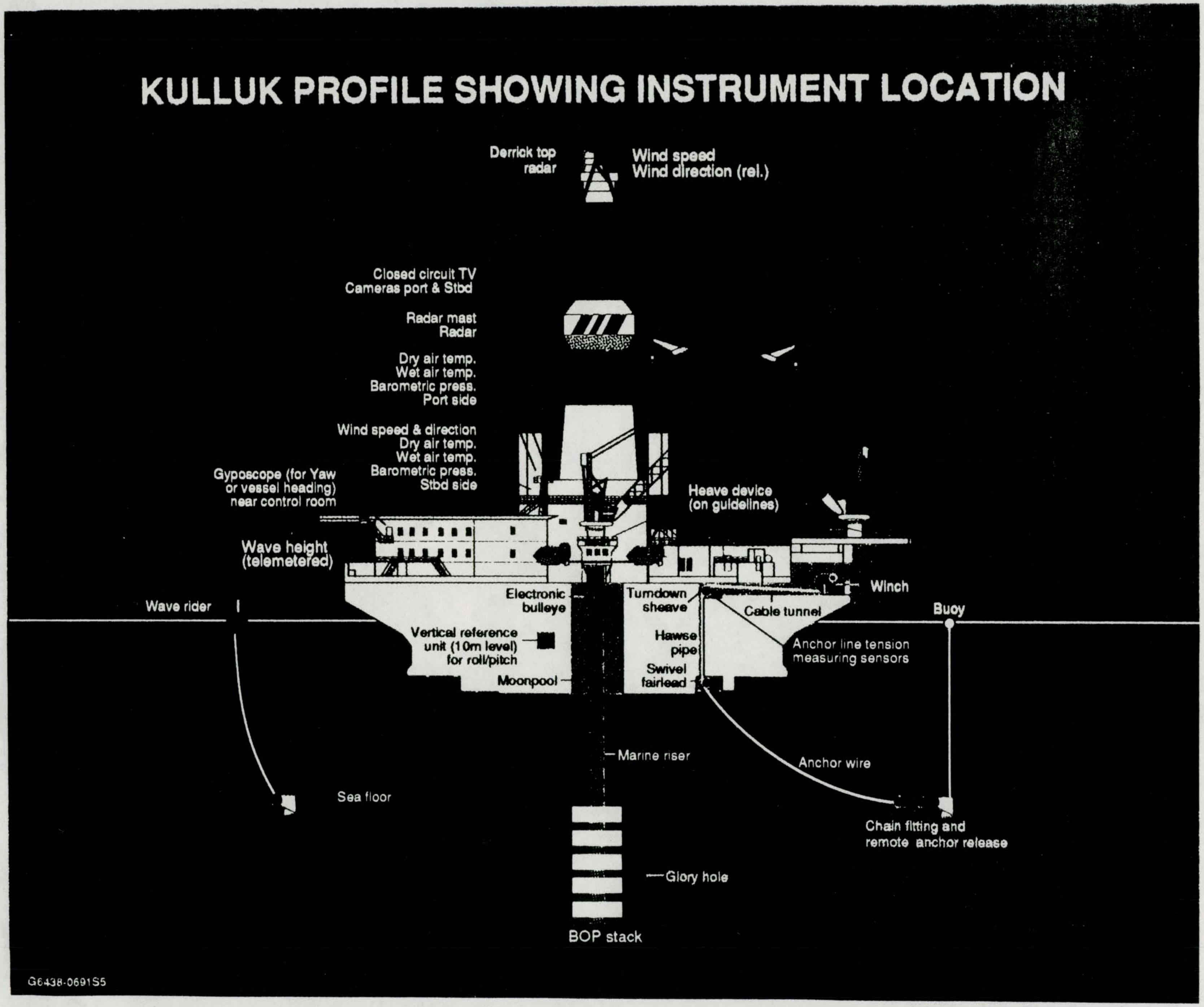

KULLUK PROFILE SHOWING INSTRUMENT LOCATION
Derrick top radar
Wind speed
Wind direction (rel.)
Closed circuit TV
Cameras port & Stbd
Radar mast
Radar
Dry air temp.
Wet air temp.
Barometric press.
Port side
Wind speed & direction
Dry air temp.
Wet air temp.
Barometric press.
Stbd side
Gyposcope (for Yaw or vessel heading) near control room
Heave device (on guidelines)
Wave height (telemetered)
Wave rider
Electronic bulleye
Turndown sheave
Winch
Cable tunnel
Buoy
Vertical reference unit (10m level) for roll/pitch
Hawse pipe
Swivel fairlead
Anchor line tension measuring sensors
Moonpool
Marine riser
Anchor wire
Sea floor
Chain fitting and remote anchor release
Glory hole
BOP stack
G6438-0691S5

FIGURE 11

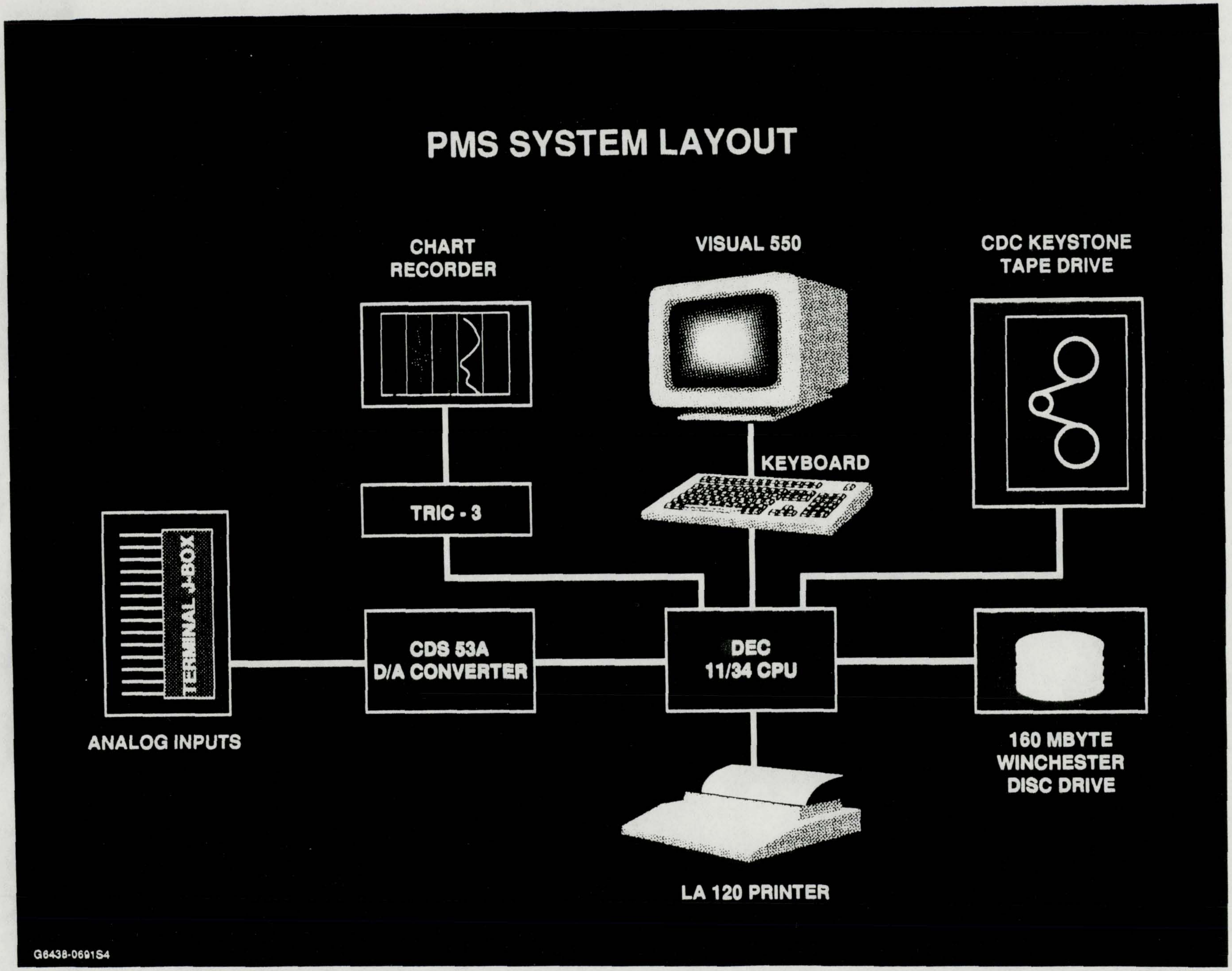
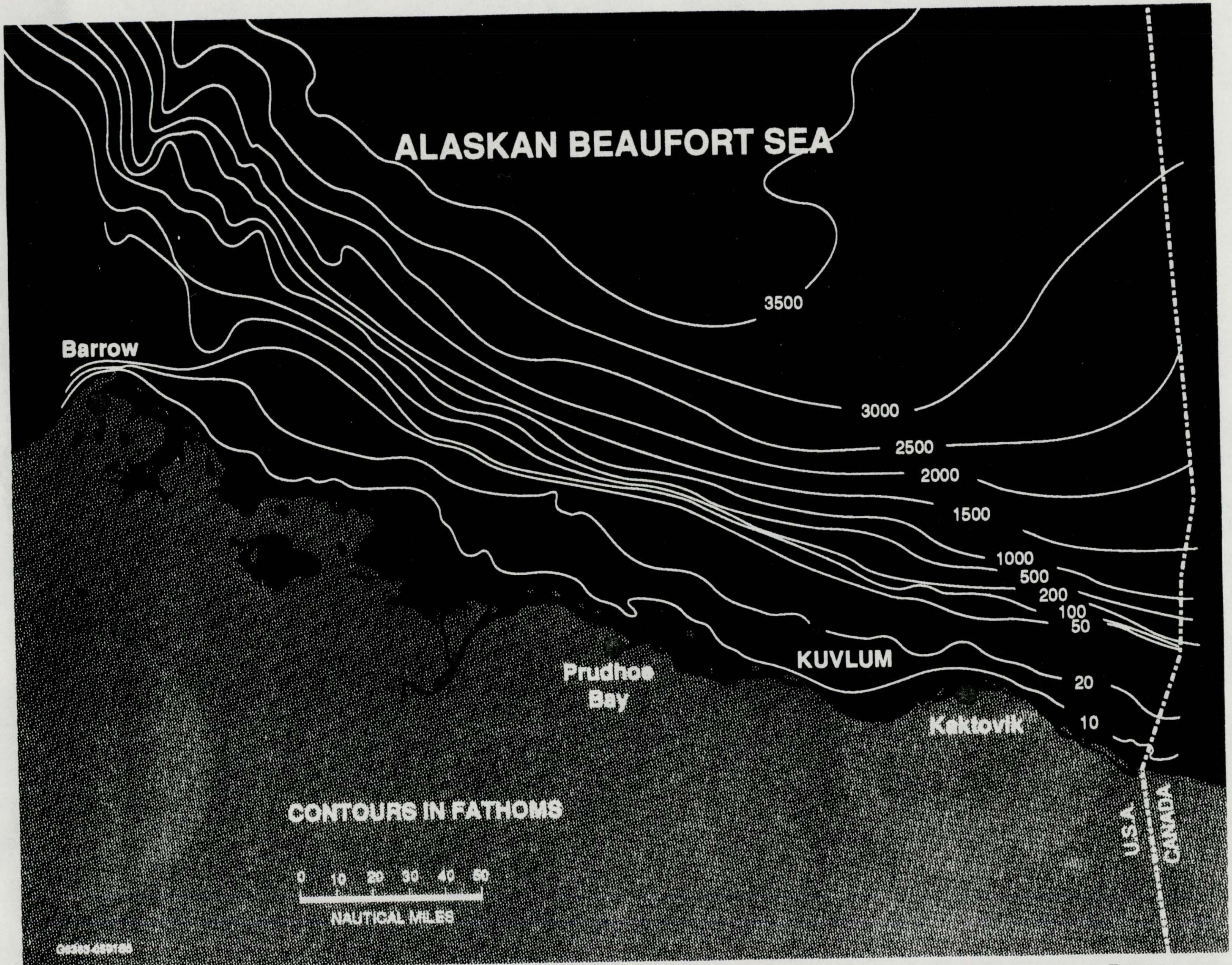

PMS SYSTEM LAYOUT
CHART RECORDER
VISUAL 550
CDC KEYSTONE TAPE DRIVE
KEYBOARD
TRIC - 3
TERMINAL J-BOX
CDS 53A D/A CONVERTER
DEC 11/34 CPU
ANALOG INPUTS
160 MBYTE WINCHESTER DISC DRIVE
LA 120 PRINTER
G6438-0691S4

FIGURE 12



ALASKAN BEAUFORT SEA
3500
3000
2500
2000
1500
1000
500
200
100
50
20
10
Barrow
Prudhoe Bay
KUVLUM
Kaktovik
CONTOURS IN FATHOMS
0 10 20 30 40 50
NAUTICAL MILES
USA
CANADA


FIGURE 14

Table 6

# COMPONENTS OF ENVIRONMENTAL MONITORING AND FORECASTING SYSTEM

| WEATHER | | BEAUDRIL | OPERATOR |
|---|---|---|---|
| **SITE SPECIFIC** | | | |
| - WINDS | ANEMOMETERS | YES | |
| - TEMPERATURE | DRY AND WET BULB THERMOMETERS | YES | |
| - PRESSURE | BAROGRAPH, BAROMETERS AND ALTIMETERS | YES | |
| - VISIBILITY | BALLONS, CEILING LIGHT PROJECTOR, VISUAL | YES | |
| - PERSONNEL | CERTIFIED OBSERVERS | YES | |
| - DATA RECORDING | ONBOARD COMPUTER ARCHIVING SYSTEM | YES | |
| - DATA TRANSMISSION | PHONE LINES | | YES |
| ( HOURLY OBSERVATIONS ) | | | |
| **SITE SPECIFIC / REGIONAL** | | | |
| - WEATHER FORECASTS | | | YES |
| - UNMANNED WEATHER STATIONS* | | | YES |
| ( TYPICALLY 4 FORECASTS PER DAY ) | | | |

| OCEAN | | BEAUDRIL | OPERATOR |
|---|---|---|---|
| **SITE SPECIFIC** | | | |
| - WAVES | VISUAL OBSERVATIONS<br>DIRECT MEASUREMENTS | YES | <br>YES |
| - CURRENTS* | | | YES |
| - SEA STATE FORECASTS | | | YES |
| - SALINITY AND TEMPERATURE PROFILES* | | | YES |
| - SEA SURFACE TEMPERATURES* | SEA BUCKET | YES | |

| ICE | | BEAUDRIL | OPERATOR |
|---|---|---|---|
| **SITE SPECIFIC** | | | |
| - ICE CONCENTRATION, TYPE ROUGHNESS, THICHKNESS | VISUAL OBSERVATION | YES | |
| - ICE DRIFT | MARINE RADAR | YES | |
| **SITE SPECIFIC / REGIONAL** | | | |
| - ICE CONDITIONS / ICE MOVEMENT | AIRBORNE IMAGERY RADAR (SAR/SLAR) AND DOWNLINK<br>NOAA SATELLITE IMAGERY<br>VISUAL ICE RECCES (FIXED WING, CHOPPERS)<br>ARGOS BUOYS*<br>GOVERNEMNT ICE CHARTS | | YES<br>YES<br>YES<br>YES<br>YES |
| - REGIONAL ICE FORECASTS | GOVERNMENT ICE FORECASTS<br>ONBOARD ASSESSMENT | <br>YES | YES<br> |

* IF REQUIRED

B-1034

COPY DISTRIBU...
1 – WHITE - C... ...RY OFFICE
2 – YELLOW - TUK BASE
3 – PINK - ORIGINATOR

# BeauDril (1987) Partnership Limited

TABLE 7

## OFFSHORE ENVIRONMENTAL OBSERVATIONS PART I — WEATHER

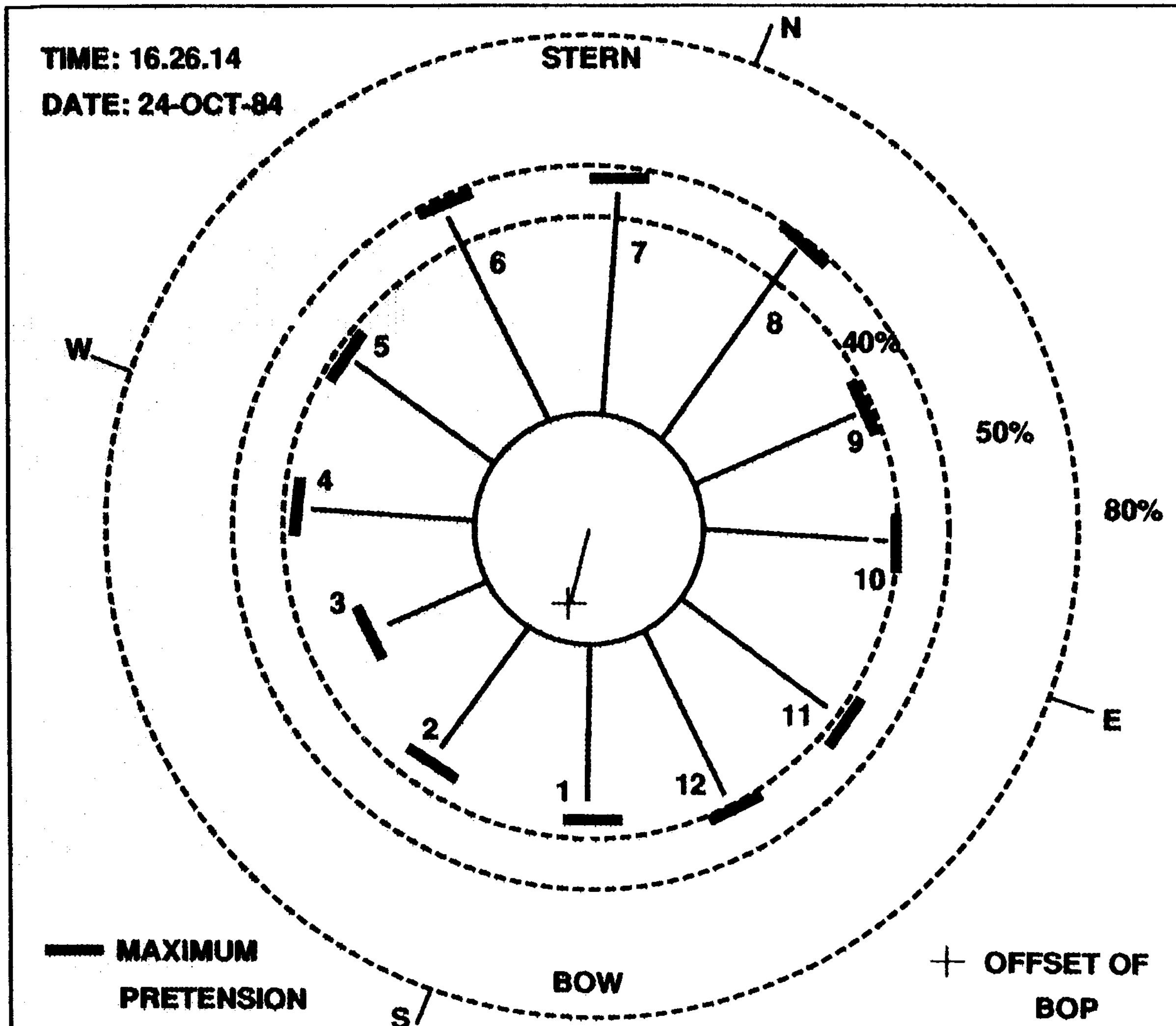
LATITUDE ______________

LONGITUDE ______________ VESSEL ______________ CALL SIGN ______________ WELL SITE ______________ OBSERVER(S) ______________

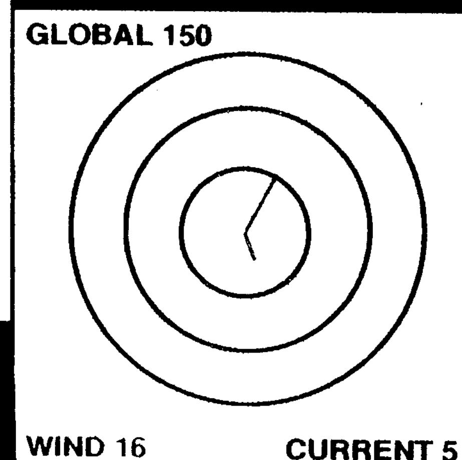
DATE ______________ YEAR MONTH DAY

| TIME GMT MINUS Hours | TYPE OF REPORT | TIME (GMT) | SKY CONDITIONS | CEILING (100's of Feet) (2) | VISIBILITY (Nautical Miles) (3) | WEATHER CODE (1) | MSL PRESSURE (Millibars) (7) | DRY BULB TEMPERATURE (Nearest 0.1°C) (8) | DRY BULB TEMPERATURE (Nearest °C) (8) | DEW PT. TEMPERATURE (Nearest °C) (9) | WIND DIRECTION FROM (10's of Degree True) (10) | WIND SPEED (Knots) (11) | WIND CHARACTER | ALTIMETER SETTING (Inches) | CLOUDS/OBSCURING PHENOMENA (Type, Opacity in Tenths) | TOTAL CLOUD (Tenths) (12) | REMARKS | PRESSURE TENDENCY | ALTIMETER SETTING No 1 (Inches) | ALTIMETER SETTING No 2 (Inches) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

# DISPLAY OF KULLUK KEY RESPONSE INFORMATION




| | |
|---|---|
| HEADING (STERN) | 340° |
| WIND SPD (KTS) | 17 |
| WIND DIRN (DEG) | 201 |
| CURRENT (KTS) | .06 |
| CURRENT DIRN (DEG) | 150 |
| SIG WAVE HT (m) | 1.2 |
| OFFSET (m) | 0.6 |
| OFFSET DIRN (DEG) | 170 |
| VESSEL TILT (DEG) | 0.2 |
| TILT DIRN (DEG) | 042 |
| HEAVE (m) | 0.3 |
| GLOBAL LOAD (TONNE) | 150 |
| G. LOAD DIRN (DEG) | 355 |
| LINE WITH NAX TENSION | 6 |
| MAX. LINE TENSION | 255 |




| LINE # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CURRENT | 182 | 175 | 124 | 197 | 190 | 255 | 248 | 253 | 182 | 204 | 197 | 190 |
| MAXIMUM | 196 | 206 | 150 | 199 | 205 | 260 | 248 | 253 | 208 | 216 | 225 | 242 |
| PRETENSION | 200 | 210 | 218 | 240 | 260 | 260 | 260 | 255 | 235 | 229 | 233 | 254 |

