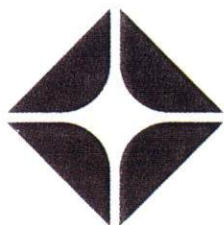


EXPLORATION PLAN
including
ENVIRONMENTAL REPORT
and
HYDROGEN SULFIDE CONTINGENCY PLAN



ARCO Alaska, Inc.

**ARCO WARTHOG NO. 1
EXPLORATION WELL**

Surface Location: OCS Y-1663
Bottomhole Location: ADL 371014

Submitted to the
MINERALS MANAGEMENT SERVICE
as per 30 CFR 250.33
April, 1997

RECEIVED
Anchorage, Alaska

AUG 19 1997

REGIONAL SUPERVISOR
FIELD OPERATION
MINERALS MANAGEMENT SERVICE

Prepared by:


FAIRWEATHER
E & P SERVICES, INC.

Anchorage, Alaska

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- A. Geological and Geophysical Information (Privileged and Confidential)
- B. Shallow Hazard Survey Report (Privileged and Confidential)
- C. Oil Spill Contingency Plan

APPENDIX

- I. Hydrogen Sulfide Contingency Plan
- II. Environmental Report

1.0 INTRODUCTION AND PROJECT SUMMARY

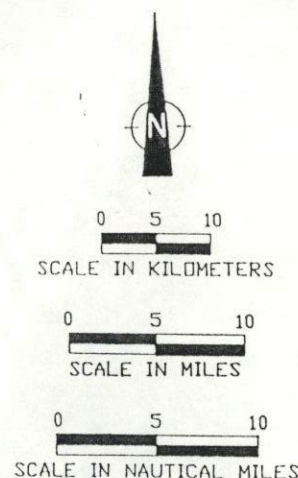
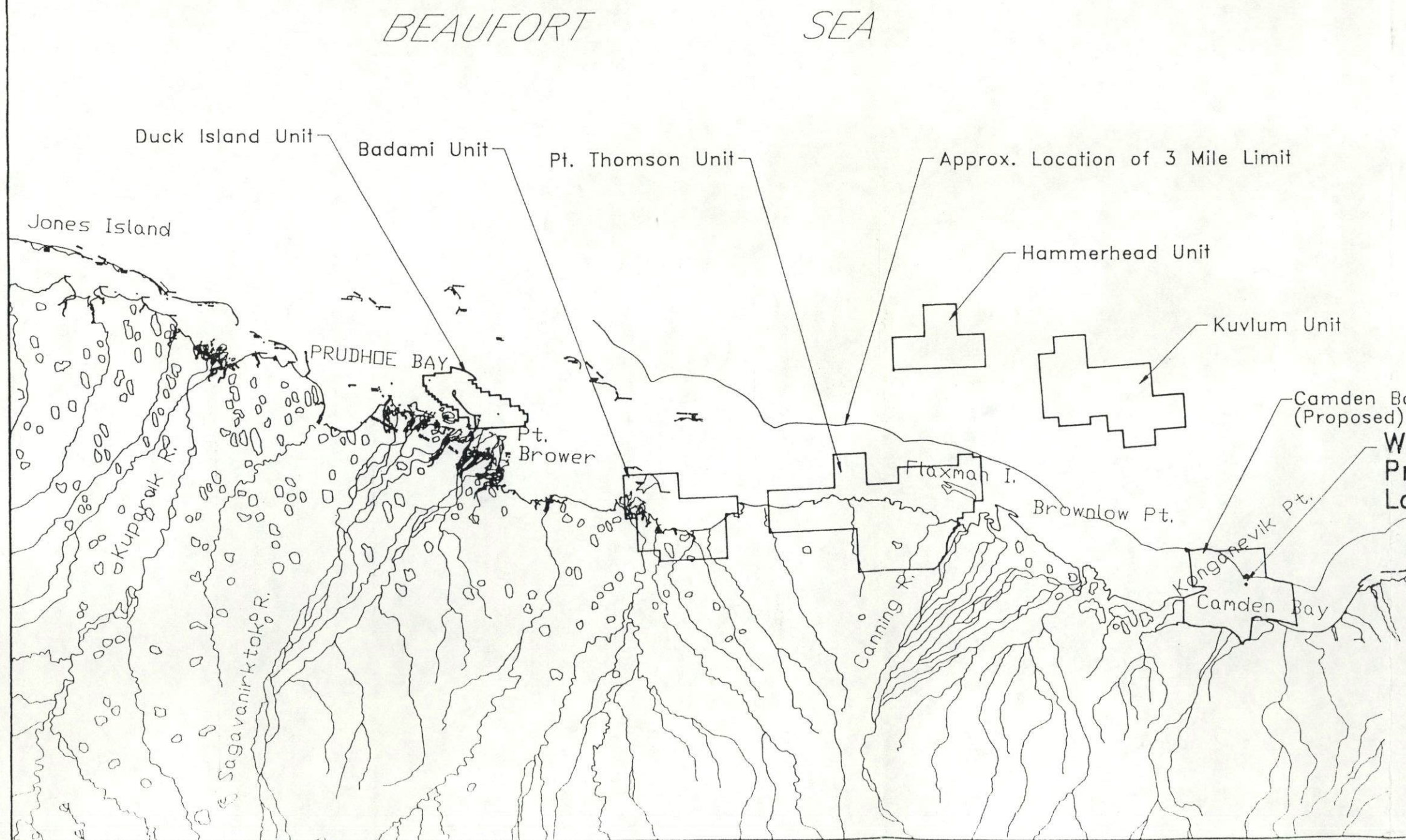
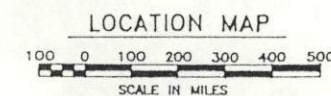
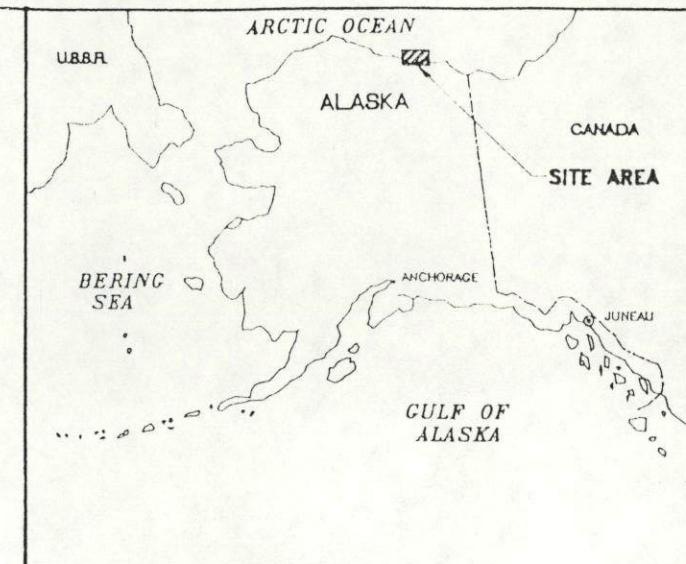
The ARCO Warthog project consists of drilling one or more exploratory wells during the 1997-1998 winter drilling season to evaluate the oil and gas potential of ARCO Alaska, Inc. (ARCO) operated leases in Camden Bay, eastern Beaufort Sea, Alaska (See Figure 1-1). These leases were acquired by ARCO in State of Alaska Oil and Gas Lease Sale No. 50 (June, 1987), and Federal OCS Lease Sale 144 (September, 1996). The area of interest covered by this Exploration Plan is encompassed within the proposed Federal/State Camden Bay Unit. (See Figure 1-2). At present, a single exploration well location has been identified in the area. This initial well, hereinafter referred to as "ARCO Warthog No. 1" is programmed as a directionally drilled hole from a surface location in OCS Lease Block Y-1663 to a bottomhole location in State of Alaska Lease Block No. 371014 (See Figure 2-1). Since both Federal and State acreage is involved in this exploration drilling program, a dual permitting path is being followed. ARCO Alaska, Inc. is the operator of the proposed well and will be the permittee of record.

The Global Marine Drilling Company "Glomar Beaufort Sea I" Concrete Island Drilling System (CIDS) will be used for the proposed drilling activity. Any additional exploration/delineation drilling is dependent on the outcome of the Warthog No. 1 well and further review of geologic, geophysical and reservoir data. The ARCO Warthog No. 1 well will be expendable, and therefore plugged and abandoned regardless of any commerciality demonstrated during testing and evaluation. If this initial well shows potential for hydrocarbon development, the original hole may be plugged back and sidetracked to a different bottomhole location, in order to provide a "second look" within the 1997-1998 drilling season.

This Exploration Plan is submitted to the MMS in accordance with the requirements of 30 CFR 250.33. The activities proposed herein will also conform with the Alaska Coastal Zone Management Program, and be conducted consistent with the terms and conditions of Federal and State permits that are required to be obtained by the operator.

Some components of this Exploration Plan are "Proprietary and Confidential," and are submitted to the MMS for their exclusive use. This material is presented in Stand-alone Exhibits and is clearly marked as to the confidential nature of the contents.

* Exploration Well Unit locations are approximate.



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ARCO Alaska, Inc.

FIGURE 1-1
 ARCO Warthog No. 1
 Exploration Well Vicinity Map

DATE: 4/2/97	DRAWN BY: SR	SCALE: AS SHOWN	DRAWING: CAMBAY2
C/SC: 1:18000	PM: B. Gardner	CHECKED: B. Gardner	PROJECT: 008-05-211

2.0 DESCRIPTION OF PROPOSED ACTIVITIES

An overview and general description of the ARCO Warthog No. 1 project is found in Section 1.0 herein. The following sub-sections expand on the type and sequence of exploratory activities and present a schedule for project execution.

2.1 Project Location

The ARCO Warthog No. 1 drilling location lies approximately 6 miles northeast of Konganevik Point in Camden Bay (See figure 2-1). Specifically the well will be located:

ARCO WARTHOG NO. 1 WELL LOCATION AND DEPTH INFORMATION						
	Lease Block- Sec./Tsp/Range	Geodetic Position	ASPC Zone 3 (ft)	UTM Zone 6 N (m)	Water Depth	Well Depth @ TD
Surface Location	OCS Block Y-1663	Lat: 70°02'40"N Long: 144°55'35"W	X = 634,206 Y = 5,866,936	X = 578,974 Y = 7,771,998	-35.5 ft MLLW	
Bottomhole Location @ -9000 FT TVDSS	State of Alaska Lease Block ADL 371014 853 ft. FEL, 2384 ft. FSL, Sec. 20, 8N., 29E., UM	Lat: 70°01'58.1"N Long: 144°56'06.1"W	X = 633,200 Y = 5,862,659	X = 578,689 Y = 7,770,689	-29 ft MLLW	-9000 ft TVDSS 10000 ft MD

Figure 2-2 shows preliminary bathymetry and seafloor features in the area of the surface and bottomhole locations. More detailed bathymetry will be run as part of the Shallow Hazard Survey scheduled for summer 1997 as soon as open water conditions allow.

2.2 Proposed Project Schedule

The ARCO Warthog No. 1 spud date is estimated to be on or around November 1, 1997, or as close to that date as possible following the formation of ice cover in Camden Bay. Numerous project related activities are scheduled to occur during the months prior to the spud date. These tasks, along with all other major components of the project schedule are shown in Figure 2-3.

Permitting and Regulatory Affairs (March 1, 1997-August 20, 1997)

Due to the dual permitting paths required by the Federal/State components of the Warthog project, approximately six (6) months have been allocated for permit application, review and approvals.