G6439-0691S3

FIGURE 13

B-1035

COPY DISTRIBUTION
1 — WHITE - CALGARY OFFICE
2 — YELLOW - TUK BASE
3 — PINK - ORIGINATOR

# BeauDril (1987) Partnership Limited

TABLE 8

## OFFSHORE ENVIRONMENTAL OBSERVATIONS PART II — SEA

DATE ________ YEAR MONTH DAY

LATITUDE ________

LONGITUDE ________

VESSEL ________ CALL SIGN ________ WELLSITE ________ OBSERVER(S) ________

| TIME GMT MINUS HOURS | SEA SURFACE TEMPERATURE (123) IDENTIFIER 1 = MINUS SIGN | SEA SURFACE TEMPERATURE (123) MINUS SIGN DEGREES C | WIND WAVES 1 = WAVE BUOY 2 = VISUAL | WIND WAVES PERIOD (SEC) (120) | WIND WAVES SIG. HEIGHT (HALF METRES) | WIND WAVES SIG. HEIGHT (METRES) (122) | SWELL DIRECTION FROM IDENTIFIER | SWELL DIRECTION FROM FIRST SET | SWELL DIRECTION FROM SECOND SET | SWELL FIRST SET IDENTIFIER | SWELL FIRST SET PERIOD (SEC) | SWELL FIRST SET SIG. HEIGHT (HALF METRES) | SWELL FIRST SET SIG. HEIGHT (METRES) | SWELL SECOND SET IDENTIFIER | SWELL SECOND SET PERIOD (SEC) | SWELL SECOND SET SIG. HEIGHT (HALF METRES) | SWELL SECOND SET SIG. HEIGHT (METRES) | ICE ACCRETION CODE | REMARKS | HELIDECK VERTICAL MOTION (METRES) | CURRENT METERS AT ___ m DEPTH SET (°T) TOWARDS (101) | CURRENT METERS AT ___ m DEPTH SPEED (cm/sec) (100) | CURRENT METERS AT ___ m DEPTH SET (°T) TOWARDS (103) | CURRENT METERS AT ___ m DEPTH SPEED (cm/sec) (102) | CURRENT METERS AT ___ m DEPTH SET (°T) TOWARDS (105) | CURRENT METERS AT ___ m DEPTH SPEED (cm/sec) (104) | SHIP MOTION HEADING (DEG TRUE) | SHIP MOTION ROLL (DEGREES) (124) | SHIP MOTION PITCH (DEGREES) (125) | SHIP MOTION HEAVE (METRES) (133) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |
| | 0 | | 1 2 | | | | 3 | | | 4 | | | | 5 | | | | 6 | | | | | | | | | | | | |

B-1036

COPY DISTRIB[illegible]
1 – WHITE - C[illegible] OFFICE
2 – YELLOW - [illegible]ASE
3 – PINK - ORIGINATOR

# BeauDril (1[illegible]7) Partnership Limited

TABLE 9

## OFFSHORE ENVIRONMENTAL OBSERVATIONS PART III — ICE

DATE ________ YEAR MONTH DAY

LATITUDE ________ LONGITUDE ________ VESSEL ________ WELLSITE ________ OBSERVER(S) ________

| TIME | | | ICE COVER | | | THICKEST ICE | | | | SECOND THICKEST | | | | THIRD THICKEST | | | | OTHER ICE | | | | | | | | RIDGE HEIGHTS | | | ICE DRIFT | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT MINUS HOURS | GMT | A.E.S. ICE CODE PREFIX | TOTAL (210) | IN STRINGS (211) | THICKNESS OF THICKEST ICE TYPE (228) | CONCENTRATION (212) | TYPE (220) | FLOE SIZE (213) | MELT STAGE (214) | IDENTIFIER | CONCENTRATION (215) | TYPE (216) | FLOE SIZE (217) | IDENTIFIER | CONCENTRATION (218) | TYPE (219) | FLOE SIZE (220) | IDENTIFIER | THICKEST TYPE (1/10 COVER (221) | REMAINING TYPE (222) | IDENTIFIER | RAFTING (223) | RIDGES/HUMMOCKS (224) | SNOW COVER (225) | SNOW DEPTH (226) | IDENTIFIER | MEAN HEIGHT (227) | EXTREME HEIGHT (228) | IDENTIFIER | DIRECTION TO (decadegrees T) (202) | SPEED (knots) (201) | REMARKS |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |
| | | I C E O B | | | | | | | | 2 | | | | 3 | | | | 4 | | | 5 | | | | | 6 | | | 9 | | | |

FIGURE 15

# SEASONAL ICE THICKNESSES

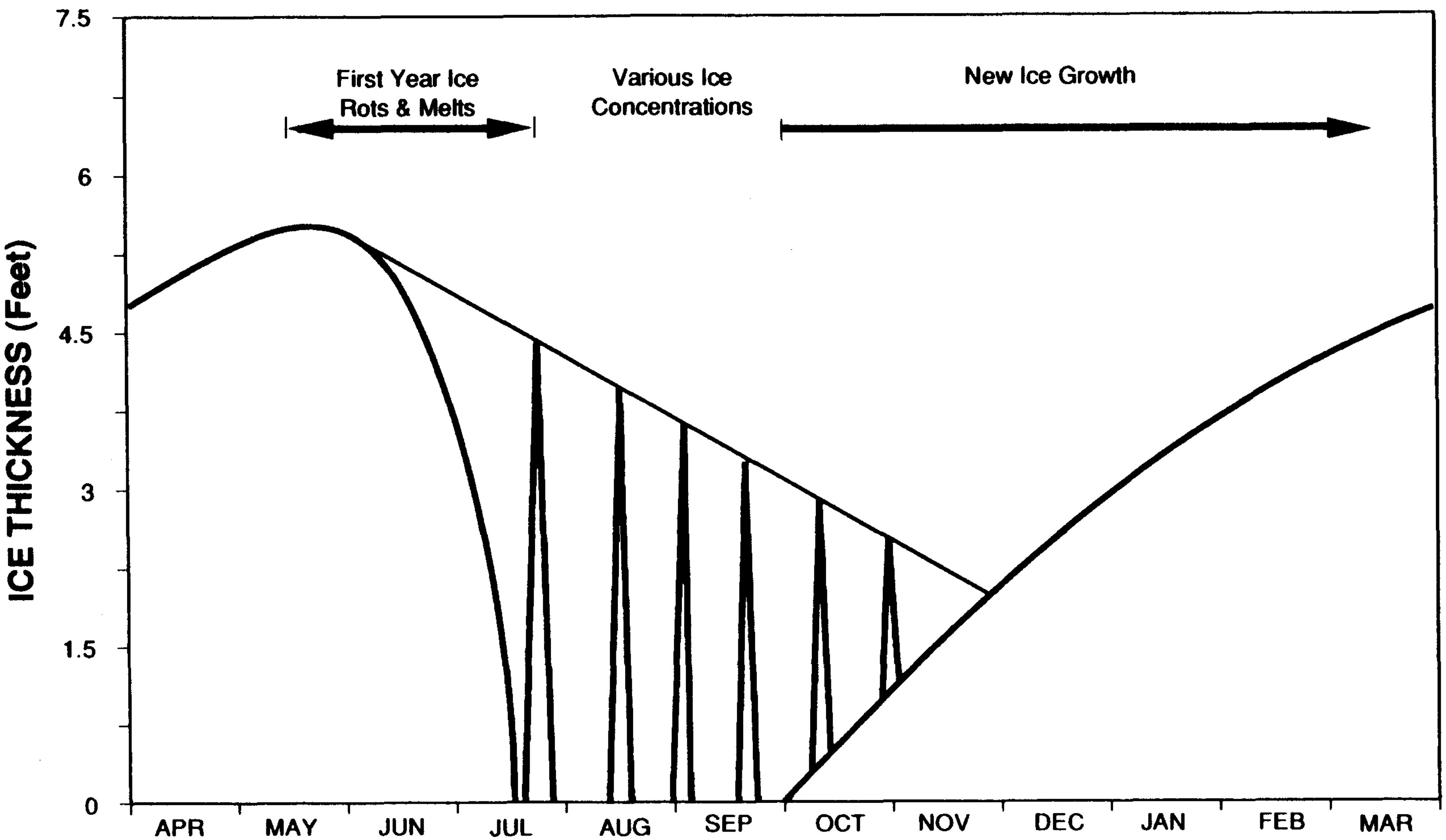


TABLE 1

# DRILLING UNIT DIMENSIONS & SPECIFICATIONS

## PRINCIPAL DIMENSIONS AND CAPACITIES

| | | | |
|---|---|---|---|
| (a) | Hull | | |
| | Hull Depth | 60.69 ft | (18.50 m) |
| | Radius at pump deck (+ 5.0 m) | 97.93 ft | (29.85 m) |
| | Radius at storage deck (+ 10.0 m) | 103.35 ft | (31.50 m) |
| | Radius at main deck (+ 18.5 m) | 132.87 ft | (40.50 m) |
| | Radius of moon pool | 13.12 ft | (4.00 m) |
| (b) | Draft/Displacement | | |
| | Lightship | 26.3 ft/19,300 ton | ( 8.0 m/17 510 tonnes) |
| | Minimum operating | 32.8 ft/25,904 ton | (10.0 m/23 500 tonnes) |
| | Maximum operating | 41.0 ft/35,825 ton | (12.5 m/32 500 tonnes) |
| (c) | Performance | | |
| | Water Depth | 60 ft - 600 ft | (18.3 - 183 m) |
| | Drilling Depth | 20,000 ft | (6 100 m) |
| (d) | Helicopter Deck Capacity | | |
| | Sikorsky S-61, Super Puma or equivalent | | |

## QUARTERS

Accomodation for 108 people maximum (minimum of 75 reserved for Contractor's people) plus adequate office space and service facilities.

KULLUK SPECIFICATIONS

Table 2

# Kulluk

## ❑ Principal Dimensions

| | |
|---|---|
| Radius @ main deck | 40. 5m (133') |
| Radius @ pump deck | 29.85m (98') |
| Hull Depth | 18. 5m (60.69') |
| Water Depth | 25 - 183m (60 - 600 ft) |
| Light Ship | 8m/17 500 tonne (26'/19,234 ton) |
| Maximum Operating | 12.5m/32 500 tonne (41'/35,832 ton) |
| Helideck | Sikorski S-61 or similar plus fueling station |
| Accommodations | Bunks for 108 people, hospital, sauna & exercise, recreation rooms |

## ❑ Major Drilling Equipment

| | |
|---|---|
| Derrick | Dreco Dynamic 48.8m (160') high with a 12.2m (40') × 12.2m (40') base load capacity of 635 tonnes (700 tons) with 14 lines |
| Drawworks | Ideco E3000 with three GE motors rated @ 940 kW each |
| Rotary Table opening | Ideco LR 495, 1 257mm (49.5") |
| Top Drive | Varco TDS-3 with one GE traction motor rated @ 940 kW |
| Motion Compensator | NL Rucker Model 18/400, 181.4 tonnes (200 tons) 5.5m (18') travel |
| Mud Pumps | Two Ideco T1600 triplex |
| Solids Control | Four Thule VSM-120 shakers, one Brandt SR-3, 3-cone desander, one Brandt SE24 24-cone desilter, one Wagner Sigma 100 centrifuge, one Thule VSM 200 mud cleaner, one Alfa-Laval AX30 mud cooler |
| Drill String | Rig equipped with adequate tubulars to drill 216 mm (8 1/2") hole to 6096 m (20,000 ft). |

## ❑ Power Plant

| | |
|---|---|
| Engines | Three Electric-Motive diesel rated 2 100 kW each @ 900 rpm, 600 volts |
| Emergency Power | One Cullen Detroit rated 650 kW |

## ❑ Storage Capacity

| | |
|---|---|
| KCl Brine | 319.5 $m^3$ (2,012 bbl) |
| Bulk Cement and Barite | A total of 13 bulk tanks capacity 608.1 $m^3$ (21 478 cu. ft) used in any configuration for bulk requirements |
| Liquid Mud | 411.2 $m^3$ (2,589 bbl) |
| Fuel | 1 603.3 $m^3$ (9,995 bbl) |
| Pipe & Casing Deck | 1 400 tonnes (1,543 tons) |
| Potable Water | 311.8 $m^3$ (1,961 bbl) |
| Drill Water | 672.0 $m^3$ (4,227 bbl) |

## ❑ B.O.P.

| | |
|---|---|
| B.O.P. Equipment | One NL Shaffer 10M, 476.25 mm (18 3/4") B.O.P.; stack with two annular and four ram type preventers 69 mPa (10,000 psi) One NL Shaffer 15M, 476.25 mm (18 3/4") B.O.P. stack, with two annular preventers 103 MPa (15,000 Psi) and four ram type preventers 102 MPa (15,000 psi) |
| Risers | 184m (600') 233mm (21") riser complete with slip joint and ball joint one complete 762mm (30") riser system complete with pin-connector and ball joints |
| Diverters | One Regan KFDS 610mm (24") One Regan KFDS 711mm (27.9") |
| B.O.P. Controls | NL Shaffer with 378.5 L fluid reservoir (100 gal) |
| Riser tensioner | Western Gear 4 @ 35,700 daN (80,000 lbs.) capacity each |
| Guide Line System | Western Gear 4 @ 1717 daN (16000 lbs.) |

## ❑ Well Testing

| | |
|---|---|
| Portatest | (1590 $m^3$/day),complete testing Suite with 2 flare booms and burners |

## ❑ Positioning

| | |
|---|---|
| Mooring System | 12 Hepburn winches with 89mm (3 1/2") × 1 147m (3,763') anchor wires a variety of Bruce/Stevpris and LWT anchors from 15 tons to 9 tons to provide adequate mooring for most bottom conditions |

## ❑ Auxiliary Equipment

| | |
|---|---|
| Cranes | Three Liebherr 65 tonne @ 9.14m (30') |
| Fork Lift | Toyota electric |
| Re-position | Honeywell RS 904 |

## ❑ Special Features

| | |
|---|---|
| Ic e Standards | Built to Canadian Arctic Shipping Pollution Prevention Act Class IV |
| Cathodic Protection | Englehard 7 Goodall |
| 28" Riser System | Built to negate the need to underream in the 26" hole section |
| Glory Hole Bit | 7.32 m (24 ft.) diameter bit capable of drilling a glory hole and setting a 12 m deep steel caisson in one pass |

KALVIK SPECIFICATIONS

Table 3

## Ship's particulars

BeauDril

### ❑ General Information

| | |
|---|---|
| Designed by: | German and Milne Inc. |
| Built By: | Burrard Yarrows Corporation (Victoria) Division |
| Delivered: | July 22, 1983 |
| Official Number: | 803564 |
| Call Sign: | VY 9403 |
| Flag: | Canadian |
| Port of Registry: | Vancouver, B.C. |
| Type: | Ice-breaker, Anchor-handling, Supply, Tug |
| Arctic Capability Rating: | CASPPR Arctic Class 4 |
| Lloyd's Class: | 100AI Ice-Breaker, Tug |
| Berths Total: | 34 |
| Crew: | 19 |
| Helideck: | Can handle up to Bell 214 ST (with skids) |

### ❑ Dimensions

| | |
|---|---|
| Length O.A.: | 88 m |
| Length B.P.: | 75 m |
| Breadth Extreme: | 17.82 m |
| Depth Moulded: | To Main Deck-10 m |
| Draft: Maximum: | 8.3 m |

### ❑ Tonnage

| | |
|---|---|
| Gross Tonnage: | 4233.71 |
| Net Tonnage: | 1970 |
| Deadweight Winter Draft: | 1823.7 |
| Displacement Winter Draft: | 6820.96 |

### ❑ Deck (Loading Capacities)

| | |
|---|---|
| Deck Measurements: | 34 m x 13 m |
| Deck Cargo Capacity: | 800 tonnes |
| Bulk Barite/ Cement Capacity: | 34 m³ x 3 = 102 m³ |
| Fuel Oil: | 1919 m³ |
| Ballast Water: | 1628 m³ |
| Fresh Water: | 237.79 m³ |

### ❑ Engine

| | |
|---|---|
| Main Engine: | (4) Stork Werkspoor Diesel |
| RPM: | 600 |
| BHP: | 23,200 |
| Thrusters FWD: | Twin Wartsila Air Bubbler System (22,000 m³/Hr. ea.) |
| Thrusters AFT: | Maritime Industries (Pleuger CPP) 500 HP Fresh |
| Water Maker Capacity: | 15 tonnes/day |
| Propellers: | 2 LIPS, N.V.C.P. 4 blades |
| Bollard Pull: | Over 200 tonnes |
| Service Speed (two engines): | 13.28 knots |
| Speed (four engines): | 15.57 knots |
| Fuel Consumption Open Water: | 30 m³/day Fuel Consumption |
| Heavy Ice: | 50 - 75 m³/day |

### ❑ Deck Machinery

| | |
|---|---|
| Tugger Winches: | 2 x 15 tonne pull |
| Capstans: | 2 x 25 tonne pull |
| Towing and Work Winches: | Complete Van der Giessen electric winch package. Tow winch has a nominal brake holding capacity of 450 tonnes and is equipped with a friction rollerset. Tow wire is 1500m long. Double anchor handling winch can generate 220 tonnes line pull (at stall). Unit has a water cooled high speed brake. |
| Deck Cranes: | 2 x 5 ton SWL Hagglund (can be rigged for limited 10 ton lifts) |

### ❑ Life-saving Units

| | |
|---|---|
| Life Boat: | 37 person Watercraft Model 7.8 m |
| Rescue Boat: | Lucas Model 700D (High speed rigid bottom inflatable with 6 cylinder turbo diesel) |

Table 4

BeauDril

# Ship's particulars

## ❑ General Information

| | |
|---|---|
| Designed by: | Robert Allan Ltd. |
| Built By: | Nippon Kokan KK (NKK), Tsurumi, Japan |
| Delivered: | April 15, 1983 |
| Official Number: | 802786 |
| Call Sign: | CZ 9982 |
| Flag: | Canadian |
| Port of Registry: | Vancouver, B.C. |
| Type: | Ice-breaker, Anchor-handling, Supply, Tug |
| Arctic Capability Rating: | CASPPR Arctic Class 4 |
| Lloyd's Class: | IOOAI Ice-Breaker, Offshore Supply Ship, Ice Class IA |
| Super Berths Total: | 34 |
| Crew: | 19 |

## ❑ Dimensions

| | |
|---|---|
| Length O.A.: | 78.95 m |
| Length B.P.: | 70.0 m |
| Breadth Extreme: | 17.22 m |
| Depth Moulded: | 9.707 m |
| Draft: Arctic Class IV: | 7.532 m |
| Arctic CLass 111: | 8.11 m |

## ❑ Tonnage

| | |
|---|---|
| Gross Tonnage: | 3255.80 |
| Net Tonnage: | 1432.43 |
| Deadweight Summer: | 1898.50 |
| Displacement: | 5107.30 |

## ❑ Deck (Loading Capacities)

| | |
|---|---|
| Deck Cargo Area: | 12.7 m x 35.6 m |
| Deck Cargo Capacity: | 1000 tonnes |
| Bulk Barite/Cement Capacity: | 4 x 35.5 = 142 $m^3$ |
| Fuel Oil: | 1596 $m^3$ |
| Ballast Water: | 1146 $m^3$ |
| Fresh Water: | 152 $m^3$ |

## ❑ Engine

| | |
|---|---|
| Main Engine: | Wartsila VASA 8R32 x 4 DIESEL |
| RPM: | 750 |
| BHP: | 3725 x 4 = 14,900 |
| Thrusters FWD: | Omnithruster/Airbubbling System 1200 HP |
| Thrusters AFT: | Kamewa 800 HP |
| Fresh Water Maker Capacity: | 10 tonnes/day |
| Propellers: | 2 LIPS, CPP with Nozzle 4 blades |
| Bollard Pull: | 150 tonnes |
| Service Speed (two engines): | 12 knots |
| Speed (four engines): | 14.7 knots |
| Fuel Consumption Open Water: | 20 $m^3$/day |
| Fuel Consumption Heavy Ice: | 35 - 58 $m^3$/day |

## ❑ Deck Machinery

| | |
|---|---|
| Tugger Winches: | 2 x 12 tonne pull |
| Capstans: | 2 x 10 tonnes pull |
| Towing and Work Winches: | 2 Double Drum Towing/Anchor-Handling Winches |
| Deck Cranes: | 2 x 5 ton SWL Hydralift |

## ❑ Life-saving Units

| | |
|---|---|
| Life Boat: | 37 person Watercraft Model 7.8 m |
| Rescue Boat: | Lucas Model 700D (High speed rigid bottom inflatable with 6 cylinder turbo diesel) |

# Ship's particulars

BeauDril

## ❑ General Information

| | |
|---|---|
| Designed by: | Robert Allan Ltd. |
| Built By: | Vancouver Shipyards Co. Ltd. |
| Delivered: | June 11, 1983 |
| Official Number: | 803537 |
| Call Sign: | VY 9292 |
| Flag: | Canadian |
| Port of Registry: | Vancouver, B.C. |
| Type: | Ice-breaker, Anchor-handling, Supply, Tug |
| Arctic Capability Rating: | CASPPR Arctic Class 4 |
| Lloyd's Class: | IOOAI Ice-Breaker, Offshore Supply Ship, Ice Class IA |
| Super Berths Total: | 34 |
| Crew: | 19 |

## ❑ Dimensions

| | |
|---|---|
| Length O.A.: | 78.85 m |
| Length B.P.: | 70.0 m |
| Breadth Extreme: | 17.22 m |
| Depth Moulded: | 9.70 m |
| Draft: Arctic Class IV: | 7.53 m |
| Arctic CLass 111: | 8.11 m |

## ❑ Tonnage

| | |
|---|---|
| Gross Tonnage: | 3338.36 |
| Net Tonnage: | 1461.76 |
| Deadweight Summer: | 1940.00 |
| Displacement: | 5047.00 |

## ❑ Deck (Loading Capacities)

| | |
|---|---|
| Deck Cargo Area: | 12.7 m x 35.6 m |
| Deck Cargo Capacity: | 1000 tonnes Bulk |
| Barite/Cement Capacity: | 4 x 35.5 = 142 $m^3$ |
| Fuel Oil: | 1500 $m^3$ |
| Ballast Water: | 1018 $m^3$ |
| Fresh Water: | 143 $m^3$ |

## ❑ Engine

| | |
|---|---|
| Main Engine: | Wartsila VASA 8R32 x 4 DIESEL |
| RPM: | 750 |
| BHP: | 3725 x 4 = 14,900 |
| Thrusters FWD: | Omnithruster/Air Bubbling System 1200 HP |
| Thrusters AFT: | Kamewa 700 HP |
| Fresh Water Maker Capacity: | 10 tonnes/day |
| Propellers: | 2 LIPS, CPP with Nozzle 4 blades |
| Bollard Pull: | 150 tonnes |
| Service Speed (two engines): | 12 knots |
| Speed (four engines): | 14.7 knots |
| Fuel Consumption Open Water: | 20 $m^3$/day |
| Fuel Consumption Heavy Ice: | 35 - 58 $m^3$/day |

## ❑ Deck Machinery

| | |
|---|---|
| Tugger Winches: | 2 x 12 tonne pull |
| Capstans: | 2 x 10 tonnes pull |
| Towing and Work Winches: | 2 Double-Drum Towing/Anchor-Handling Winches |
| Deck Cranes: | 2 x 5 ton SWL Hydralift |

## ❑ Life-saving Units

| | |
|---|---|
| Life Boat: | 37 person Watercraft Model 7.8 m |
| Rescue Boat: | Lucas Model 700D (High speed rigid bottom inflatable with 6 cylinder turbo diesel) |

TABLE 10

# KULLUK DESIGN CRITERIA FOR WAVES

- MAINTAIN LOCATION AND CONTINUE DRILLING IN A 1 YEAR RETURN PERIOD BEAUFORT SEA STORM

  $H_S$ = 9 FT.
  
  $H_{MAX}$ = 18 FT.
  
  T = 8.5 SEC

- MAINTAIN LOCATION IN A SURVIVAL MODE (BIASED MOORING) IN A 100 YEAR RETURN PERIOD BEAUFORT SEA STORM

  $H_S$ = 24 FT.
  
  $H_{MAX}$ = 48 FT.
  
  T = 12.5 SEC.

- SURVIVE A 100 YEAR NORTH PACIFIC STORM WHILE UNDER TOW (STABILITY AND MAJOR STRUCTURE)

  $H_S$ = 50 FT.
  
  $H_{MAX}$ = 100 FT.
  
  T = 16 SEC.

*NOTE:* $H_S$ = SIGNIFICANT WAVE HEIGHT (AVERAGE OF THE HIGHEST 1/3RD OF THE WAVES)

$H_{MAX}$ = MAXIMUM WAVE HEIGHT (ROUGHLY TWICE THE SIGNIFICANT WAVE HEIGHT FOR LONG DURATION STORMS)

ATTACHMENT I

KULLUK ALERT SYSTEM

Note: The following text has been extracted from the BeauDril Kulluk Operations Manual, Chapter 27.

# ATTACHMENT I

## Table of Contents

## 27.8 EMERGENCY PROCEDURES

### 27.8.1 The Alert System

The purpose of an "Alert System" is to anticipate hazardous events, and assign to all concerned personnel, general pre-determined responses. It is recognized that such a system can never anticipate all the situations that may arise, nor completely outline the required responses. The intention is that the considerate formulation of certain responses will relieve on site personnel of some of the time consuming deliberations at the scene, and ensure that everyone is following consistent, and complimentary courses of action.

#### 27.8.1.a A Consideration of Hazards

For purposes of definition, the Alert System considers that all hazards which may threaten the ***Kulluk*** fall into one of three categories.

i) Environmental Hazards

These are hazards resulting from the forces of the natural environment.

ii) Well Hazards

Hazards which may result from the drilling operation such as well bore pressure, gas liberated by drilling, and well bore instability.

iii) Vessel Hazards

All hazards, other than environmental or well, which compromise the vessels stability, and/or integrity. Examples are: fire, collision, the failure of equipment essential for the conduct of safe operations, and conducting operations which require extreme vigilance such as loading heli fuel, etc.

### 27.8.2 The Color Code

A code of five colors, (green, blue, yellow, red, black), in ascending degrees of gravity, is used to define the status of the well, the vessel, the environment and adjust the response as the degree of the hazards severity changes.

By applying the color code to each one of the categories the nature and coincidence of different hazards can be recognized. This is essential as drilling operations secure procedures, and times will differ considerably when more than one hazard is influential. For example if an environmental yellow alert exists, while the well and vessel are on green, normal drilling operations might continue within the available lead time. However if the yellow environmental alert was accompanied by a yellow well alert, drilling operations would be severely restricted, or suspended until the environmental situation was less threatening.

~~Since vessel and well hazards are essentially unpredictable, the Alert System defines them in terms of present status only.~~

~~Environmental hazards can be forecast.~~ Therefore, the Alert System defines not only their present status, but also considers how they may influence operations at some point in the future. This is done in terms of Hazard Time, Secure Time and Operating Time. (Table 27.8.2)

27.8.3 Communicating The Emergency Response System

27.8.3.a The Alert Systems Board

The alert systems color code, with definitions and a brief generalized explanation of the responses required, is posted throughout the rig on a large white board entitled "***Kulluk*** Alert System."

27.8.3.b The Alert Status Level

The actual, moment to moment, alert status level for the environment, the well, and the vessel, along with the procedures and times to secure the well and vessel, is posted throughout the rig on a small white board entitled "The Alert Status Level."

Consequently, at a glance the particular status concerning all aspects of the operations is evident.

27.8.4 Response Times

27.8.4.a The Hazard Time (HT)

Hazard Time is the forecast time before the arrival of hazardous environmental conditions which will disrupt or exceed the operating capability of the ***Kulluk***.

27.8.4.b Secure Time (ST)

Secure Time is the time required to bring the ***Kulluk*** to a state in which it is ready to handle the environmental hazards, without compromising the security of the well, or the integrity of the vessels equipment.

27.8.4.c Operating Time (OT)

Once a hazard has been forecast, and the secure time determined the remaining is the time available for conducting operations, or: HT-ST=OT.

27.8.5 Secure Time

27.8.5.a Determining Secure Time

A precise consideration of "Secure Time" involves three operations, the time to secure the well, the time to disconnect from the wellhead, and the time to secure the vessel. The first operation will always be done; the second and third operations may or may not, depending on the nature of the hazard.

i) The Time To Secure the Well

The specific procedure chosen to secure the well may depend on many variables. These would include well bore stability, well bore pressure and the time anticipated that the vessel may be off location, etc.

The essential aspect of such a consideration is that the well bore is securely isolated from the natural environment.

Whether or not the hazard is environmental, well, or vessel, the well must always be rendered secure.

ii) The Time To Disconnect The Vessel

(From the seabed, or wellhead)

This operation must be done in a manner that ensures no equipment damage will occur.

The operation should ensure that the disconnect is completed in a normal manner and that emergency, or last resort procedures are not required.

This operation would only be carried out in the cases where keeping the vessel on location would compromise vessel, and/or personnel safely.

iii) The Time To Secure The Vessel

After the well is secure, and the equipment is disconnected, the vessel must be prepared to resist or accommodate the impending environmental hazard.

This operation may involve biasing the anchor system, retrieving anchors, lashing down loads etc.

Securing the vessel must not interfere with securing the well and disconnecting the wellhead equipment. Therefore, the Secure Time may be the sum of these three operations, or in the case where some portion of the vessel securing procedure is occurring simultaneously with well and disconnect operations, the Secure Time will be a smaller value than the sum.

Examples

When the Secure Time is the sum of the times to secure the well, disconnect and secure the vessel:

- The well securing procedure requires hanging off the drill string, and disconnecting the LMRP. This would take six hours.
- The vessel securing procedures require that the anchoring system be biased. This would take two hours.
- However, biasing the anchors will result in a horizontal displacement which could interfere with disconnecting the LMRP, and therefore this operation cannot commence until the LMRP is disconnected.
- The Secure time is the sum of the two operations, or eight hours.

When the Secure Time is a partial sum of the times to secure the well, disconnect and secure the vessel:

- The well securing procedures require that the drill string be hung off, and the LMRP disconnected. This would take six hours.
- The vessel securing procedures require that all twelve anchors be retrieved. This would take eight hours.
- However six anchors may be retrieved while well securing operations are taking place. This would require four hours.
- The remaining anchors cannot be retrieved without interfering with the well securing procedures. Retrieving the last six anchors would take four hours.
- Therefore the secure time is the sum of the well securing operations six hours and a partial sum of anchor retrieving operations four hours, or ten hours.

27.8.5.b Adjusting Secure Time

When the hazard is unpredictable, reliance cannot be placed on a single secure time or procedure. Therefore, Secure Times should be considered from these perspectives.

i) Optimum Secure Time

The time required to finish or undertake certain operations which would leave the well in an ideal condition, but which are not essential to well securing operations, plus the essential secure time.

Examples of non essential operations may be tripping, circulating, pulling the LMRP to surface, displacing the riser prior to disconnect, etc.

ii) Minimum Secure Time

The time required to conduct only those operations essential to securing the well, and to disconnect from the wellhead, using normal procedures.

These operations are denoted on the Alert Status board by a star (*).

iii) Emergency Secure Time

This is the time required to secure the well and disconnect from the wellhead using emergency procedures.

Such procedures are used only as a last resort.

*Note:* *In all cases, operations should be determined by the optimum Secure Time. The minimum secure time is only noted so that if the situation deteriorates more rapidly than anticipated, personnel are made aware of the procedures to be eliminated.*

27.8.5.c The Secure Time Safety Factors

For all operations the secure time used to determine the Alert Status should be the Optimum Secure Time. Since this time may already contain operations which are not absolutely essential to the securing procedure, it may have a certain "built in" safety factor. However at the Supervisor's discretion, a safety factor, to cover various contingencies can be added to the secure time. This safety factor must be individually identified on the "Alert Status" board.

27.8.6 Calculating Operating Time

i) Once hazard time has been forecast and secure time determined the time remaining is the time available for conducting operations or HT-ST = Operating Time (OT).

ii) The difference between HT and ST determines the amount of time available before a response to the hazard must begin. For example, if a large ice ridge is expected in twelve hours, and it requires six hours to properly secure the well, the following might occur.

An environmental "Yellow Alert" is declared, since by definition this is in effect any time there is six hours or less remaining in which operations may be conducted, before well securing procedures must commence.

- A calculation of Operating Time (OT) is made:
  HT - ST = OT
  12 - 6 = 6

- The ice ridge moves to within six hours of contacting the *Kulluk*, and the ST has remained at six hours.

- A calculation of Operating Time (OT) is made:
  HT - ST = OT
  6 - 6 = 0

- An environmental Red Alert is declared. Since there is no time left during which operations may be conducted, all remaining time must be used to secure the well.

27.8.7 The Time Analysis

An historical analysis of the times to complete various operations is kept, and constantly updated with each wells completion.

This analysis is used to determine the time required to complete various operations. Secure times must not be subjectively estimated.

The only significant variables involved in establishing the time required to conduct operations are weather, distance, hole conditions and equipment failure. Once these factors are considered the times to complete repetitive operations should be very consistent.

| | |
|---|---|
| Weather: | The analysis averages the times to conduct operations over years and therefore, should account for unfavorable environmental conditions. |
| Distance: | Operations conducted at different water depths, or drilled depths will obviously vary. When appropriate depths are not found in the analysis use a factor to estimate the time. For example, it would take twice as long to pull 200 m of riser as it would to pull 100 m. |
| Hole Conditions: | Open hole operations are entirely dependent upon hole conditions at the time and therefore, times must be adjusted for every case. Previous trip and drill records will assist in determining open hole operations. |
| Equipment Failure: | Most equipment that is prone to failure has redundant back-up. However, a safety factor may be added to the secure time to cover such occurrences. |

27.8.8 The Alert System Color Codes

The following is a sequential list of the alert status color codes with reference to their source, some examples, and a brief explanation of the actions they require. Hazards can occur individually, or simultaneously, in any combination of the three categories namely: the environment, the well, or the vessel. This discussion can not itemize all the situations which would be defined under the alert levels, nor can it consider the complications resulting from different alert levels in more than one category. This is left to the discretion of the personnel on the scene.

27.8.8.a An Alert Status *"Green"* means *Normal* Operations

The Environment: No environmental hazards exist, or are anticipated which may interrupt operations.

The Well: [redacted] (KT) level is on 1. The hole is stable and no well control, stuck pipe or fishing operations are anticipated.

The Vessel: The vessel is fully operational with no deficiencies. No operations which require vigilance above the level of a normal watch are taking place.

<u>The Drill Crew's Response</u>

1. An Environmental *"GREEN"* Alert
   - Restrict operations to available lead time.

2. A Well *"GREEN"* Alert
   - Apply normal drilling practice, and normal well monitoring procedures as defined by KT = 1.

3. A Vessel *"GREEN"* Alert
   - Normal drilling practices apply.

<u>The Marine Crew's Response</u>

1. An Environmental *"GREEN"* Alert
   - Maintain a normal watch.

2. A Well *"GREEN"* Alert
   - Maintain a normal watch.

3. A Vessel *"GREEN"* Alert
   - Maintain a normal watch.

27.8.8.b An Alert Status *"Blue"* means *Early Alert*

The Environment: All conditions are normal, but it is possible for an environmental hazard to develop within the time required to secure the well, disconnect and secure the vessel, plus 12 hrs. ST + 12hrs

The Well: The [redacted] is on Level II and/or; incidental well bore instability, which requires attention, has been detected.

The Vessel: Vessel stability and integrity is adequate to conduct drilling operations.
Minor equipment has failed, or is being repaired.
Boats are along side and loading operations are taking place.
Vessel movement is appreciable but does not significantly interfere with operations.

<u>The Drill Crew's Response</u>

1. An environmental *"BLUE"* Alert
   - Restrict operations to available lead time.

---

* Kick Tolerance refers to a system derived by BeauDril that may be replaced by the operator's criteria.

2. A Well *"BLUE"* Alert

- Increased vigilance in well monitoring procedures ~~as defined under Kick tolerance~~ Level II.
- Implement drilling operations as necessary to rectify or accommodate well bore problems.

3. A Vessel *"BLUE"* Alert

- Normal operations with allowances for minor equipment malfunctions, vessel movement and loading operations.

<u>The Marine Crew's Response</u>

1. An Environmental *"BLUE"* Alert

- Maintain a normal watch.

2. A Well *"BLUE"* Alert

- Maintain normal watch.

3. A Vessel *"BLUE"* Alert

- Maintain a normal watch.

27.8.8.c An Alert Status *"Yellow"* means *Early Secure Warning*

The Environment: There is less than six hours remaining in which operations may be conducted, before well securing procedures must commence. ST + 6 hrs

The Well: ~~Kick Tolerance~~ is on Level III and/or; well bore stability is tenuous and remedial work is constantly taking place.

The Vessel: Major equipment which will affect operations but not jeopardize safety has malfunctioned.
Loading heli fuel, fuelling choppers or other operations which require extreme vigilance are taking place.
Vessel movement requires that operations be conducted with extreme caution.

<u>The Drill Crew Response</u>

1. An Environmental *"YELLOW"* Alert

- Drilling operations are restricted to available lead time.
- Determine the method by which the well will be secured and make all the required preparations.

2. A Well *"YELLOW"* Alert

- Drilling operations are restricted ~~as defined under Kick tolerance Level 3~~, to enhance well monitoring procedures and avoid stuck pipe.

  Refer to Chapter 12, General Drilling Procedures. Consideration may be given to setting casing.

3. A Vessel *"YELLOW"* Alert

- Operations are restricted to accommodate equipment malfunctions, vessel movement or potentially hazardous operations such as heli fuel transfers, etc.

<u>The Marine Crew Response</u>

1. An Environmental *"YELLOW"* Alert
   - Maintain an "alert watch".
   - Begin preparations for the "Hazards" arrival.

2. A Well *"YELLOW"* Alert
   - Maintain an "alert watch".

3. A Vessel *"YELLOW"* Alert
   - Maintain an "alert watch".
   - Restrict operations as required to accommodate equipment malfunctions, vessel movement, and potentially hazardous operations.

27.8.8.d Alert Status *"Red"* means a *Hazard Is Imminent* 5T + 0hrs

| | |
|---|---|
| The Environment: | There is no time left in which operations may be conducted. All remaining time available must be used to secure the well and the vessel. |
| The Well: | Well control procedures are in effect. Tubulars are stuck in the hole. |
| The Vessel: | Equipment essential to the conduct of safe operations has failed.<br>The stability, or integrity of the vessel has been compromised.<br>Fire, or collision has occurred.<br>Vessel movement is beyond the operating criteria. |

<u>The Drilling Crew Response</u>

1. An Environmental *"RED"* Alert
   - Cease all drilling operations, and secure the well.
   - Standby to disconnect, or disconnect from the wellhead, as required.

2. A Well *"RED"* Alert
   - Control the well as required.
   - Conduct fishing operations as required.
   - Continually advise Marine as to severity of situation.

3. A Vessel *"RED"* Alert:
   - Cease all drilling operations and secure the well.
   - Standby to disconnect, or disconnect from the wellhead as required.
   - Standby to assist marine crews as required.

<u>The Marine Crews Response</u>

1. An Environmental *"RED"* Alert
   - Secure the vessel.

2. A Well *"RED"* Alert
   - Maintain a standby watch.
   - Assist drill crews as required.
   - Prepare to evacuate non essential personnel or take the vessel off location if kick severity requires.

3. A Vessel *"RED"* Alert
   - Maintain a standby watch.
   - Secure the vessel as required.

27.8.8.e An Alert Status "Black" Means a Hazard Has Compromised Personnel Safety, and/or Vessel Integrity.

| | |
|---|---|
| The Environment: | An extreme hazard is imminent. |
| Ice: | The resultant forces will exceed the mooring systems capacity and the *Kulluk* must move off location. |
| Weather Waves: | The forces will exceed the station keeping ability of the *Kulluk*. |
| The Well: | Control of the Well has been lost. Well bore pressure has exceeded equipment limitations. |
| The Vessel: | Control over the stability, or integrity of the vessel has been lost, with the consequence that personnel safety is seriously jeopardized. |

<u>The Drill Crew's Response</u> $ST_{AVAILABLE} < ST_{OPTIMUM}$

1. An Environmental *"BLACK"* Alert
   - Suspend all operations, secure the well, and disconnect from the wellhead by the most immediate means.
   - Secure all pipe deck loads.
   - Secure pipe racked in derrick.
   - Assist Barge as required.

2. A Well *"BLACK"* Alert
   - Suspend all operations by the fastest means possible and take the vessel off location or evacuate as required.

3. A Vessel *"BLACK"* Alert
   - Suspend the well by the most immediate means possible and evacuate the vessel.

<u>The Marine Crew's Response</u>

1. An Environmental *"BLACK"* Alert
   - Disconnect anchors, or bias the mooring system as required. - Evacuate personnel if required.

2. A Well *"BLACK"* Alert
   - Evacuate personnel or take the vessel off location, as required.

3. A Vessel *"BLACK"* Alert
   - Evacuate personnel

27.8.9 Using the Alert system to Determine Operations

27.8.9.a Introduction

*The Hazard Time cannot be changed to accommodate the Secure or Operating times.* However operating and well securing procedures may be changed to accommodate the hazard times. This is vital in cases where the hazards action cannot be accurately forecast. By adjusting the Operating and Secure Times, the Alert System allows the flexibility required to operate safely when confronted with an unpredictable environmental hazard.

27.8.9.b Adjusting Operating Time and Secure Procedures

In cases where operating time exceeds available lead time, operations may be carried out incrementally to remain within the lead time.

Example: The Operation is running casing.

- An ice feature is stable but with an anticipated weather change would threaten the ***Kulluk*** within 25 hrs.
- The total casing and cement job requires 30 hrs, HT = 25 hrs.
- It is decided that the secure procedure would be to hang the casing and close the shear rams. This would take three hours.
  HT - ST = OT
  20 - 3 = 17

From this, it is determined that adequate time to complete the operation is not available. However, since the ice feature could remain in the static condition for days, it is decided to run the casing. The job is divided into increments each of which can be completed within the available lead time, leaving adequate time to secure the well in every case. In other words each individual operation along with its secure time, must remain under 25 hrs. The following operational analysis along with Secure Times is made.

27.8.9.c The Decision Process

Are the means used to secure the well acceptable to the operator in each case.

A decision is made that leaving uncemented casing in open hole is not acceptable, but that running the seal assembly may be omitted.

The casing running operations begins:

After each step is completed the HT Time is re-evaluated to ensure that lead time is available to complete the next step.

Casing is run to the shoe. This is a critical decision point. From here it would be 21 hrs before the casing was cemented and the well secure.

- If the HT is still adequate the job would continue.
- If conditions have deteriorated and the HT is no longer adequate then the job would be suspended.

27.8.10 Responsibilities

27.8.10.a The Operator

Will determine the alert status level of the well, the means by which the well will be secured, and advise the on duty Drilling Supervisor accordingly.

Will consult with the on duty Rig Superintendent to determine the secure times.

Will ensure that the concerns of government agencies, and regulatory bodies in reference to a suspended well are met.

27.8.10.b The On Duty Rig Superintendent

Will consult with the Operator to determine the well alert status level, the mean by which the well will be secured and the time required.

Will consult with the Marine Supervisor to ensure that operations are being conducted within the available lead time, to determine the "Vessel Alert" status, an the procedures required to secure the vessel.

Will ensure that at all times the drill crews are aware of the alert status level and its consequences, and prepared to implement the appropriate secure procedure.

Will continuously update the Alert Status Board in terms of the Well Alert Status, the operations and time to secure the well and disconnect the vessel from the wellhead or seabed.

*Note: The on duty Rig Superintendent is the only person authorized to determine secure procedures and secure times.*

27.8.10.c The Marine Superintendent

Will continuously determine the "Environmental Alert" status, the Hazard Times, and the procedures required to secure the vessel, and immediately inform the on duty Drilling Supervisor of any changes in status.

Will consult with the on duty Rig Superintendent and Maintenance Superintendent to determine the "Vessel Alert" status.

Will continuously update the Alert Status Board in terms of the environmental alerts, and procedures to secure the vessel.

*Note: The Marine Superintendent, or his designate, is the only person authorized to determine the environmental alert status.*

TABLE 27.8.2

| ALERT STATUS | INTERPRETATION | HAZARDS SOURCE | ALERT STATUS | DRILLING RESPONSE | MARINE RESPONSE |
|---|---|---|---|---|---|
| GREEN | NORMAL OPERATIONS | ENVIRONMENT | HT IS MORE THAN 12 HOURS | RESTRICT OPERATIONS TO AVAILABLE LEAD TIME | NORMAL WATCH |
| | | WELL | KT IS ON LEVEL I | NORMAL WELL MONITORING AS PER KT = I | |
| | | VESSEL | ALL EQUIPMENT FULLY OPERATIONAL | NORMAL DRILLING OPERATIONS | |
| BLUE | EARLY ALERT | ENVIRONMENT | HT-ST IS LESS THAN 12 HOURS | RESTRICT OPERATIONS TO AVAILABLE LEAD TIME | NORMAL WATCH |
| | | WELL | KT IS ON LEVEL II | INCREASE WELL MONITORING VIGILANCE AS PER KT = II | |
| | | VESSEL | MINOR EQUIPMENT MALFUNCTION | NORMAL DRILLING OPERATIONS | |
| YELLOW | EARLY WARNING | ENVIRONMENT | HT-ST-ET IS LESS THAN 6 HOURS | RESTRICT OPERATORS TO AVAILABLE LEAD TIME | PREPARE FOR HAZARDOUS ARRIVAL |
| | | WELL | KT IS ON LEVEL III. GAS LEVELS HIGH | RESTRICT DRILLING TO ENHANCE WELL MONITORING AS PER KT-III | ALERT WATCH |
| | | VESSEL | MAJOR EQUIPMENT MALFUNCTION. PROCEDURES REQUIRE VIGILANCE BEING CONDUCTED | RESTRICT DRILLING OPERATIONS AS REQUIRED | |
| RED | HAZARD PRESENT | ENVIRONMENT | HT-ST IS 0 OR LESS | STOP OPERATIONS AND SECURE WELL AND DISCONNECT | SECURE VESSEL |
| | | WELL | WELL CONTROL OPERATIONS IN EFFECT | CONTROL WELL, AND ADVISE BARGE AS TO DEGREE OF KICK SEVERITY | SECURE VESSEL STANDBY WATCH |
| | | VESSEL | ESSENTIAL EQUIPMENT MALFUNCTION<br>VESSEL STABILITY OR INTEGRITY COMPRISED | STOP OPERATIONS, AND SECURE WELL | SECURE VESSEL |
| BLACK | HAZARD THREATENS PERSONNEL SAFETY AND/OR VESSEL STABILITY AND INTEGRITY | ENVIRONMENT | HAZARD IS EQUAL TO OR LESS THAN<br>VESSEL SECURE TIME & EVAC. TIME | USE EMERGENCY PROCEDURES TO SECURE WELL IF NECESSARY | EVACUATE PERSONNEL |
| | | WELL | CONTROL OF WELL IN DANGER OF, OR<br>HAS BEEN LOST | USE EMERGENCY PROCEDURES TO SECURE WELL | |
| | | VESSEL | VESSEL STABILITY, OR INTEGRITY IN DANGER OF, OR HAS BEEN LOST | USE EMERGENCY PROCEDURES TO SECURE WELL | |

KULLUK ALERT STATUS SYSTEM

# ATTACHMENT II

# ICE MANAGEMENT SYSTEM

for the

KULLUK

at

KUVLUM

# ATTACHMENT II

## Table of Contents

## 1.0 KULLUK ICE MANAGEMENT SYSTEM

### 1.1 General

In most ice conditions, ice management support is required to increase the efficiency and safety of drilling operations from KULLUK . This support is provided by BeauDril's Arctic Class IV icebreaking vessels which play a key role in drilling operations from KULLUK.

KULLUK, with no icebreaker support, has been designed to withstand 4 ft. of level ice with its twelve line mooring system deployed. However, it is well known that during break-up, summer ice intrusions, and early winter conditions, various features within the ice cover will be encountered which exceed this design capacity.

During towing operations, ice management support is also required, particularly in thicker ice and ridge conditions where the resistance of KULLUK is quite high. In these conditions, the use of specific ice management strategies reduces KULLUK's resistance and increases the efficiency of towing operations.

### 1.2 Ice Management

The requirement for ice management and the resultant effects on operational efficiency are schematically shown in Table 1.2. During operations, BeauDril continually evaluates the suitability of applied ice management techniques in real time with KULLUK's performance monitoring instrumentation. This instrumentation provides immediate information on the global ice load and anchor line tensions as an indicator of ice management effectiveness. The most effective ice management strategies in terms of global ice load and line tension reductions have been documented in the form of recommended ice management guidelines which are used during stationkeeping and towing operations. In most circumstances, breaking the ice that moves towards the drilling unit reduces the ice forces it experiences, thus reducing KULLUK's motions and the tensions in its mooring lines. However, because the effect of various icebreaking patterns and ice/KULLUK interactions are different, specific ice management techniques are considered optimal in given ice situations. The basic incentives for the use of these specified ice management techniques are:

1.2.1 to reduce the ice loads from potential ice hazards experienced by KULLUK and accordingly, reduce KULLUK displacements and line tensions and increase drilling efficiency;

1.2.2 to enhance the clearance at large ice pieces around KULLUK and allow it to do significant icebreaking on its own;

1.2.3 to reduce the amount of vessel icebreaking carried out to achieve the required level of ice management support and reduce vessel fuel consumption;

1.2.4 to reduce the ice resistance on KULLUK while under tow and improve its transit efficiency.

1.2.5 to avoid inappropriate ice management strategies that could result in more severe ice forces on KULLUK .

For example, excessive icebreaking during the ice management process in first-year ice encourages rafting and ridging on the upstream side of KULLUK , amplifies ice forces and, given continued icebreaking in the drilling area, creates significantly thicker rubble ice around the unit. This ice rubble increases loads on KULLUK and reduces the transiting and maneuvering effectiveness of the support vessels around it. Several examples of more effective ice management strategies to support stationkeeping and towing operations are shown in Figures 1.2 (1), 1.2 (2), 1.2 (3).

## 1.3 Communication and Responsibilities

It is important to recognize that good communication between the ice management vessels and KULLUK is essential when ice management is underway since unmanaged ice features or unexpected ice interactions can lead to high, rapidly applied loads on KULLUK. Ice management is conducted under the guidance of the Marine Superintendent, Icebreaker Masters and Environmental Advisors as shown in Table 1.3 below.

TABLE 1.2

## ICE MANAGEMENT LOGIC

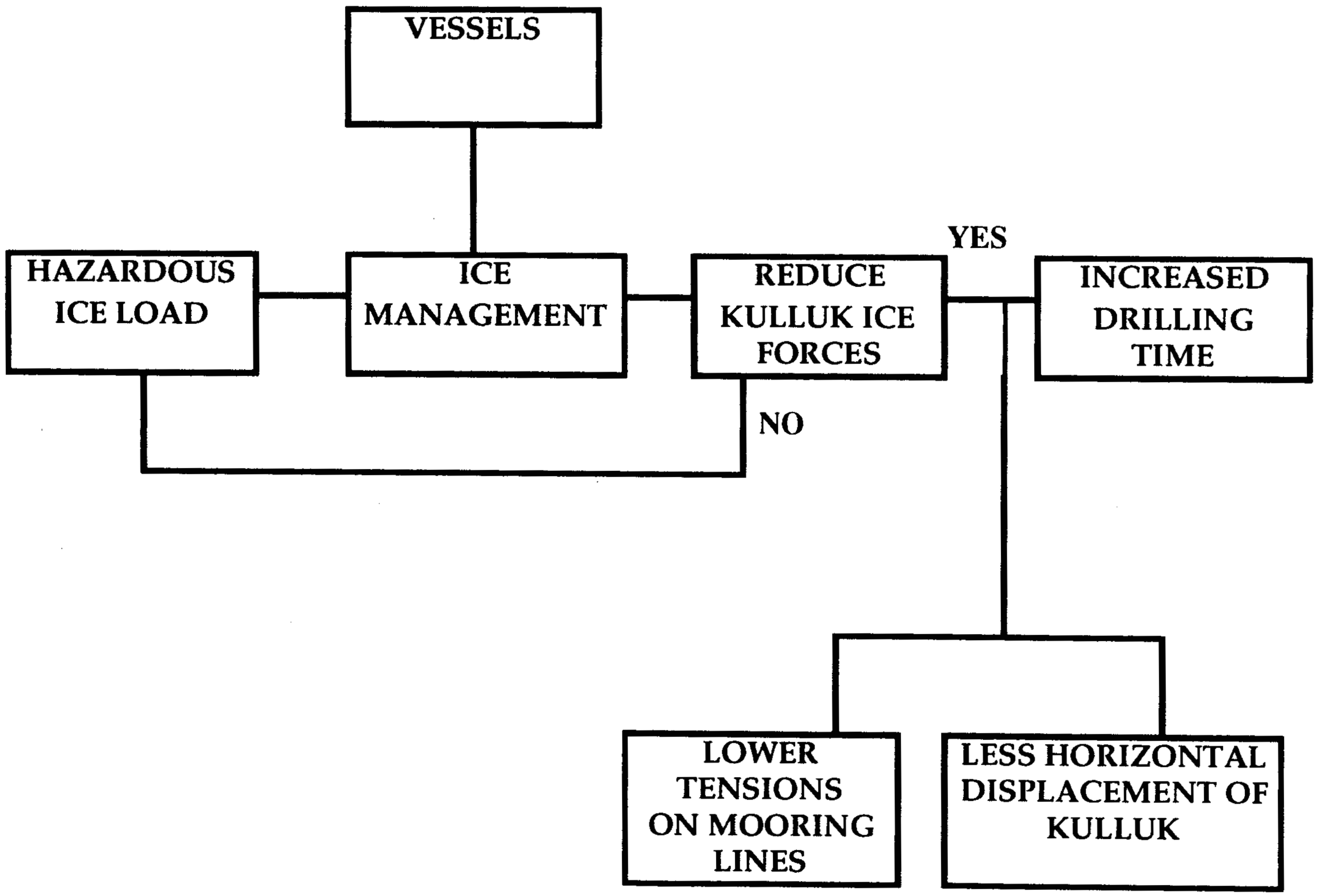
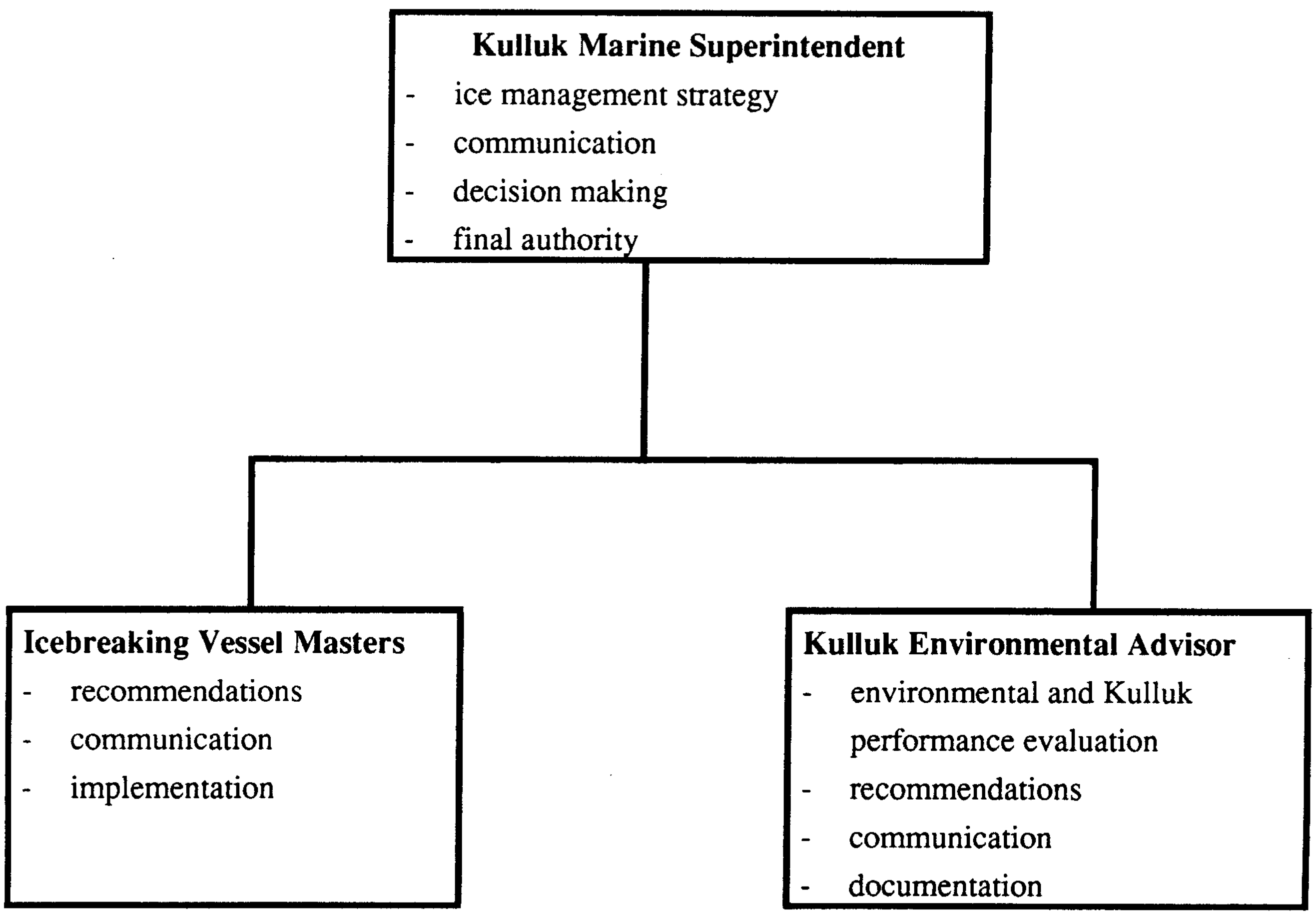
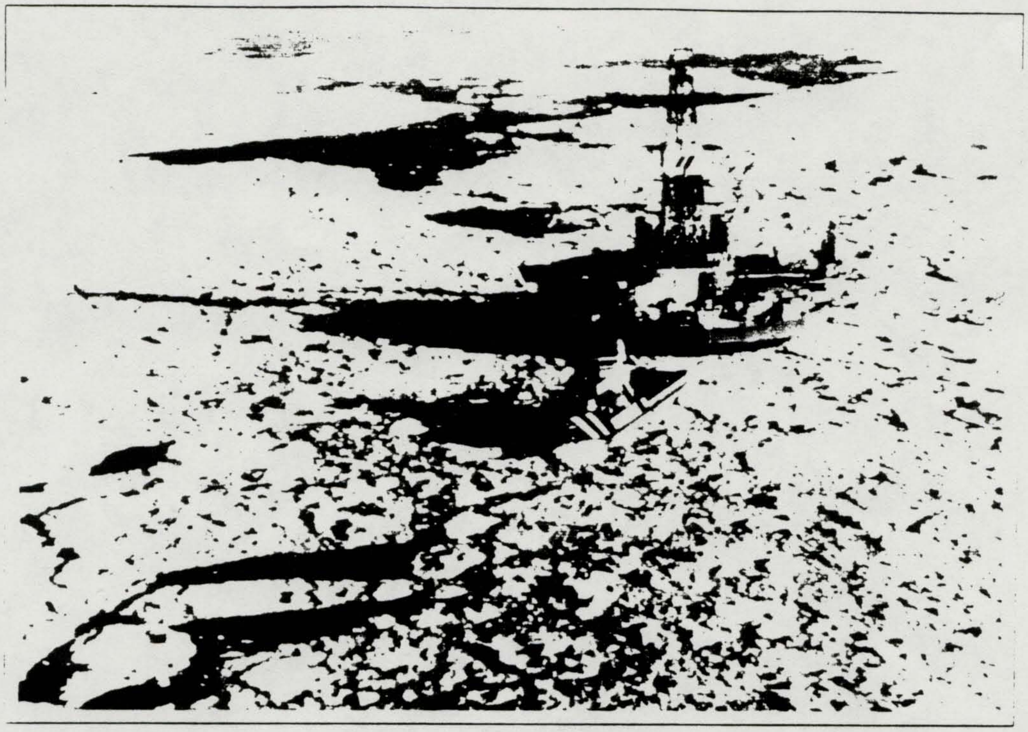
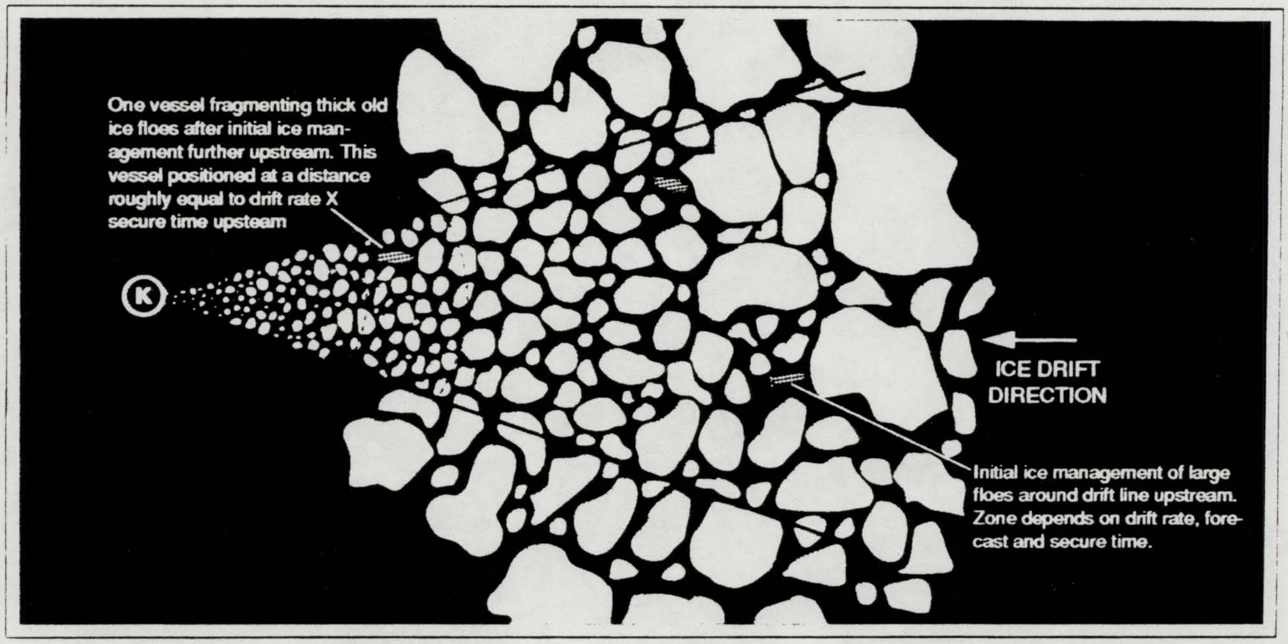


**TABLE 1.3**

# ICE MANAGEMENT RESPONSIBILITIES



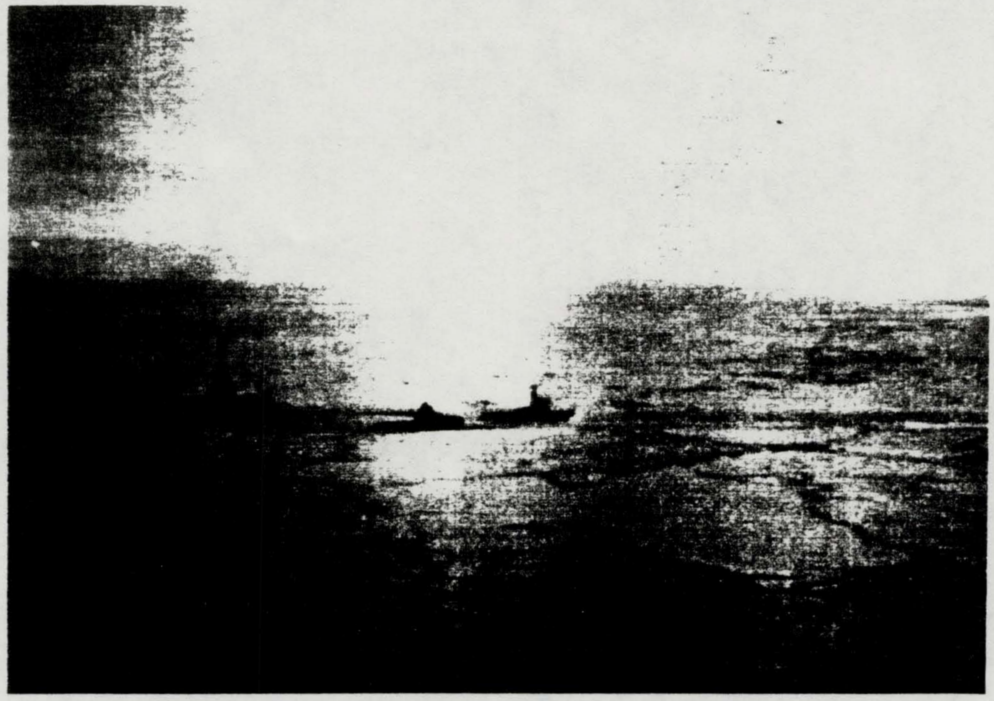


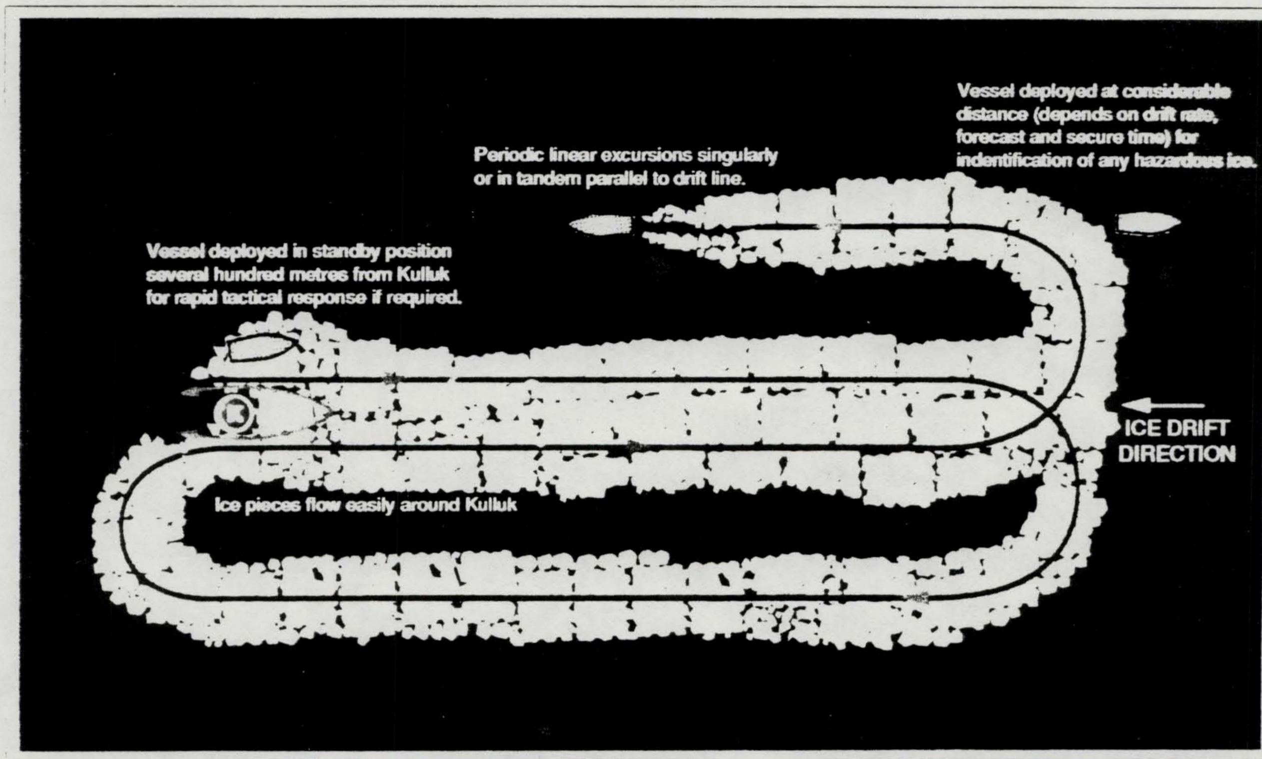



The ice management system usually used in old ice conditions. With an evironmental monitoring capability in place, the general ice cover and hazardous features within the sector of actual and forecasted ice movement are continually known. The icebreakers are deployed in a sector centered along the "ice drift line" at certain distances upsteam. Here, they fragment the approaching ice into smaller pieces roughly 50 to 100 m in extent so that potential impact loads on the Kulluk are acceptable. Typically, the two most powerful icebreakers are positioned further upstream to break larger floes into moderately sized pieces, An icebreaking supply vessel is positioned at a nearer distance equivalent to the well secure time times the ice encroachment speed and fragments these moderately-sized, partially-managed ice floes into smaller pieces. This ice management system is closely related to the alert procedure since hazardous ice floes not manageable by the icebreakers and then the supply vessel are identified in a timely manner, allowing a smooth transition for Kulluk drilling operations from yellow to red alert status.

G6290-0491S1

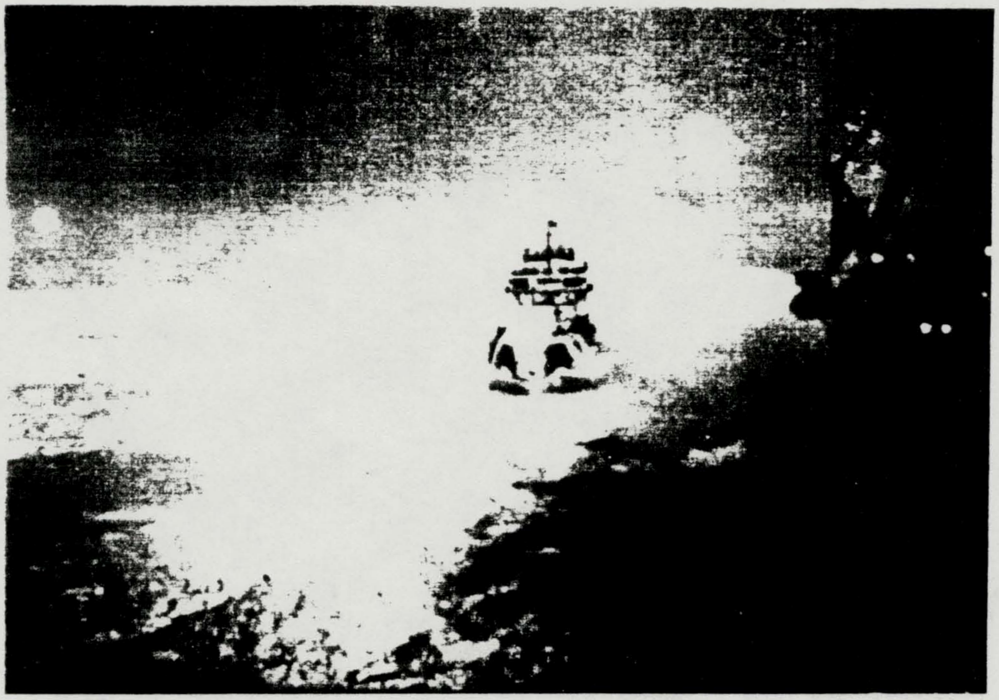
FIGURE 1.2 (1)

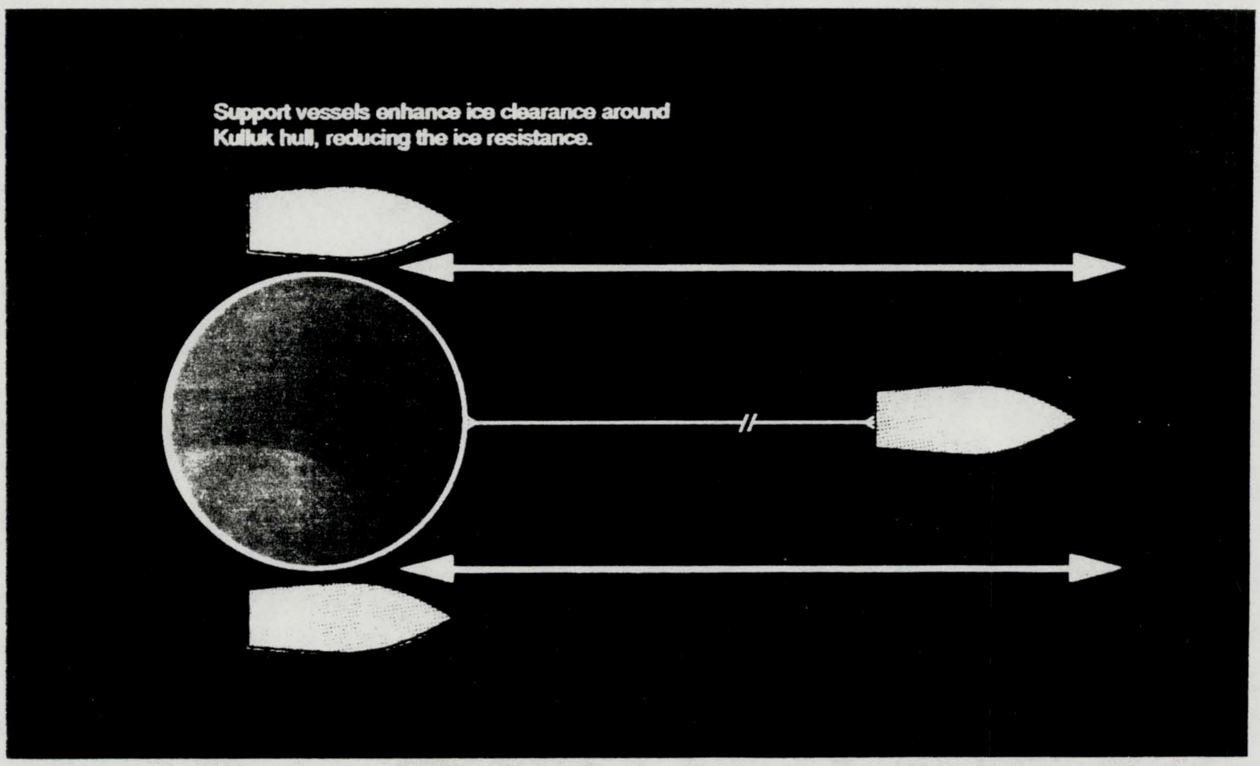





The most effective technique in relatively thin ice is to have the ships proceed at high speed along lines parallel to the ice drift direction on a periodic basis. The vessel's wake waves propagate into and induce flexural failure in the surrounding ice cover, resulting in ice platelets in the 5 - 10 m diameter range. These platelets smoothly flow around the Kulluk and result in very low loads on the system

FIGURE 1.2 (2)






Ice management is important in supporting early winter towing operations. The best strategy for the towing operation involves the deployment of two vessels close to the port and starboard quarters of the Kulluk to enhance the flow of ice pieces around it

FIGURE 1.2 (3)

# ATTACHMENT III

## EMERGENCY WELL SUSPENSION
## for the
## KULLUK
## at
## KUVLUM

*NOTE: The following text has been extracted from the BeauDril Kulluk Operations Manual, Chapter 27.*

# ATTACHMENT III

## Table of Contents

# ATTACHMENT III

## Table of Contents

## 27.9 EMERGENCY DISCONNECT FROM ANCHORS (BLOWOUT)

In the unfortunate event of an uncontrollable blowout, the ***Kulluk*** will be moved from the well site with the utmost speed. This is done primarily to avoid or minimize serious hazards such as fire, explosion, poisonous gases or loss of buoyancy, and secondly, to ensure that the ***Kulluk*** is not damaged and so can be used for relief well operations.

### 27.9.1 Possible Local Environmental Conditions at the Time of a Blowout

In Open Water: Static conditions.
Wind and/or current at the drill site.
Adverse weather (storm conditions).

In Ice: Static conditions.
Ice drift.
Ice under pressure.

### 27.9.2 Contingency Plan

The ***Kulluk*** can leave the location in three different ways:

- Heave itself off location.
- Be towed away from location.
- Use wind and current to drift or swing off location.

The three methods are listed in order of preference.

#### 27.9.2.a Abandonment, Open Water, Static Conditions

Since there is no wind or current, the direction of abandonment should be based on wind and weather *forecasts*. The intent then is to stay up wind of the well site.

Method: Slacken down nine anchor wires to a maximum of 100 tonnes tension. The remaining three anchors should be in the direction of abandonment.

- Release the nine slackened anchor wire RARs and heave them in to within 10 m below the fairleads.
- Heave the rig off location with the remaining three anchor wires.
  <u>Time required 1-1/2 to 2 Hours</u>
  If time does not allow for abandonment as described above, use the following method:
- Actuate the emergency brake release system and let the wires run off the drums for the nine winches, decided upon by the weather forecast.
- Heave the rig off location with the remaining three anchor wires.
  <u>Time Required 30 Minutes</u>
- If power to the anchor winches is not available, connect the towing vessel, actuate the manual emergency brake releases, run all the wires off the drums and tow the rig away from the well site.

#### 27.9.2.b Abandonment, Open Water, With Wind and/or Current

The direction of abandonment is 40° to the right of the current and/or wind direction. In the event where wind and current come from different directions, a vector diagram will be made and the resultant will be taken as the direction of the acting force.

Method: Slacken down nine anchor wires to a maximum of 100 tonnes tension. The remaining three anchors should be in the direction of abandonment.
Release the nine anchor wire RARs and heave them into within 10 m below the fairleads.

- Heave the rig off location with the remaining three anchor wires.
  Time Required 1-1/2 to 2 Hours.
  If time does not allow for abandonment as described above, use the following method:
- Actuate the emergency brake release system and let the wires run off the drums for the nine winches decided upon from the resultant force.
- Heave the rig off location with the remaining three anchor wires.
  Time required 30 minutes.
  If power to the anchor winches is not available, connect the towing vessel, actuate the manual emergency brake releases, run all the wires off the drums, and tow the rig away from the well site.

27.9.2.c Abandonment, Open Water In Adverse Weather (Storm Conditions)

Weather conditions could be such that it becomes very difficult to heave the rig into the wind and the oncoming seas. In this case use the following method:

- Keep three anchors, 30°, 60° and 90° to the right of the present seas and wind direction.
- Slack the remaining anchors to 100 tonnes tension.
- Release the RARs of the six down wind anchors and heave them in to 10 m below the fairleads.
- Release the two anchors that are at 30° and 60° to the left of the seas and wind direction and heave them in to 10 m below the fairleads.
- Release the anchor which is facing the wind and the seas and heave it in to 10 m below fairleads as fast as possible.
- The rig will slowly swing off location.
  Time 2 Hours.
  If time does not allow for an abandonment as described above, use the following method:
- Keep three anchors, at 30°, 60° and 90° to the right of the present seas and wind direction.
- Use the emergency brake release but try to keep 10-30 tonnes tension on all but the three selected anchors. This should keep the anchor wires from damaging the wellhead. The rig will slowly swing off location .
  Time 30 Minutes.
  If the power to the winches is not available, actuate the manual emergency brake release system and run all but the three selected anchor wires off their drums.

27.9.2.d Abandonment In Ice, Static Conditions

The method of abandonment is the same as described above.

In addition, ice breaker assistance could be required to ease the winching of ***Kulluk*** through the ice depending on the type of ice and percentage of coverage.

27.9.2.e Abandonment in Ice, During Ice Drift

- Keep three anchors at 30°, 60° and 90° to the right of the present ice drift.
- Slacken the remaining anchors to 100 tonnes tension.
- Release the RARs on the six down drift anchors and heave the wires in to 10 m below the fairleads.
- Release the two anchors at 30° and 60° to the left of the ice drift, then heave the wire in to 10 m below the fairleads.
- Release the anchor that is facing the ice drift and heave it in to 10 m below fairleads as fast as possible.
- The rig will now swing off location quickly.
  Time Required 2 Hours.
- Depending on the rate of the ice drift and the ice coverage, a towing vessel would be connected at this time, the remaining three anchors can then be released.

If time does not allow for an abandonment as described above, use the following method:
- Keep three anchors at 30°, 60° and 90° to the right of the present ice drift.
- Use the emergency release to run the wires off the drums of the six down drift anchors.
- Use the emergency brake release on the remaining three anchors, but try to keep tensions between 20 - 50 tonnes until the wires are off the drums. It is hoped that this will keep the anchor wires from damaging the wellhead. The rig will then swing off location quickly.

Time 30 Minutes

- If power to the winches is not available, actuate the manual emergency brake release.
- Run all but the selected three anchor wires of the drums.

27.9.2.f Abandonment in Ice Under Pressure

This condition requires that the rig be towed away from the drill site as fast as possible. It is quite likely that more than one vessel will be required under these circumstances.

The following method should be used:

- Slack all the anchor wires to below 100 tonnes tensions.
- Release the RARs and heave the wires in to 10 m below fairleads.
- Connect the towing vessel while the anchors wires are being heaved in.

In case of a power failure:

- Release the anchors and let the wires run off the drums by actuating the manual emergency brake releases.
- Connect the towing vessel while running the wires off the winch drums.
- Tow the rig away from the well site.

27.9.2.g Preparations For A Severe Storm

The severe storm which is indicated in the titles following and taken from the U.S.C.G. Code of Federal Regulations, is not from the Beaufort wind/sea scale but rather an environmental condition that puts the ***Kulluk*** on a higher alert status. This is readily apparent by utilizing the environmental alert board.

This storm that creates a Red Alert is a Beaufort Sea (not to be confused with the international Beaufort wind/sea scale) 10 year return storm condition.

| | |
|---|---|
| 1 minute sustained wind speed | 35 - 53 knots |
| Significant wave height (Hs) | 3-4.5 m (9.8 - 14.7 Fr) |
| Maximum current speed | 1 - 1.5 knots |

Preparations For A Severe Storm While Under Tow

1. Have the radio officer procure all weather reports.
2. Commence monitoring of vessel roll/pitch, barometric pressure, sea state, wind speed and direction.
3. Notify all departments to secure the vessel for rough weather.
4. Notify all personnel by public address to secure their personal possessions.
5. Have the Marine Supervisor or Watch Keepers inspect all tow points and ensure that the standby tow equipment is ready for immediate use.
6. Discuss with the Master of the tow vessel the possibilities of weather routing, hoving to, seeking shelter or if in water depths less than 50 meters (150') an alteration of course to deeper water.
7. Have the Marine Supervisor or Watch Keepers service, run and prepare the survival anchor for deployment.

8. Ensure that the weather tight and watertight doors are firmly closed.
9. If the draft is greater than 10.0 meters (33') deballast to a draft of 9.5 m - 10.0 m (31-33').

Preparations For A Severe Storm While Moored On Location

1. Have the Radio Officer procure all weather forecasts.
2. Commence monitoring of anchor line tensions, vessel roll/pitch, barometric pressure, sea state, wind speed and wind direction.
3. Notify all departments to secure the vessel for rough weather.
4. Notify all personnel by public address to secure their personal possessions.
5. Put all R.A.R. command units on standby.
6. Have the Chief Electrician lower the R.A.R. transducer.
7. Secure all weather-tight doors.
8. If the vessel motions are nearing the maximum operating criteria, shut in the well and disconnect the vessel from the well.
9. Once the disconnection has been achieved, bias the mooring wires for a softer mooring pattern.
10. Deballast to vessel to 9.5 - 10.0 meter draft.

Items Of Concern When Securing For Rough Weather

1. Rig Superintendent

   Pipe Racks

   - Secure pipe with chain and binders.

   Drill Stores

   - Tie down, chock and chain all drilling equipment likely to move.

   Drill Floor

   - Tie down all tools.
   - Lock the fingers on the setback load.
   - Snub the setback load at the pipe midpoint.
   - Run the top drive down to the floor.
   - Snub the top drive hoses at the midpoint in the derrick.
   - Secure all weather tight doors on the drill floor.
   - Secure the "V" doors closed.

   Miscellaneous

   - Secure the sub sea shop.
   - Secure the Pump Man's work shop.

2. Maintenance Superintendent

   - Tie down and secure all tools in the machine shop, pump rooms, water maker room, boiler room and engine room.

3. Marine Superintendent

   Port Deck

   - Lash together full barrels.

- Lash together empty barrels.
- Secure lube cube rack.
- Chain down steel rack.
- Chock wheels on forklifts.
- Chock R.A.R. bodies.
- Lash shackles.

Fwd Deck

- Chock R.A.R. bodies.
- Chain and binder slop oil tank.
- Tie down ladders in ladder rack.
- Secure paint locker.

Stbd Deck

- Chock R.A.R. bodies.
- Lash shackles.
- Wire rope/chain and binder caisson if applicable.
- Chain or wire rope with binders all large drilling equipment and miscellaneous.
  10 meter Level

Rental Stores

- Tie down all equipment likely to move.

Remaining Compartments

- Secure.

Heli-Deck

- Tie down heli-loader.
- Secure all items stationed on heli-deck and drill floor wings.

27.9.3 Critical Stages Leading to Drill Site Abandonment

27.9.3.a Gas Alarm

The alarm rings on the drill floor, in the control room and in the Rig Superintendent's office only.

The Control Room Operator will activate the general alarm and the Marine Supervisor will make a public announcement.

27.9.3.b Well Control/Blowout Muster

All personnel are required to report to their respective well control stations as stated on their "Emergency Procedure Bunk Cards" and the muster list.

All personnel have been instructed and trained in their assigned emergency duties by their immediate supervisors.

27.9.3.c Decision to Abandon Drill Site

The decision to abandon the drill site must be made in conjunction with the operator's representative and must be made in accordance with pre-established well control principles. It must be made in the best interests of the personnel and the ultimate safety and integrity of the Vessel.

27.9.4 Personnel With Critical Roles During Emergency Abandonment of the Well Site

27.9.4.a Marine Superintendent

- Go to the Control Room.
- In charge of the Emergency Abandonment.
- Since the Drilling Superintendent is occupied, the Marine Supervisor will notify the operations base and the necessary authorities.

27.9.4.b Marine Supervisor

- Goes to the #3 Remote Winch Control station and waits on stand by.
- Keeps in UHF radio contact with the Control Room and the Deck.
- Has a breathing apparatus with him from #1 locker.
- In direct charge of Crane Crew and Maintenance Foreman.

27.9.4.c On Duty Watch Keeper

- Stays in the Control Room until he is relieved by the Marine Supervisor.
- Then goes to the #1 remote winch control station and waits on stand by.
- In UHF radio contact with the control room and the deck.
- Has a breathing apparatus with him from the #1 locker.

27.9.4.d Off Duty Watch Stander

- Goes to the #2 remote winch control station and waits on stand by.
- In UHF radio contact with the control room and the deck.
- Has a breathing apparatus with him from the #2 locker.

27.9.4.e Radio Operator

- Stays in the Radio Room and stops all normal communications.
- Notify the Ice breakers to go on standby.
- Monitor all communications, assist as required and keep a complete record.

27.9.4.f Medic

- Goes to the first aid room and waits on stand by with the stretcher party.

27.9.4.g Superintendent

- Goes to the boiler room and waits on stand by.
- Maintains UHF radio communication with the control room and monitors all transmissions from the other groups.
- In charge of the Mechanical/Electrical group .
- Will coordinate all the required tasks of this group.
- Has two breathing apparatus from the #2 Locker with his group in case they are needed in one of the winch houses.

27.9.4.h Rig Electrician

- Goes to the switchgear room.
- In UHF radio communications with the control room and the remote control winch stations.

- Will assign SCR power to the anchor winches on request.
- In case an electrician has to go to one of the winch houses, he will take a breathing apparatus with him from the #3 locker.

27.9.4.i Rig Mechanic

- Goes directly to the engine room.
- Have all the three engines running.
- Have all the compressors running.
- After this, with the Offshore Maintenance Engineer, waits on stand by in the boiler room.

27.9.4.j Instrument Technician

- Goes to the control room.
- Prepares the RARs release systems to be ready to use.
- Prepares to take gas readings on the deck.
- In UHF contact with the control room.
- When on the deck takes a breathing apparatus with him from the #3 locker.

27.9.4.k Ice Advisor/Observer

- Goes to the control room.
- Provides the Marine Supervisor with constantly updated information on wind, current, ice drift and any weather forecasts.
- Keeps a record of all communications and operations.

27.9.4.l Crane Operators, Assistants and Deck Foreman

- Stand by on the starboard deck.
- Have a breathing apparatus with them from the #1 locker.
- Act as secondary winch operators in case of accidents or injury to the primary operators.
- Will make the towing gear ready under the direction of the Assistant Marine Supervisor.
- In UHF radio contact with the control room and the Assistant Marine Supervisor.
- Keeps all the doors to accommodation and the 10 m level closed.
- Maintenance Foreman will make constant patrols of the decks and report to control room regularly.

27.9.5 Emergency Well Abandonment Board

In order to give a quick and visual indication of certain critical conditions that affect emergencies such as a well control problem, a large board has been designed. This board contains the following information.

An arrow shows the direction from which either the wind, the current, the resultant of both or the ice drift comes. A line drawn perpendicular to the resultant force and through the center of the ***Kulluk*** divides the anchor diagram into three sectors. The largest sector is down wind or down drift. These anchors will be released first. Next to be released are the anchors in the blue sector. Anchors in the red sector are not released. The board also shows the release codes for all RARs in question and S.C.R assignment for all anchor winches. In addition it shows wind speed and direction plus the direction and the speed of the ice drift. These are constantly updated on this board.

This board is kept in the control room and always is displayed in a prominent place.

27.9.6 Conclusions

The purpose of the fore mentioned procedures is to provide a basic guideline for the orderly abandonment of a well site under emergency conditions.

Experience gained over the last four years in operating the ***Kulluk***, especially abandoning locations in heavy ice conditions has been incorporated into these procedures.

However, to this date, no real data is available that would indicate how acoustically operated anchor releases (RARs) would perform under blowout conditions. Therefore, a secondary method of running anchor wires off their drums is described. The secondary method may also be necessary in case of mechanical problems.

## 27.10 EMERGENCY WELL SUSPENSION

### 27.10.1 Introduction

When an environmental or vessel red alert is declared, drilling operations must be suspended, the well secured and possible the vessel disconnected from the seabed, or well head. At all times and for every operation, the appropriate emergency procedures must be determined. This is particularly important in the Beaufort where ice concentrations and movement present a continuous hazard.

Well suspension procedures must consider all aspects of the drilling operation both before and after the vessel is connected to the well head. To account for all situations, operations are divided into three cases.

*Case 1:* *Operations Conducted With No Connections to the Well Bore.*
- All operations in the 914 mm (36") surface hole section, whether or not a temporary guide base is used.
- Running casing in the 660 mm (26") hole section.

*Case 2:* *660 mm (26") Conductor Hole Operations.*
- Includes all operations, conducted through an hydraulic wellhead connector.

*Case 3:* *Operating Through a BOP.*
- Includes all operations conducted through a BOP stack.

### 27.10.2 Normal and Emergency Well Suspension Procedures

Well suspension procedures will be divided into parts as follows:

i) Normal Suspension Procedures
- These are the predetermined suspension procedures that would be adopted when events transpire more or less as anticipated, and time remains adequate to complete the securing operation.
- These procedures would be adopted on any "Red Alert" status.

ii) Emergency Suspension Procedures
- These are the procedures that would be used if unpredictable events occur which threaten the vessel, and therefore require a suspension of operations by the most immediate means.

### 27.10.3 A Definition of Secure

This section will propose various emergency means by which a well may be secured. The actual means chosen will depend on Operator preference, environmental circumstances and well bore conditions. However, before determining what well securing procedure is chosen consider that:

i) The well must be securely isolated from the natural environment.

ii) The well bore should be left in a stable state that would minimize permanent formation or casing damage and allow future operations to resume with a minimum of inconvenience.

iii) Any equipment left on the wellhead should not be in danger of being damaged by ice floes.

iv) If the possibility exists that operations may not be resumed within a short time, the well must be secure for as long as the vessel may remain off location.

v) The requirements of all regulatory bodies must be satisfied.

27.10.4 Normal Suspension Procedures While Conducting Operations With No Connection To the Wellbore

27.10.4.a Introduction

This would include all situations in the 914 mm (36") surface hole section, and running casing in the 660 mm (26") conductor hole section. These procedures all assume that:

- Surface hole section is drilled with returns to the seabed, casing is run in the conductor hole section with returns to the seabed, the suspension procedure does not require that the well bore be isolated from the natural environment.

However, if hydrocarbons, fresh water flows, or salt water flows are anticipated, an open well bore may not be acceptable. Therefore, prior to spudding either hole section, the Operator must determine the acceptable suspension methods.

27.10.4.b Normal Suspension Procedures While Drilling With Returns To Surface

i) Circulate as necessary to condition, freeze or depress the drilling fluid.

ii) Trip out the drill string.

iii) If a temporary guide base is in use, shear out and retrieve the guidelines.

iv) Secure the vessel as necessary.

27.10.4.c Emergency Suspension Procedures While Drilling With Returns To Surface

i) If time allows, trip out to place the bit a distance off the bottom equal to the distance from the rotary table to the seabed.
If time does not allow, proceed directly to step (ii).

ii) Drop the drill string by backing out the top drive.

27.10.4.d Normal Well Suspension Procedures While Logging With No Connection To The Well Bore

i) Retrieve the logging tools.

ii) If a temporary guide base is being used, shear out and retrieve the guidelines.

27.10.4.e Emergency Well Suspension Procedures While Logging With No Connection To The Well Bore

i) Shear out the rope socket weak link. This procedure would be used if logging tools were stuck and the rig was being forced off location.

ii) If a temporary guide base is being used, shear out and retrieve the guidelines.

27.10.4.f Normal Well Suspension Procedures While Running Casing With No Connection To The Well

i) Retrieve the casing, or finish the casing job, whichever is faster.

27.10.4.g Emergency Well Suspension Procedures While Running 762 mm (30") Casing

i) This procedure is to be used in the event that time does not allow tripping the casing above the seabed.

- Ensure inner bushings are removed from master bushings.
- Release hydraulic handling tool while rapidly lowering casing string.
- If above procedure won't release the casing, install inner bushings and set the slips.
- Screw top drive into casing handling tool with enough threads to pick up casing string.
- Pick up pull slips and bushings.
- Back out top drive, dropping string.

ii) Emergency Well Suspension Procedures while running the 762 mm (30") Casing Landing String.

- Raise and rapidly lower the casing to lower the tension at the running tool.
- Apply 10,500 kPa (1,500 psi) to the unlock port of the running tool.
- Continue this procedure until the running tool disengages and casing is dropped.
- POH the landing string.
- Shear out the TGB guidelines, if applicable. If there is not adequate time for this procedure, drop the string by reversing the top drive.

27.10.4.h Emergency Well Suspension Procedures While Running 508 mm (20") Casing

i) This procedure is to be used in the event that time does not allow tripping the casing above the seabed.

- First consideration is to make up the wellhead and attempt to land the casing string.
- If time does not allow picking up the wellhead, the casing will have to be dropped.
- Remove the 500T elevator slips from rotary table.
- Rapidly lower the casing, this will reduce the tension on the 500 T elevators. At the same time attempt to release the elevators.

*Note: Excessive weight of the casing string might not allow the release of the 500T elevators. Depending on the severity of the situation, consideration should be given to cutting the casing.*

ii) Emergency Well Suspension Procedures while running the 508 mm (20") Casing Landing String.

- Make up wellhead joint with running tool.
- Remove master bushings from rotary table.
- Attempt to land casing.
- If time does not allow landing of casing, screw top drive into casing landing string. Rapidly lowering casing, reverse top drive.
- Shear out guidelines.

27.10.4.i Normal Well Suspension Procedures While Drilling Through The Wellhead Tieback Tool

i) POH the drill string to the seabed.

ii) Displace the riser to sea water, recovering mud as the pit capacity allows.

iii) POH to surface.

iv) Disconnect, and pull the tieback tool to surface.

v) Shear out the guidelines.

27.10.4.j Emergency Procedures While Drilling Through The Wellhead Tieback Tool

i) If time does not allow pulling the drill string to surface, disconnect procedures may begin as soon as the bit is above the seabed.

- If time does not allow tripping to above the seabed, POH to place the bit off bottom by a distance equal to the distance from the rotary table to the seabed. Drop the string by reversing out the top drive.
- If the string is stuck, mechanically back out as low in the string as possible.

ii) Disconnect the wellhead connector and lift it as high as possible with the tensioners.

iii) Shear out the guidelines.

iv) Disconnect anchors to move off location.

v) While disconnecting anchors, continue pulling the riser.

27.10.5 Well Suspension When Drilling Through The BOP

27.10.5.a Introduction

When a well must be suspended by leaving the BOP on the wellhead, it is always preferable to have the drill string inside the casing with the bit as close to the casing shoe as is practical. This will facilitate well control operations, which may be necessary, upon returning to the location. Leaving pipe in open hole will almost invariably result in a stuck string. Suspending a well with no pipe in the hole may result in a situation which requires a stripping operation to kill the well.

- Assure that the mud is always in good condition so that solids settling, or chemical degradation will not stick, or plug the drill string.
- Ensure that freeze depression is adequate.
- Drill with the largest size jets practical.

27.10.5.b Using a Lynes Retrievable Self Anchoring Plug

*Note: This procedure is only to be used when 508 mm (20") casing is set and the BOP stack is inoperative or must be pulled.*

Tool Specifications:

| | |
|---|---|
| Maximum Tensile Load: | 102350 daN (230,000 lbs) |
| Maximum Burst Pressure: | 69000 kPa (10,000 psi) |
| Maximum Collapse Pressure: | 58000 kPa (8,500 psi) |
| Maximum Differential Pressure: (above or below) | 17200 kPa (2,500 psi) |
| Maximum Deflated OD: | 400 mm (15-3/4") |
| Minimum ID: | 41.2 mm ( 1-5/8") |

Lynes Retrievable Plug Running Procedure

i) In any situation, whether drilling, tripping, or out of the hole, it is preferable to set the pipe as deep in the casing as possible.

To determine bit and plug setting depth, let:

a = Depth from RT to the position of the bit prior to picking up the Lynes plug.
b = Depth from RT to set the packer.
c = Casing shoe depth.
d = Safety factor (two stands of DP or equivalent).
e = Length by which BHA exceeds water depth from RT. This would only be applicable when drilling in extremely shallow water. The distance from the Lynes plug to the rotary table should be adequate to allow running BHA in case jarring or milling is necessary to unseat the packer.
f = Wellhead depth from RT.

ii) Pull or run pipe as necessary to position the bit at a.

(a = c - f - d - e).

- Pump a weighted slug into the annulus to compensate for the hydrostatic pressure loss when the riser is removed, if necessary.
- Pump down the hydril latch in dart.

iii) Note and record the string weight prior to picking up the Lynes assembly.

iv) Connect the DP to the 4-1/2" IF box of the plug running tool.

- Do not allow the top sub of the plug to rotate, as this could cause the mandril to move to the deflate position.

v) Run in slowly with the Lynes plug to setting depth.

- When in shallow water, where the length of the drilling BHA exceeds water depth, set the plug at a depth from RT equal to the length of the drilling BHA.

*Note: Once the plug is connected to the drill string, do not attempt to circulate, as this will shear open the pump out sub.*

vi) Fill the running string with water.

vii) Hook up a circulating wedge, low torque valve and chiksans to the running string.

viii) Set the Motion Compensator at 3/4 open.

ix) Pressure up on the running string to 10000 kPa (1,450 psi) to inflate and set the packer.

- As the packer sets, be prepared to rapidly vent the Motion Compensator , or slack off the blocks to avoid exceeding the tensile limits of the tool when the vessel heaves. If the heave is extreme, it may be advantageous to hang the running string on the rams for setting and releasing from the plug.
- Hold the 10000 kPa (1,450 psi) for two minutes, then rapidly bleed off the pressure to set the check valve.

x) Slack off 5000 to 10000 daN (10 - 20 ton) to assure the plug is set.

xi) Close the upper annular and pressure test the tool through the choke line to 3500 kPa (500 psi).

xii) Pressure up on the running string again to 14000 kPa (2,000 psi), record strokes to shear the pins in the running tool. The pressure should drop, indicating that the pins have sheared.

- Do not exert pressure above the tool after disengaging the DP.

xiii) Pull the stinger to above the shear rams.

xiv) Close and block the shear rams.

xv) Displace the riser to sea water recovering mud as tank capacity allows.

xvi) POH with the landing string.

- Check the mandril and install the protector, before standing back or breaking off the mandril.
- Rope off the landing string.

xvii) Continue operations as required.

xviii) Fully describe the string left in the hole, the running string, and the BOP status in the tour report.

27.10.5.c Retrieving the Lynes Self Anchoring Plug, refer to Lynes Procedure Manual

i) Open the well to surface by opening the appropriate sub sea choke or kill valve by a sensitive pressure gauge to a closed choke. If no pressure is evident, open the choke and check for flow.

- After flow checking, close the choke and kill valves.

ii) Pick up the retrieving tool below a 444.5 mm (17-1/2") stabilizer.

- Check the O-rings.

iii) Run in to above the shear rams.

iv) Set the Motion Compensator to support landing string weight. Lightly engage shear rams. Begin displacing the riser to mud at a high rate to flush out any debris which may have settled above shear rams. After adequate flushing, pick up above shear rams and continue displacing the riser to mud.

v) Open the shear rams and flow check the well.

vi) Run in and engage the plug with 5000 daN.

- Pressure up to 7000 kPa (1,000 psi) to ensure that the retrieving tool is latched.
- Continue pressuring up to 11000 kPa (1,600 psi) to shift the sleeve in the bottom of the tool, thereby establishing communication between the annulus and the running string. A drop in pressure indicates the tool has opened.
- If the tool does not open at 11000 kPa (1,600 psi), pressure under the packer (a live well) must be assumed.
- Continue pressuring up to a maximum of 80% of the casing burst pressure plus 11000 kPa (1,600 psi) to open the tool. Control the well as necessary.

vii) After the tool has opened, flow check the DP.

viii) To unseat the packer, use the Motion Compensator to pick up to running string weight, and rotate the string six right turns.

ix) Pick up to the original string weight and wait five minutes for the elements to deflate.

- Flow check the well.

27.10.5.d Well Suspension with the Primary Emergency Drill Pipe Hang Off Tool

This procedure is to be used:

i) Any time drilling operations are being conducted with either the 10 m or 15 m BOP in place.

ii) With any casing string larger than 178 mm (7") set in the wellhead.

The reason this tool should be used is, the secondary emergency drill pipe hang off tool (wear bushing hang off tool) will prevent working the pipe down. The primary hang off tool will pass through all wear bushings except the 178 mm (7").

i) The running tool which is the 4-1/2 IF box by a 1" pitch left hand general purpose acme box.

ii) The hang off tool has an upper tool joint which is a 4-1/2 IF square shouldered box, with an external 1" pitch left hand acme general purpose thread with 2 - '0' ring seals to ensure a pressure competent seal at low make up torque.

*Note: The tool can be retrieved by screwing and torquing the drill string into the 4-1/2" IF box. If a 4-1/2" IF tool joint is used to retrieve the drill string the connection should not be torqued to over 60% of running string make up torque. This would allow the string to be backed out if necessary.*

However, it is recommended that at least on the first run to retrieve the string, the left hand running tool be used. This would eliminate the problem of releasing from the string, if necessary.

- This assembly should be racked in the derrick on a stand of drill pipe and kept functional, and immediately accessible at all times when drilling through the BOP.
- Consideration should be given to maintain a unique pre-measured and marked landing string for running the hang off tool. The string should be marked at the rotary table to indicate that the hang off tool is in the landed out position on the middle rams.

Primary Emergency DP Hang Off Tool Preparation

i) Install 2 joints of grade S-135 drill pipe into the 4-1/2 IF Box end of the primary emergency DP. Hang off running tool and torque up to maximum recommended make-up torque.

ii) Install a 3 m (10 ft.) ± HWDP pup joint below the hang off tool (min ID 70 mm).

iii) Install a hydril check guard sub directly below the HW pup.

- Thoroughly clean and generously grease the interior of the check guard sub.
- Ensure the dart latching mechanism functions, grease the dart and latch it into the sub.

iv) Thoroughly clean and grease the interior of the stabbing valve and install it below the check guard sub.

- Function the stabbing valve and leave it in the open position.

v) Make up all 4-1/2 IF connections to the maximum recommended torque.

vi) Ensure the acme connection is well lubricated and made up chain tong tight only.

vii) Rack the primary emergency drill pipe hang off tool assembly in the derrick.

viii) Keep the assembly functional and accessible at all times.

ix) Designate and rope off a unique landing string to be used for the primary hang off tool.

Primary Emergency BOP Ram Hang Off Tool Running Procedure

i) Condition the mud and circulate as necessary, or as time allows.

ii) Anytime casing larger than 7" is set and time permits:

- Whether drilling, tripping, or out of the hole, run, or pull pipe to position the bit as close as possible to the casing shoe depth, minus two stands, minus the distance from RT to the wellhead, <u>before picking up the hang off assembly</u>.

iii) Anytime casing is set and the pipe must be hung off in open hole:

- Pull as much pipe as time allows. If on bottom, pull a minimum of pipe to position the bit, at a depth equal to TD, minus the distance from the rotary table to the wellhead, minus two stands.
- This will ensure that the pipe is two stands off bottom when the string is hung off.

iv) Make up the hang off assembly to the string.

- Check to ensure that the stabbing valve is open.
- Check to ensure the dart is installed in the Check Guard sub.

v) Ensure that the running tool is chain tong tight only.

vi) Run in, measuring the drill string if necessary to ensure proper landing depth, and position the tool hanger 2 m plus rig heave above the <u>middle ram</u>.

- Just prior to landing, note and record the string weight.
- If heave warrants, stroke out the Motion Compensator.

vii) If necessary, spot a heavy slug in the hole to compensate for the hydrostatic pressure lost when the riser is removed.

viii) Vent down the manifold pressure to 3500 - 5000 kPa (500 - 700 psi).

- This assures that if the rams are inadvertently closed on tool joint, or the hang off tool, no damage would occur and that stripping down to land out results in minimum ram rubber damage.
- Close the middle rams.

ix) Strip down until a loss in weight verifies that the hanger is on the middle rams.

- Mark the string at the rotary table.

x) Lift up just off the rams and boost the manifold pressure to 10500 kPa (1,500 psi).

- The minimum pressure required to activate the posilocks is 5500 kPa (800 psi).
- Monitor fluid volume to assume ram closure.

xi) Slack the string back down until a minimum loss of weight verifies the string is on the rams.

- The mark on the drill string should be at the same position as in (ix).
- Block the rams.

xii) Slack off until only the weight of the landing string is supported in the blocks.

xiii) Close the lower rams with 10500 kPa (1,500 psi) manifold pressure and block the rams.

*Note: Do not close upper rams.*

xiv) To confirm rams closure.

- Pump down through the lower choke line until a pressure build up (approximately 3500 kPa (500 psi) confirms that both rams are completely closed.

xv) If necessary, set the Motion Compensator to support the running string weight.

xvi) Release the running string with seven right hand turns.

xvii) Raise the string 3 m (10 ft) to clear the shear rams.

xviii) Close the shear rams with a minimum of 14000 kPa (2,000 psi) and block the rams.

- Monitor the fluid to ensure the SPM functions.
- Close the upper annular and pressure up to 500 psi to confirm closure.

xvix) Ensure all choke and kill line valves are closed and blocked.

- If time allows pressure up against all choke and kill valves to ensure closure.

xx) If time allows, displace the riser to sea water by pumping through the running string, recovering the mud as the pit capacity allows.

xxi) POH with the landing string.

- Fully describe the string left in the hole, the running string and the BOP status in the tour report, sub sea report and well file.

xxii) WOW or disconnect (see rig procedure), as required.

27.10.5.e Retrieving the Primary Emergency Drill Pipe Hang Off Tool From 10 and 15 m BOPs

*Note: If the LMRP has been disconnected, the checks outlined in steps (ii) to (vii) should be carried out. If the LMRP has not been disconnected, and there is no reason to suspect possible BOP system malfunctions, the retrieval procedure may start at step (viii).*

i) Run and reconnect the LMRP.

Refer Chapter 16, BOP Operations.

ii) Fill the riser with sea water and flow check to ensure that the rams and drill pipe shut off valves have held.

iii) Ensure that all choke manifold valves are in the drilling position. Yellow open, Red indicates all valves closed.

iv) Put the annulus on the trip tank.

v) Connect a Tee to the #1 valve outlet on the choke manifold.

- Connect the Dowell unit to one outlet of the Tee.
- Connect a closed plug valve to the other outlet of the Tee.

vi) Pressure test the choke and kill lines, to the high and low values of the last BOP test.

vii) To ensure annular and choke and kill functions, after relatching:

a) Set the annular regulator pressure to 4000 kPa (600 psi).
b) Partially close, reopen the upper annular.
c) Repeat (a) and (b) for the lower annular.
d) Open and close the upper outer choke valve.
e) Open and close the upper inner choke valve.
f) Open and close the lower outer choke valve.
g) Open and close the lower inner choke valve.
h) Open and close the outer kill valve.
i) Open and close the inner kill valve.

*Note: Flow check continuously at the choke manifold rig floor outlet and at the riser while carrying out these checks.*

At this point, we have confirmed that all choke and kill valves and both annulars to be fully operational. However, remember that the LMRP connector has not been pressure tested since relatching, and therefore if any well bore pressure is encountered in subsequent operations, the rams and not the annulars should be used to control the well.

*Note: **DO NOT OPEN EITHER PIPE RAMS.** Opening the middle rams will drop the drill string.*

viii) Run in with the hang off assembly running tool to just above the shear rams.

- Use the highest strength pipe aboard, preferably S135.
- Make up all connections in the running string to maximum torque.

ix) Engage the top drive and using the Motion Compensator if necessary, lightly tag the shear rams. Pick up string approximately "0.5 ft" (15 cm)

- Mark the drill string at the rotary table.

x) Begin displacing the riser to mud at a maximum pump rate (2 x 100 SPM) to flush out any debris which may have settled above the shear rams.

- After adequate flushing, pick up and continue displacing the riser to mud.

xi) To flow check the annulus:

- Open the kill line to surface by a sensitive pressure gauge to a closed choke manifold.
- If there is no pressure evident, visually check flow at the rig floor outlet by opening choke manifold valve #1.

Note: *Expect some gas in the annulus due to the migration of gas entrained in the mud.*

Note: *It is recognized that it is preferable not to use the kill line outlets unless absolutely necessary, for if the valves failed to close or seal, the well could not be shut in for disconnect purposes.*

However, in this case it has been considered preferable, particularly since the valves have been function and pressure tested, to use the kill line rather than open the rams under potential pressure.

xii) With the Dowell Unit pump a maximum of two times surface plus choke line volume to ensure that the kill line is not plugged.

- Bleed back any pressure from this operation and flow check.
- Shut the inner kill line valve.

Note: *This procedure does not confirm that the well is dead, as ice, barite or formation bridges may be isolating well bore annular pressure.*

xiii) To flow check the drill string:

- Open the upper choke line to surface by a sensitive pressure gauge to a closed choke.
- If there is no pressure evident visually, flow check at the rig floor by opening choke manifold valve #6.

Note: *A lack of pressure only indicates that the drill pipe non return valves have held, that well bore pressure (if any) is not in communication with the upper drill string, and that the pipe rams have held. This check is not a positive indication that the drill string is dead.*

Although freeze depressed mud and the proper glycol water mixture should eliminate ice plug problems in the drill string and annulus, and in the BOP, the possibility of these plugs existing still must be considered.

Note: *Other problems which may isolate pressure from surface may be as follows:*

a) Plugged jets.
b) Barite plugs in the drill string and/or annulus.
c) Formation bridging in the annulus.

xiv) Lower the retrieving string to just above the shear ram.

- Use the previous mark for reference (item ix).

xv) Close the upper annular.

xvi) Line up the stand pipe manifold to monitor pressure and flow.

xvii) Line up the riser on the trip tank.

xviii) Open the shear rams.

- Flow check at the riser and trip tank.

xix) Vent down manifold pressure to 700 psi and close and reopen the shear rams to confirm that they are fully operational.

xx) Pump down the drill pipe until returns at the choke manifold valve #6 confirm that the upper choke line is not plugged.

- Close the upper inner choke.
- We are now sure there was no pressure below the shear rams.

xxi) Open the upper annular.

xxii) Lower the running string to reconnect to the hang off tool.

- Use the mark when the shear rams were tagged as reference.
- The top of the hang off tool will be 1.0 m below the top of the shear rams.

xxiii) To re-engage the hang off tool with:

a) The left hang acme running tool.

- This is the preferred method and should be attempted first.
- Stroke out the Motion Compensator if necessary.
- Lower the drill string and with the minimum possible weight contact the hang off tool.
- Make one turn to the right to align the threads.
- Turn the tool to the left until a slight increase in torque is noted. This should take approximately seven turns.

b) Open ended drill pipe.

- This method can be used if pulling the string requires vigorous working the pipe and rotating.
- Stroke out the Motion Compensator if necessary.
- Lower the drill string and with the minimum possible weight contact the hang off tool.
- Turn the string to the right torquing up the connection to no more than 70% of the make up torque of the running string. This should allow releasing at the tool if necessary.

*Note: The first attempt to retrieve the string, should be made with the running tool.*

xxiv) Pick up the string weight.

xxv) Open the lower rams.

xxvi) Close and reopen the rams to ensure they are fully operational.

xxvii) Open the middle rams.

xxviii) Close and reopen the middle rams to ensure they are fully operational.

xxix) Open the lower chokes.

xxx) Open choke manifold valves #13 and #9 and with the Dowell Unit Pump down the lower choke until returns at the trip tank confirm the line is clear.

*Note: At this point, all BOP functions have been confirmed as "OK" and no pressure has been detected. However, the previously mentioned plugs in the drill string and/or annulus are still a possibility.*

xxxi) Hoist the drill string to establish whether or not it is free.

xxxii) Circulate to condition the mud and/or hole.

- Break circulation very carefully as the annulus may be bridged.
- Ensure pit volumes are being accurately monitored.
- If circulation pressures are high or if the integrity of the running strings connection to the hang off tool is suspect, drop a dye marker or a carbide to ensure the connection is not washing out.

xxxiii) POH the drill string as soon as possible to remove the hang off tool.

- Test the BOP if required.

27.10.5.f Well Suspension By Hanging Off On A Drill Pipe Tool Joint

This procedure is only to be used when:

- Pipe must be hung off in open hole when 178 mm (7") casing is set to surface or if the primary emergency hang off tool is not available and it is not advisable to use the secondary (wear bushing) hang off tool which will not allow downward movement of the string.

A description of the assembly:

- If the primary hang off tool is not available and before drilling out of 178 mm (7") casing, the following assembly should be made up and racked in the derrick. From the top:

1) A double of S135 drill pipe.
2) One sub 4-1/2 IF pin by 4-1/2 IF box approximately 1 m long.
    - The clearance between the bottom of the shear rams, and the top of the middle hang off rams is 1.52 m (5 ft) in the 10 m BOP and 1.93 m (6.3 ft) in the 15 m BOP. This sub will aid in retrieval operations if an overshot must be used.
3) One single of S135 drill pipe.
4) One retrievable dart sub with the dart installed.
5) One kelly cock type valve in the open position.

Procedure For Suspending The Well By Hanging Off On A Drill Pipe Tool Joint.

i) Circulate, and/or condition the mud as time allows.

ii) Pull as much pipe as time allows. If on bottom, pull at a minimum, enough pipe to position the bit, at a depth equal to TD, minus the distance from the rotary table to the wellhead, minus two stands.

- This will ensure that the pipe is two stands off bottom when the string is hung off.

*Note: The string will be run in, and landed on a loose tool joint. Reaming and circulating must be avoided. Therefore, the hole under the bit must be in reasonably good condition for the distance that the landing string must be run.*

iii) Make up the hang off assembly to the string.

- Check to ensure that the stabbing valve is open.
- Check to ensure the dart is installed in the Check Guard sub.

iv) Break the connection between the XO sub box, and the drill pipe pin, and remake it up chain tong tight only.

v) Run in, measuring the drill string if necessary to ensure proper landing depth, and position the loose drill pipe tool joint, 2 m (6 ft) plus rig heave above the middle ram.

- Do not allow the string to turn when making up connections. Left hand turns may back out the landing string. Right hand turns may tighten the connection making release difficult.
- Just prior to landing, note and record the string weight.
- If heave warrants, stroke out the Motion Compensator .

vi) If necessary, spot a heavy slug in the hole to compensate for the hydrostatic pressure lost when the riser is removed.

vii) Vent down the manifold closing pressure to 3500 - 5000 kPa (500 - 700 psi).

- This assures that if the rams are inadvertently closed on tool joint, no damage would occur and that stripping down to land out results in minimum ram rubber damage.
- Close the middle rams.

viii) Strip down until a loss in weight verifies that the tooljoint is on the rams.

ix) Lift up just off the rams and boost the manifold pressure to 10500 kPa (1,500 psi).

- The minimum pressure required to activate the posilocks is 5500 kPa (800 psi).
- Monitor fluid volume to assure ram closure.

x) Slack the string back down until a minimum loss of weight verifies the string is on the rams.

- The mark on the drill string should be at the same position as in (ix).
- Block the rams.

xi) Slack off until only the weight of the landing string is supported.

xii) Close the lower rams with 10500 kPa (1,500 psi) manifold pressure and block the rams.

*Note:* ***DO NOT CLOSE UPPER RAMS.***

xiii) To confirm ram closure.

- Pump down through the lower choke line until a pressure build up [approximately 3500 kPa (500 psi)] confirms that both rams are completely closed.

xiv) If necessary, set the Motion Compensator to support the running string weight.

xv) Release the landing string with five left hand turns.

xvi) Raise the string ten feet to clear the shear rams.

xvii) Close the shear rams with a minimum of 14000 kPa (2000 psi) and block the rams.

- Monitor fluid volume to ensure SPM functions.

xviii) To ensure shear ram closure:

- Engage the top drive.
- Lower the drill string to just above the shear rams.
- Close the upper annular and pump down the drill string until a sharp pressure increase ±3500 kPa (± 500 psi), confirms that the shear rams are fully closed.

xix) Open the upper annular.

xx) Ensure all choke and kill line valves are closed and blocked.

xxi) If time allows, displace the riser to sea water by pumping through the running string, recovering the mud as the pit capacity allows.

xxii) POH with the landing string.

- Fully describe the string left in the hole, the running string and the BOP status in the tour report, sub sea report and well file.

xxiii) WOW or disconnect, as required.

27.10.5.g Retrieving the String When The Pipe Has Been Hung Off On a Tool Joint

*Note: If the LMRP has been disconnected, the checks outlined in steps (ii) to (vii) should be carried out. If the LMRP has not been disconnected and there is no reason to suspect possible BOP systems malfunctions, the retrieval procedure may start at step (viii).*

i) Run and reconnect the LMRP.

ii) Fill the riser with sea water and flow check to ensure that the rams and drill pipe shut off valves have held.

iii) Ensure that all choke manifold valves are in the drilling position. Yellow open, Red indicates all chokes closed.

iv) Put the annulus on the trip tank.

v) Connect a Tee to the #1 valve outlet on the choke manifold.

- Connect the Dowell unit to one outlet of the Tee.
- Connect a closed plug valve to the other outlet of the Tee.

vi) Pressure test the choke and kill lines, to the high and low values of the last BOP test.

vii) To ensure annular and choke and kill functions, after re- latching:

a) Set the annular regulator pressure to 4000 kPa (600 psi).
b) Partially close; reopen the upper annular.
c) Repeat (a) and (b) for the lower annular.
d) Open and close the upper outer choke valve.
e) Open and close the upper inner choke valve.
f) Open and close the lower outer choke valve.
g) Open and close the lower inner choke valve.

h) Open and close the outer kill valve.
i) Open and close the inner kill valve.

Note: *Flow check continuously at the choke manifold rig floor outlet and at the riser while carrying out these checks.*

At this point, we have confirmed that all choke and kill valves and both annulars should be fully operational. However, remember that the LMRP connector has not been pressure tested since relatching. Therefore, if any well bore pressure is encountered in subsequent operations, the rams and not the annulars should be used to control the well.

viii) Run in with open ended drill pipe to just above the shear rams.

- Place a 445 mm (17-1/2") stabilizer one single up.
- Use the highest strength pipe aboard, preferably S135.
- Make up all connections in the running string to maximum torque.

ix) Engage the top drive and using the Motion Compensator if necessary, lightly tag the shear rams. Mark the pipe at the RT for future reference.

x) Begin displacing the riser to mud at a maximum pump rate (2 x 100 SPM) to flush out any debris which may have settled above the shear rams.

- After adequate flushing, pick up and continue displacing the riser to mud.

xi) To flow check the annulus:

- Open the kill line to surface by a sensitive pressure gauge to a closed choke manifold.
- If there is no pressure evident, visually check flow at the rig floor outlet by opening choke manifold #1.

Note: *Expect some gas in the annulus due to the migration of gas entrained in the mud.*

Note: *It is recognized that it is preferable not to use the kill line outlets unless absolutely necessary for if the valves failed to close or seal, the well could not be shut in for disconnect purposes.*

However, in this case it has been considered preferable, particularly since the valves have been functioned and pressure tested, to use the kill line rather than open the rams under potential pressure.

xii) With the Dowell Unit, pump a maximum of two times the surface and choke line volume, to ensure that the kill line is not plugged.

- Bleed back any pressure from this operation and flow check.
- Shut the inner kill line valve.

Note: *This procedure does not confirm that the well is dead, as ice, barite or formation bridges may be isolating well bore annular pressure.*

xiii) To flow check the drill string:

- Open the upper choke line to surface by a sensitive pressure gauge to a closed choke.
- If there is no pressure evident visually, flow check at the rig floor by opening choke manifold valve #6.

*Note: A lack of pressure only indicates that the drill pipe non return valves have held, that well bore pressure (if any) is not in communication with the upper drill string and that the pipe rams have held. This check is not a positive indication that the drill string is dead.*

*Although freeze depressed mud and the proper glycol water mixture, should eliminate ice plug problems in the drill string and annulus, and in the BOP, the possibility of these plugs existing still must be considered.*

*Note: Other problems which may isolate pressure from surface may be:*

- Plugged jets.
- Barite plugs in the drill string and/or annulus.
- Formation of bridging in the annulus.

xiv) Lower the retrieving string to just above the shear ram.

- Use the previous mark for reference, see above (ix).

xv) Close the upper annular.

xvi) Line up the stand pipe manifold to monitor pressure and flow.

xvii) Line up the riser on the trip tank.

xviii) Open the shear rams.

- Flow check at the riser and trip tank.

xix) Vent down manifold pressure to 5000 kPa (700 psi) and close and reopen the shear rams to confirm that they are fully operational.

xx) Pump down the drill pipe until returns at the choke manifold valve #6 confirm that the upper choke line is not plugged.

- Close the upper inner choke.
- We are now sure there was no pressure below the shear rams.

xxi) Open the upper annular.

xxii) Lower the running string to reconnect to the drill string.

- Use the mark when the shear rams were tagged as reference.

xxiii) To re-engage to hang off tool:

- Stroke out the Motion Compensator if necessary.
- Lower end drill string end with the minimum possible weight contact the hang off tool.
- It may be necessary to use the lower annular to help centralize the running string.
- Turn the string to the right torquing up the connection to no more than 70% of the make up torque of the running string. This should allow releasing the running string if necessary.

xxiv) Pick up the string weight.

xxv) Open the lower rams.

xxvi) Close and reopen the rams to ensure they are fully operational.

xxvii) Open the middle rams.

xxviii) Close and reopen the middle rams to ensure they are fully operational.

xxix) Open the lower chokes.

xxx) Open the choke manifold valves #13 and #9 and with the Dowell Unit pump down the lower choke until returns at the trip tank confirm the line is clear.

*Note: At this point, all BOP functions have been confirmed as "OK" and no pressure has been detected. However, the previously mentioned plugs in the drill string and/or annulus are still a possibility.*

xxxi) Hoist the drill string to establish whether or not it is free.

xxxii) Circulate to condition the mud and/or hole.

- Break circulation very carefully as the annulus may be bridged.
- Ensure pit volumes are being accurately monitored.
- If circulation pressures are high or if the integrity of the running strings connection to the hang off tool is suspect, drop a dye marker or a carbide to assure the connection is not washing out.

xxxiii) Continue with operations as necessary. POH the drill string as soon as possible to:

- Remove the hang off joint.
- Test the BOP.

27.10.5.h Well Suspension with the Hang Off Tool

*Note: This procedure is to be used ONLY:*

- When 406 mm (16"), 340 mm (13-3/8"), 245 mm (9-5/8"), 178 mm (7") casing has been set. The 441 mm (17-3/8") OD lower hanger body will not set on the larger 447.7 mm (17-5/8") ID wellhead housing wearing bushing.

*AND*

- The drill string is to be hung off in the cased hole. If the drill string was hung off in the open hole and consequently became stuck, the inability of passing the fluted hanger past the wear bushing would prevent working the pipe down.

*Note: This assembly should be racked in the derrick on a stand of drill pipe of convenient height for the derrick man and kept functional, and immediately accessible at all times when the primary tool is not available.*

Consideration should be given to maintaining a unique pre measured landing string for running the hang off tool. The string should be marked at the rotary table to indicate that the hang off tool is in the landed out position.

The tool consists of six portions:

1. The running tool which is a 4-1/2 IF box, by a 1" pitch left hand modified acme box. The acme box has an 0-ring which ensures a pressure competent seal at low make up torque.

2. The upper body has an upper tool joint which is a 4-1/2 IF square shouldered box, with an external 1" pitch left hand acme thread.

The tool can be retrieved by screwing and torquing the drill string into the 4-1/2 IF box. If a 4-1/2 IF tool joint is used to retrieve the drill string the connection should not be torqued to over 70% of running string make up torque. This would allow the string to be backed out if necessary.

However, it is recommended that at least on the first run to retrieve the string the left hand running tool be used. This would eliminate the problem of releasing from the string, if necessary.

3. A double pin pup designed to space out the tool for ram closure.

4. The lower body is a 441 mm (17-3/8") OD fluted hanger with a 4-1/2 IF box up and a 4-1/2 IF pin down.

5. A hydril "Check Guard" sub with the dart latched in. The sub should be marked "Dart In" to avoid confusion when running the assembly.

6. A lower kelly cock type valve with an adequate ID to allow passage of the hydril check guard "Dart", and a string shot. This would allow for internal string control when removing the tool on the surface.

Emergency Hang Off Tool Preparation

i) Thoroughly clean and generously grease the interior of the hydril check guard.

ii) Ensure that the dart latching mechanism functions. Grease the dart and latch it into the sub.

iii) Function test the dart retrieving tool.

iv) Make up the check guard sub, with the dart latched in, directly below the hang off tool.

v) Thoroughly clean and grease the interior of the stabbing valve, and install it below the check guard sub in the 'open' position.

vi) Make up all connections on the hang off tool, except the acme threaded running tool, to the recommended torque for 4-1/2 IF tool joints.

vii) Make up the running tool to a single.

viii) Check the running tool 0-ring and threads.

ix) Connect the running tool to the hang off assembly with four left hand turns. Ensure that the acme connection is chain tong tight only.

x) Pick up a 3 m (10 ft) pup, and one single to rack the assembly in the derrick.

xi) When racking back, place the valves below the hanger in a chuck filled with soluble oil, to prevent rusting.

xii) Keep the assembly functional and accessible at all times.

<u>Procedure For Running the Secondary Emergency Drill Pipe Wear Bushing Hang Off Tool</u>

i) Condition the mud and circulate as necessary or as time allows.

ii) Pull or run pipe as necessary to position the bit at a depth equal to the casing shoe depth minus the distance from the rotary table to the wellhead, minus the length of two stands.

- This will ensure that the pipe is two stands inside the shoe when the string is hung off.

iii) Prior to picking up the hang off assembly, note and record the string weight.

- Check to ensure that the stabbing valve is open and that the dart is installed.
- Make up the hang off assembly to the drill string.

iv) Ensure that the running tool is chain tong tight only.

v) Run in, measuring the drill string, if necessary to ensure proper landing depth, and land the hang off tool on the wear bushing.

- Install a wiper rubber as soon as the hang off tool has passed the rotary table to prevent debris from entering the well bore.
- Just prior to landing, note and record the string weight.

vi) Paint mark the string at the rotary table.

vii) Close and block the lower pipe rams with 10500 kPa (1,500 psi) operating pressure and block the rams.

viii) Close and block the middle pipe rams with 10500 kPa (1,500 psi) operating pressure.

ix) To confirm ram closure:

- Pump down through the lower choke line until a pressure build up (approximately 3500 kPa (500 psi) confirms that both rams are completely closed.

x) If necessary, set the Motion Compensator to support the running string weight. This is the weight recorded in (iii) minus the weight recorded in (vi).

xi) Release the landing string with four right hand turns.

xii) Raise the string ten feet to clear the shear rams.

xiii) Close and block the shear rams with 14000 kPa (2,000 psi).

xiv) To ensure shear ram closure:

- Engage the top drive.
- Lower the drill string to just above the shear rams.
- Close the upper annular and pump down the drill string until a sharp pressure increase ±3500 kPa (±500 psi) confirms that the shear rams are fully closed.
- Open the upper annular.

xv) Ensure all choke and kill line valves are closed and blocked.

xvi) If time allows, displace the riser to sea water by pumping through the running string, recovering the mud as the pit capacity allows.

xvii) POH the landing string.

- Inspect the running tool.
- Tie off and mark the landing string.
- Record and write the following in the tour report:

a) A full description of the string left in the hole.

b) The status of every BOP function.

c) A full description of the landing string.

xviii) WOW or disconnect, as required. Refer to Chapter 16.

27.10.5.i Retrieving the Emergency Drill Pipe Hang Off Tool From the 10 and 15 m BOPs

*Note: If the lmrp has been disconnected, the following checks should be made to ensure bop functions.*

*If it has not been disconnected, start the retrieval procedure at step no. (vii).*

i) Fill the riser with sea water and flow check, to ensure that the rams and drill pipe shut off valves have held.

ii) Ensure that all choke manifold valves are in the drilling position to start. Yellow valves open, red valves and all chokes closed.

iii) Put the annulus on the trip tank.

iv) Connect a Tee to the #1 valve outlet on the choke manifold.

- Connect the Dowell unit to one outlet of the Tee and a closed plug valve to the other.

v) Pressure test the choke, and kill lines to the high and low values of the last BOP test.

vi) To ensure annular and choke and kill valve functions, after re-latching:

- Set the annular regulator pressure to 4000 kPa (600 psi).
- Partially close, then reopen the upper annular.
- Partially close, then reopen the lower annular.
- Open and close the upper outer choke valve.
- Open and close the upper inner choke valve.
- Open and close the lower outer choke valve.
- Open and close the lower inner choke valve.
- Open and close the outer kill valve.
- Open and close the inner kill valve.

*Note: Flow check continuously at manifold and riser while carrying out these checks.*

At this point we have confirmed that all choke, and kill valves, and both annulars are fully operational. However, remember that the LMRP has not been pressure tested since re-latching. Therefore, if any well bore pressure is encountered in subsequent operations, the rams and not the annulars should be used to control the well.

vii) Flow check the drill string.

- Open the upper choke.

- If there is no pressure evident open choke manifold valve #6 and visually flow check at the open ended outlet.
- Close the upper inner choke.

Note: *A lack of pressure only indicates that the drill pipe non return valves have held, that well bore pressure (if any) is not in communication with the upper drill string, and that the pipe rams have held. This check is not a positive indication that the drill string is dead.*

Although freeze depressed mud and the proper glycol water mixture should eliminate ice plug problems in the drill string and annulus and in the BOP, the possibility of these plugs existing still must be considered.

Other problems which may isolate pressure from the surface drill string may be plugged jets, settled out barite in the drill string and/or annulus, or formation bridging in the annulus.

viii) To flow check the annulus.

Note: *Expect some gas under the lower rams due to the migration of gas entrained in the mud.*

- Open the kill line.
- If there is no pressure evident open choke manifold valve #1 and the plug valve and visually flow check.
- Close the plug valve and with Dowell, pump two times surface volume and kill line volume to ensure that the line is not plugged.
- Close the inner kill.

Note: *It is recognized that it is advisable not to use the kill line outlets unless absolutely necessary, for if the valves failed to close or seal, the well could not be shut in for disconnect purposes.*

However, in this case, it has been considered preferable, particularly since the valves have been functioned and pressure tested, to use the kill line rather than to risk damaging the rams by opening them under potential pressure.

Again, be aware that a lack of pressure does not prove that the well is dead, as annulus pressure may be isolated from surface by freeze back, formation bridging, or settled out barite.

x) Open the lower rams.

- Flow check at the riser.

x) To confirm that the lower rams are fully operational, close and reopen the rams.

xi) Open the middle rams.

- Flow check at the riser.

xii) To confirm that the middle rams are fully operational, close and reopen the rams.

Note: *At this point all BOP functions have been confirmed as fully operational except the shear rams.*

xiii) To confirm that the lower chokes are not plugged:

- Open the lower chokes.

- Pump down the kill line with the Dowell unit until returns are observed at choke manifold valve #6.
- Close the lower inner choke.

xiv) To confirm that the upper chokes are not plugged:

- Open the upper chokes.
- Pump down the kill line with the Dowell unit until returns are observed at choke manifold #6.
- Close the upper inner choke.

xv) To retrieve the drill string, run in to above the shear rams with the drill pipe hang off running tool.

- Ensure all drill pipe connections are made up to optimum torque.

xvi) Stroke out the Motion Compensator if necessary. Lightly engage the shear rams. Displace the riser to mud at a high rate to flush any debris which may have settled above the shear rams. After adequate flushing, pick up above the shear rams and continue displacing riser mud.

xvii) Open shear rams - flow check. Close the shear rams to confirm full shear ram function. Reopen the shear rams.

- Place all BOP and choke manifold functions in the drilling position.

xviii) To re-engage to hang off tool with:

a) The left hand acme running tool.

- Stroke out the Motion Compensator if necessary
- Lower the drill string and with the minimum possible weight contact the hang off tool.
- Make one turn to the right to align the threads.
- Turn the tool to the left until a slight increase in torque is noted. This should take approximately four turns.

b) Open ended drill pipe.

- Stroke out the Motion Compensator if necessary.
- Lower end drill string end with the minimum possible weight contact the hang off tool.
- Turn the string to the right torquing up the connection to no more than 70% of the make up torque of the running string. This should allow releasing at the tool if necessary.

xix) Hoist the drill string to establish whether or not it is free.

xx) Circulate to condition the mud and/or hole.

- Break circulation very carefully as the annulus may be bridged.
- Ensure pit volumes are being accurately monitored.
- If circulation pressures are high or if the integrity of the running strings connection to the hang off tool is suspect, drop a dye marker or a carbide to ensure the connection is not washing out.

xxi) Continue with operations as necessary.

xxii) POH and resume operations as necessary.

27.10.5.j Emergency Well Suspension With a Hook Wall Packer When Drilling Through the BOP and Either 340 mm (13-3/8"), 235 mm (9-5/8") or 178 mm (7") Casing Has Been Set

- This procedure is only to be used when the entire BOP must be pulled, or is inoperative.
- Using the Howco RTTS and SSC Valve

| PACKER SIZE | TENSILE LIMIT | | MINIMUM WT UNDER TO SET |
|---|---|---|---|
| 7" (178.0 mm) | 150000 daN | (370,000 lbs) | 4500 daN (10,000 lbs) |
| 9-5/8" (244.5 mm) | 338000 daN | (760,000 lbs) | 6800 daN (15,000 lbs) |
| 13-3/8" (340 mm) | 743000 daN | (1,700,000 lbs) | 9000 daN (20,000 lbs) |

RTTS Running Procedure:

In any situation, whether drilling, tripping, or out of the hole, it is preferable to set the pipe as deep in the casing as possible. To determine bit and RTTS setting depth, let:

a = Depth from RT to the position of the bit prior to picking up the RTTS.
b = Depth from RT to set the packer.
c = Casing shoe depth.
d = Safety factor (two stds of DP or equivalent).
e = Length by which BHA exceeds water depth from RT. This would only be applicable when drilling in extremely shallow water. The distance from the RTTS to the rotary table should be adequate to allow running the BHA in the event jarring or milling is necessary to unseat the packer.
f = Wellhead depth from RT.

i) Pump down the hydril latch in dart.

ii) Pull or run pipe as necessary to position the bit at a.
(a = c - f - d - e).

iii) Note and record the string weight prior to picking up the RTTS hang off assembly.

iv) Connect the RTTS assembly to the drill string.

- Ensure the acme back off connection is chain tong tight only.
- Ensure the kelly valve is open.

v) Run in slowly with the RTTS. Ensure that all connections above the acme back-off thread are properly torqued.

- When in shallow water where the length of the drilling BHA exceeds water depth, set the RTTS at a depth from RT equal to the length of the drilling BHA.

*Note: It is imperative that no junk is allowed to enter the hole above the RTTS.*

- Check all handling equipment, and install a wiper rubber as soon as the RTTS passes through the rotary table.

vi) Note and record the string weight at the RTTS setting depth, in the tour report.

vii) Pump a weighted slug to compensate for the hydrostatic pressure loss when the riser is removed, if necessary.

viii) To set the RTTS packer:

- Stroke out the Motion Compensator .
- Raise the string 1 m (3 ft), make a minimum of two right hand turns, and slowly slack off until the weight (record in step 3) is lost. Repeat this procedure if necessary.

Note: *Do not exert pressure above the SSC valve after backing off the landing string or the pump out plug will shear. The shear pin valve is normally 21000 kPa (3,000 psi), but different shear pressures are available by changing the shear pin size.*

- Determine the desired shear valve when ordering the RTTS.

ix) Close an appropriate annular preventer and pump down the choke or kill line to pressure test the RTTS from the top to 10000 kPa (1,500 psi).

x) To back off from the RTTS and close the SSC valve, rotate the 155.6 mm (6-1/8") and 120.7 mm (4-3/4") tools 22 turns to the left. Rotate the 94.5 mm (3.7") tool 20 turns to the left.

xi) Note the string which is hung off, the running string and the RTTS and bit depths in the tour report.

xii) POH to above the shear rams.

xiii) Close and block the shear rams and all choke and kill valves.

xiv) Displace the riser to sea water, recovering mud as mud tank capacity allows.

xv) POH with the landing string.

- Check the mandril and install the protector, before standing back or breaking off the mandril.
- Rope off the landing string.

xvi) Continue operations as required.

xvii) Fully describe the string left in the hole, the running string, and the BOP status in the tour report.

27.10.5.k Retrieving the RTTS

i) Open the well to surface by opening the appropriate sub sea choke or kill valves by a sensitive pressure gauge to a closed choke. If no pressure is evident, open the choke and check for flow.

- After flow checking, close the choke and kill valves.

Note: *If the well is flowing, a decision must be made to:*

a) Strip out, remove the RTTS hang off assembly and strip to bottom and kill the well.

b) Unseat the packer and kill the well immediately.

c) Bullhead.

*Note:* *A lack of pressure of flow only indicates that the packer and SSC valve have held, not that the well is dead.*

ii)
- Install and lock in the diverter insert packer.
- Pick up the SSC mandril. Remove the protector.
- Check the threads and ensure O-rings are in place and in good condition.
- Run the retrieving assembly to above the shear rams as soon as possible.

iii) Set the Motion Compensator to support landing string weight. Lightly engage shear rams. Begin displacing riser to mud at a high rate to flush out any debris which may have settle above the shear rams. After adequate flushing, pick up above shear rams and continue displacing the riser to mud.

iv) Open the shear rams and flow check the well.

v) Lightly engage the SSC valve and make a minimum 18 right hand turns (or until a slight torque build up is noticed), to engage the RTTS and open the SSC valve.

- If in doubt that the string is fully engaged, back out and repeat the procedure.

vi) Open the standpipe valve, or kelly valve in the case of the Surface Circulating Assembly, and flow check the well.

vii) Pick up to the previously recorded string weight plus 5000 to 10000 daN (10,000 to 20,000 lbs) to unseat the RTTS. Hold this tension for five minutes to allow the rubber element to retract.

viii) Flow check for a minimum of fifteen minutes.

ix) POH slowly with the motion compensator unlocked.

- It is not recommended that a circulation commence until the RTTS has been removed and the bit is as close as possible to bottom.

x) Resume operations as necessary.

*Note:* *Service the RTTS hang off assembly after each run.*

27.10.5.I Well Suspension By Shearing the Drill Pipe

i) Pump down the hydril dart sub, if time allows.

ii) Position the pipe so that the tool joint is 2 m (6 ft) plus rig heave above the middle pipe rams.

iii) Vent down the ram closing pressure to 3500 kPa (500 psi) to 5000 kPa (700 psi).

- This will ensure that if the rams are inadvertently closed on the tool joint, no damage will occur, and that stripping down to land out results in minimum ram rubber damage.

iv) Strip down until a loss of weight verifies that the tool joint is on the rams.

- Use the Motion Compensator if necessary.

v) Lift up just off the rams and boost the ram closing pressure to 10500 kPa (1,500 psi) and block the rams.

vi) Set the string back down on the rams and continue slacking off until only the weight of the string above the shear rams is supported.

vii) Close and block the lower rams with 10500 kPa (1,500 psi) closing pressure.

viii) Close and block all choke and kill valves.

ix) Close and block the shear rams with 14000 kPa (2,000 psi).

x) Pick up on the string to confirm that the pipe has been sheared.

- If shear has not been accomplished, open and close the shears as necessary until the pipe is cut.

xi) POH the landing string.

xii) Disconnect at the LMRP if time allows.
Refer to Chapter 16.11.15.

xiii) Fully describe the string left in the hole and the BOP status in the tour report.

27.10.5.m Retrieving A Sheared Off Drill String

*Note: If the LMRP has been disconnected, the checks outlined in steps (ii) to (vii) should be carried out. If the LMRP has not been disconnected, and there is no reason to suspect possible BOP systems malfunctions, the retrieval procedure may start at step (viii).*

i) Run and reconnect the LMRP.

ii) Fill the riser with sea water and flow check to ensure that the rams and drill pipe shut off valves have held.

iii) Ensure that all choke manifold valves are in the drilling position. Yellow open, Red indicates all chokes closed.

iv) Put the annulus on the trip tank.

v) Connect a Tee to #1 valve outlet on the choke manifold.

- Connect the Dowell unit to one outlet of the Tee.
- Connect a closed plug valve to the other outlet of the Tee.

vi) Pressure test the choke and kill lines, to the high and low values of the last BOP test.

vii) To ensure annular and choke and kill functions after re-latching:

a) Set the annular regulator pressure to 4000 kPa (600 psi).
b) Partially close, open the upper annular.
c) Repeat (a), for the lower annular.

d) Open and close the upper outer choke valve.
e) Open and close the upper inner choke valve.
f) Open and close the lower outer choke valve.
g) Open and close the lower inner choke valve.
h) Open and close the outer kill valve.
i) Open and close the inner kill valve.

Note: *Flow check continuously at the choke manifold rig floor outlet and at the riser while carrying out these checks.*

At this point, we have confirmed that all choke and kill valves and both annulars are fully operational. However, remember that the LMRP has not been pressure tested since re-latching. Therefore, if any well bore pressure is encountered in subsequent operations, the rams, and not the annulars, should be used to control the well.

viii) Make up the fishing assembly with the appropriate overshot and mill guide.

- The mill guide must be used to dress the sheared off joint back to its original size.
- Use adequate drill collars, jars, and the highest strength drill pipe aboard.

ix) Run in with open ended drill pipe to just above the shear rams.

- Use the highest strength pipe aboard, preferably S135.

x) Engage the top drive and using the Motion Compensator if necessary, lightly tag the shear rams.

- Mark the drill string at the rotary table.

xi) Begin displacing the riser to mud at a maximum pumps (2 x 100 SPM) to flush out any debris which may have settled above the shear rams.

- After adequate flushing, pick up and continue displacing the riser to mud.

xii) To flow check the annulus:

- Open the kill line to surface by a sensitive pressure gauge to a closed choke manifold.
- If there is no pressure evident, visually check flow at the rig floor outlet by opening choke manifold #1.

Note: *Expect some gas in the annulus due to the migration of gas entrained in the mud.*

Note: *If is recognized that it is preferable not to use the kill line outlets unless absolutely necessary for if the valves failed to close or seal, the well could not be shut in for disconnect purposes.*

However, in this case it has been considered preferable, particularly since the valves have been functioned and pressure tested, to use the kill line rather than open the rams under potential pressure.

xiii) With the Dowell unit, pump a maximum of two times surface plus choke line volume to ensure that the kill line is not plugged.

- Bleed back any pressure from this operation and flow check.
- Shut the inner kill line valve.

Note: *This procedure does not confirm that the well is dead, as ice, barite or formation bridges may be isolating well bore annular pressure.*

xiv) To flow check the drill string:

- Open the upper choke line to surface by a sensitive pressure gauge to a closed choke.
- If there is no pressure evident visually, flow check at the rig floor by opening choke manifold valve #6.

Note: *A lack of pressure only indicates that the drill pipe non return valves have held, that well bore pressure (if any) is not in communication with the upper drill string and that the pipe rams have held. This check is not a positive indication that the drill string is dead.*

Although freeze depressed mud and the proper glycol water mixture should eliminate ice plug problems in the drill string and annulus and in the BOP, the possibility of these plugs existing still must be considered.

Note: *Other problems which may isolate pressure from surface may be:*

a) Plugged jets.
b) Barite plugs in the drill string and/or annulars.
c) Formation of bridging in the annulus.

xv) Lower the retrieving string to just above the shear ram.

- Use the previous mark for reference.

xvi) Close the upper annular.

xvii) Line up the stand pipe manifold to monitor pressure and flow.

xviii) Line up the riser on the trip tank.

xix) Open the shear rams.

- Flow check at the riser and trip tank.

xx) Close and reopen the shear rams to confirm that they are fully operational.

xxi) Pump down the drill pipe until returns at the choke manifold valve #6 confirm that the upper choke line is not plugged.

- Close the upper inner choke.
- We are now sure there was no pressure below the shear rams.

xxii) Open the upper annular.

xxiii) Lower the running string to dress the sheared off drill string.

- Use the mark when the shear rams were tagged as reference.

xxiv) Begin milling off the flattened portion of the sheared area until the overshot will slip over the pipe.

- Continue lowering the string until the overshot bottoms out.

xxv) Pick up the string weight.

xxvi) Open the lower rams.

xxvii) Close and reopen the rams to ensure they are fully operational.

xxviii) Open the middle rams.

xxix) Close and open the middle rams to ensure they are fully operational.

xxx) Open the lower chokes.

xxxi) Open choke manifold valves #13 and #9 and with the Dowell unit pump down the lower choke until returns at the trip tank confirm the line is clear.

*Note: At this point, all BOP functions have been confirmed as "OK" and no pressure has been detected. However, the previously mentioned plugs in the drill string and/or annulus are still a possibility.*

xxxii) Hoist the drill string to establish whether or not it is free.

xxxiii) Circulate to condition the mud and/or hole.

- Break circulation very carefully as the annulus may be bridged.
- Ensure pit volumes are being accurately monitored.
- If circulation pressures are high or if the integrity of the running strings connection to the hang off tool is suspect, drop a dye marker or a carbide to assure the connection is not washing out.

xxxiv) Continue with operations as necessary.

27.10.5.n Well Suspension While Running 406 mm (16") or Smaller Casing Through BOP

i) Suspension With Casing In Casing

- Pick up hanger joint.
- ***Do Not*** run seal assembly with hanger.
- Run and land casing in wellhead.
- Measure in to ensure hanger is properly spaced out in housing.
- Back-off and recover landing string.
- Ensure an accurate tally of length, number of joints in hole, shoe depth, etc., is kept.
- Continue suspension procedures as described in 27.10.5.d.

ii) Suspension With Casing In Open Hole

This procedure is used only if time does not allow either finishing running casing or pulling casing back inside previous casing shoe.

- Pick up hanger joint.
- ***Do Not*** run seal assembly with hanger.
- Run and land casing in wellhead.
- Measure in to ensure hanger is properly spaced out in housing.
- Back-off and recover landing string.
- Ensure an accurate tally of length, number of joints in hole, shoe depth, etc., is kept.
- Continue suspension procedures as described above.

iii) Suspension When Running Landing String

- Continue running casing and land out in wellhead.
- Measure in to ensure hanger is properly spaced out in housing.
- Ensure an accurate tally of length, number of joints in hole, shoe depth, etc., is kept.
- Back-off and recover landing string.
- Continue suspension procedures as described above.

iv) Suspension When Running Liner

- Pick up liner hanger and running assembly if not already down hole.
- Pick up and run in with primary hang off assembly and hang off as described in 27.10.5.d.
- Continue suspension procedures as described above.

Emergency Procedures While Running Casing Through BOP

i) Suspension With Casing In Elevators

- Close both annulars.
- Remove 500 ton Spider Slips from rotary.
- Slack-off on blocks and open elevators.
- Open annulars to drop casing.
- Wait a minimum of two minutes to allow casing to pass BOP.
- Continue with emergency disconnect procedures as described above.

27.10.6 L.M.R.P. Disconnect Procedures

27.10.6.a Normal Disconnect

i) Condition

Well has been suspended normally. L.M.R.P. is being retrieved for repair, or a pending ice condition.

ii) Procedure

Refer to normal rig BOP procedures.

27.10.6.b Emergency Disconnect

i) Conditions

- Weather conditions deteriorating rapidly, so that the combined effect of pitch/roll and riser angle is greater than 4°.
- Anchor tensions dangerously high, or 80% of pre-tension values.
- Ice conditions deteriorating rapidly so that time does not allow normal alert status procedures to be carried out.

ii) Procedure

- If no D.P. in hole, close shear rams.
- If pipe in hole, pick up primary hang-off tool. Hang-off on middle pipe rams per procedures.
- Close lower pipe rams.
- Back off running tool with 7 right hand turns.
- Pick up running string at least 3 m and close shear rams.

- Block all functions from main B.O.P. hydraulic panel except riser connector (primary and secondary).
- Set guideline tension at 7,000 lb.
- Have the combined riser tensioner pull set at 10% less than the weight of the slip joint outer barrel + riser + L.M.R.P.
- Ensure all standby and emergency standby APV's are fully charged to 2,200 psi, and that all 3 standby bottles are open to system.
- Select one active APV per riser tensioner system and close the remaining 4 APVs.
- Unlatch L.M.R.P. connector (primary and secondary). Monitor fluid flow and manifold read back to ensure connector has released.
- Increase pressure to riser tensioners until slip joint is fully collapsed.

*Note. Slip joint should begin moving at approx. 50,000 lb over weight set in step 7.*

- After slip joint collapsed increase weight an additional 50,000 lbs to secure package in this position.

*Option 1 If rig moving off location more than 50 ft, imminent.*

a) Shear guidelines and bring to surface.

b) Install riser spider and attempt to pull L.M.R.P. into moonpool high enough so that nothing extends below hull.

*Option 2 If option 1 is unwarranted.*

a) Slack guidelines as situation warrants.

b) Same as Option 1.

*Note: In the event pitch and roll is greater than 3.5° (which may exist in a clear water condition) therefor making rig moving off location unlikely, riser should be suspended on tensioners until such times as condition warrants relatching to B.O.P.*

27.10.6.c Extreme Emergency Procedures In Open Sea Storm Conditions

i) Condition

Weather conditions deteriorating rapidly, so that the combined effect of pitch/roll and riser angle is greater than 6°.

Emergency disconnect procedures have failed re H-4, L.M.R.P. connector failure, or other?

ii) Procedure

Well is secure.

- Block all functions (from main hydr. unit if possible).
- Drill crew unlatch and pull diverter packer.
- Make up diverter handling tool.
- Vent flowline seals and unlatch diverter from pump room diverter panel.
- Ensure both pod tensioners are at lower end of stroke. (approx .5 m (1.5') of exposed rod depending on heave.)
- Ensure both clutches and brakes are securely engaged on pod hoists.
- Increase podline tension to 14,000 lb (ensure pod hoist drums do not slack off as tension is increased).

- Select active APV for each riser tensioner system. Reduce total applied tension to 30% over weight (slip joint outer barrel + riser + top half of AMF).
- Unlatch AMF (watch for indication on manifold read back and flow meter).
- As riser starts to move upward, increase tension until slip joint fully collapsed.
- Shift both pods to unlatch position. (thereby engaging riser jacks). Pods should now release from L.M.R.P. and pod tensioners should fully stroke out. More air may have to be added to podline tensioners to accomplish above after tensioner begins to stroke out.
- Remove diverter control block.
- Pull diverter slip joint and riser as far as possible into moonpool.
- Remove RBQ's from hose reels.
- Continue pulling pods to surface with hoists, stopping only to remove pod hose clamps. Continue reeling in pod hose.
- If rig starts to move off location.
- Increase tension to 14,000 lb on guidelines shearing out as many lines as possible, if shearing fails.
- Feed out line till line pulls out of drum. Bleed down guideline air to 0 psi while feeding out lines.

Note: *To implement above, entire Deck Crew, Sub Sea, Tool Pusher and Drill Crew will be required.*

Note: *For any of the above, RBQ plates will not be removed from hose reel before slip joint begins to collapse and pods are pulled free.*

- Begin releasing RAR's and/or anchor winches.
- Continue pulling riser while releasing anchors.

27.10.6.d Extreme Emergency Procedures In Ice Conditions

i) Condition

A large mass of ice has evaded detection by ice monitors and now is at or near rig, making immediate rig departure from location imminent.

ii) Procedure

- Secure well, by closing shear rams, which may require shearing pipe, casing, logging tools, and/or dropping drill string in fastest way possible.
- Increase manifold pressure to 2,000 psi minimum.
- Try to follow 27.10.6.b procedure if time allows and riser angle under 5°.
- Over 5°, block all functions on stack.
- Clear drill floor of all personnel and unlock A.M.F.

Note: *Depending on riser tensioner pressure, riser may sling shot out of water, shear diverter lock down dogs and push rotary bushings and diverter past drill floor.*

- Unlock both pods and increase tension on line till pods pull free of receptacle.
- Pull pods to surface.
- Shear guidelines and retrieve.
- Pull diverter, slip joint, riser and lay down.
- If guideline shear pins do not shear, bleed down tensioner pressure to 0 psi and allow line to feed off as rig moves off location. When all line is fed off, line will pull out of drum and drop to sea bed. Insure all personal are clear of moonpool area during this operation.
- If pods do not pull free, remove RBQ and feed off pod hose, cut hose off at drum and drop to sea bed.

**TABLE 27.8.2**

| ALERT STATUS | INTERPRETATION | HAZARDS SOURCE | ALERT STATUS | DRILLING RESPONSE | MARINE RESPONSE |
|---|---|---|---|---|---|
| GREEN | NORMAL OPERATIONS | ENVIRONMENT | HT-ST IS MORE THAN 12 HOURS | RESTRICT OPERATIONS TO AVAILABLE LEADTIME | NORMAL WATCH |
| | | WELL | KT IS ON LEVEL I | NORMAL WELL MONITORING AS PER KT=I | |
| | | VESSEL | ALL EQUIPMENT FULLY OPERATIONAL | NORMAL DRILLING OPERATIONS | |
| BLUE | EARLY ALERT | ENVIRONMENT | HT-ST IS LESS THAN 12 HOURS | RESTRICT OPERATIONS TO AVAILABLE LEAD TIME | NORMAL WATCH |
| | | WELL | KT IS ON LEVEL II | INCREASE WELL MONITORING VIGILANCE AS PER KT=II | |
| | | VESSEL | MINOR EQUIPMENT MALFUNCTION | NORMAL DRILLING OPERATIONS | |
| YELLOW | EARLY WARNING | ENVIRONMENT | HT-ST IS LESS THAN 6 HOURS | RESTRICT OPERATIONS TO AVAILABLE LEAD TIME | PREPARE FOR HAZARD ARRIVAL |
| | | WELL | KT IS ON LEVEL III. GAS LEVELS HIGH | RESTRICT DRILLING TO ENHANCE WELL MONITORING AS PER KT=III | ALERT WATCH |
| | | VESSEL | MAJOR EQUIPMENT MALFUNCTION. PROCEDURES REQUIRE VIGILANCE BEING CONDUCTED | RESTRICT DRILLING OPERATIONS AS REQUIRED | |
| RED | HAZARD PRESENT | ENVIRONMENT | HT-ST IS 0 OR LESS | STOP OPERATIONS AND SECURE WELL AND DISCONNECT | SECURE VESSEL |
| | | WELL | WELL CONTROL OPERATIONS IN EFFECT | CONTROL WELL, AND ADVISE BARGE AS TO DEGREE OF KICK SEVERITY | SECURE VESSEL STANDBY WATCH |
| | | VESSEL | ESSENTIAL EQUIPMENT MALFUNCTION VESSEL STABILITY OR INTEGRITY COMPROMISED | STOP OPERATIONS AND SECURE WELL | SECURE VESSEL |
| BLACK | HAZARD THREATENS PERSONNEL SAFETY AND/OR VESSEL STABILITY AND INTEGRITY | ENVIRONMENT | HAZARD IS EQUAL TO OR LESS THAN VESSEL SECURE TIME & EVAC. TIME | USE EMERGENCY PROCEDURES TO SECURE WELL IF NECESSARY | EVACUATE PERSONNEL |
| | | WELL | CONTROL OF WELL IN DANGER OF, OR HAS BEEN LOST | USE EMERGENCY PROCEDURES TO SECURE WELL | |
| | | VESSEL | VESSEL STABILITY, OR INTEGRITY IN DANGER OF, OR HAS BEEN LOST | USE EMERGENCY PROCEDURES TO SECURE WELL | |

**KULLUK ALERT STATUS SYSTEM**