Pre-Mobilization Activities On Board Drilling Vessel (June 1, 1997-August 15, 1997)

The CIDS rig has been cold stacked in the Prudhoe Bay area, south of Reindeer Island, since 1990. Prior to returning the vessel to active service, numerous inspections, maintenance, and renewal of certifications are required. Personnel necessary to accomplish these tasks are

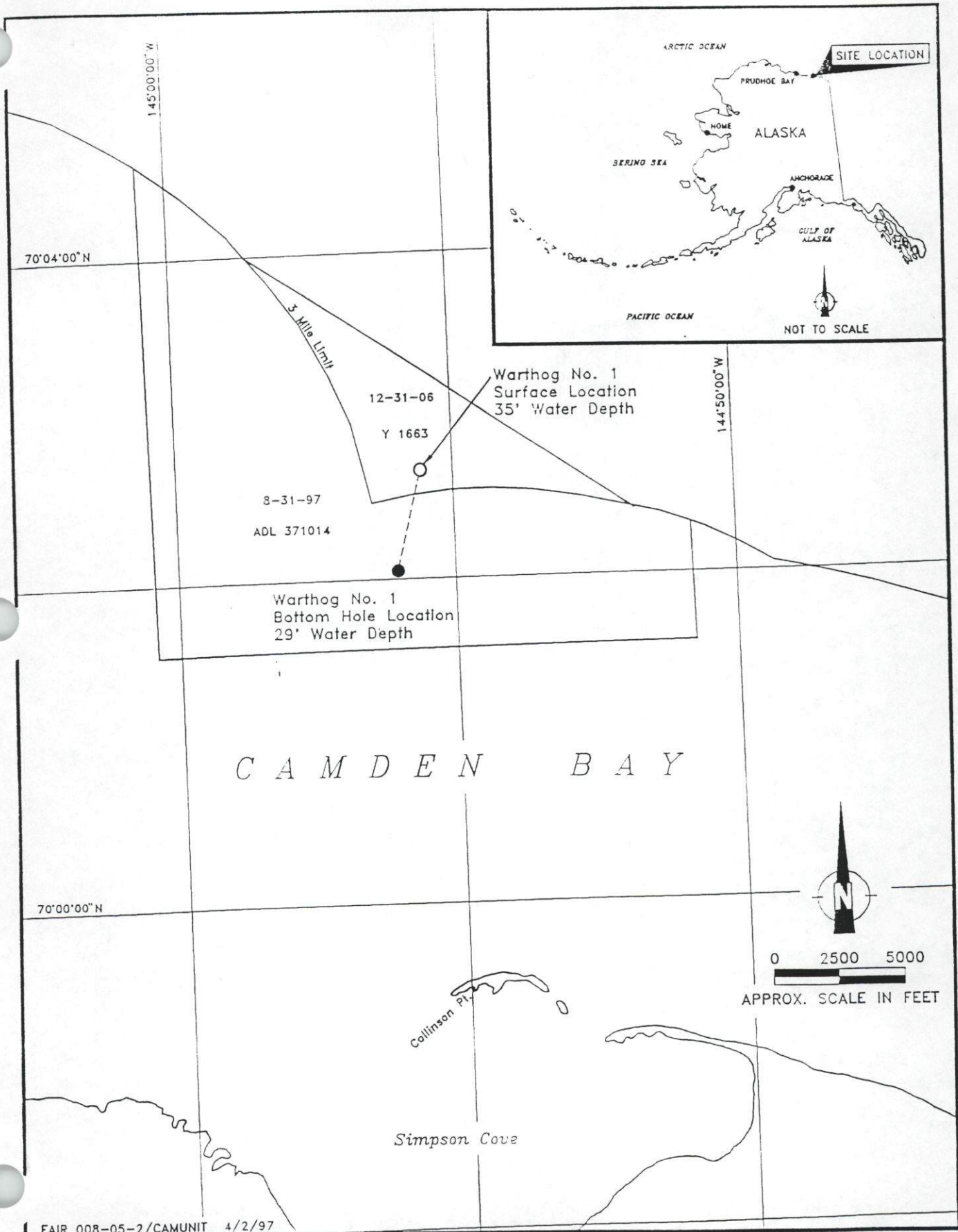


Figure 2-1
 ARCO Warthog No. 1
 Location Map

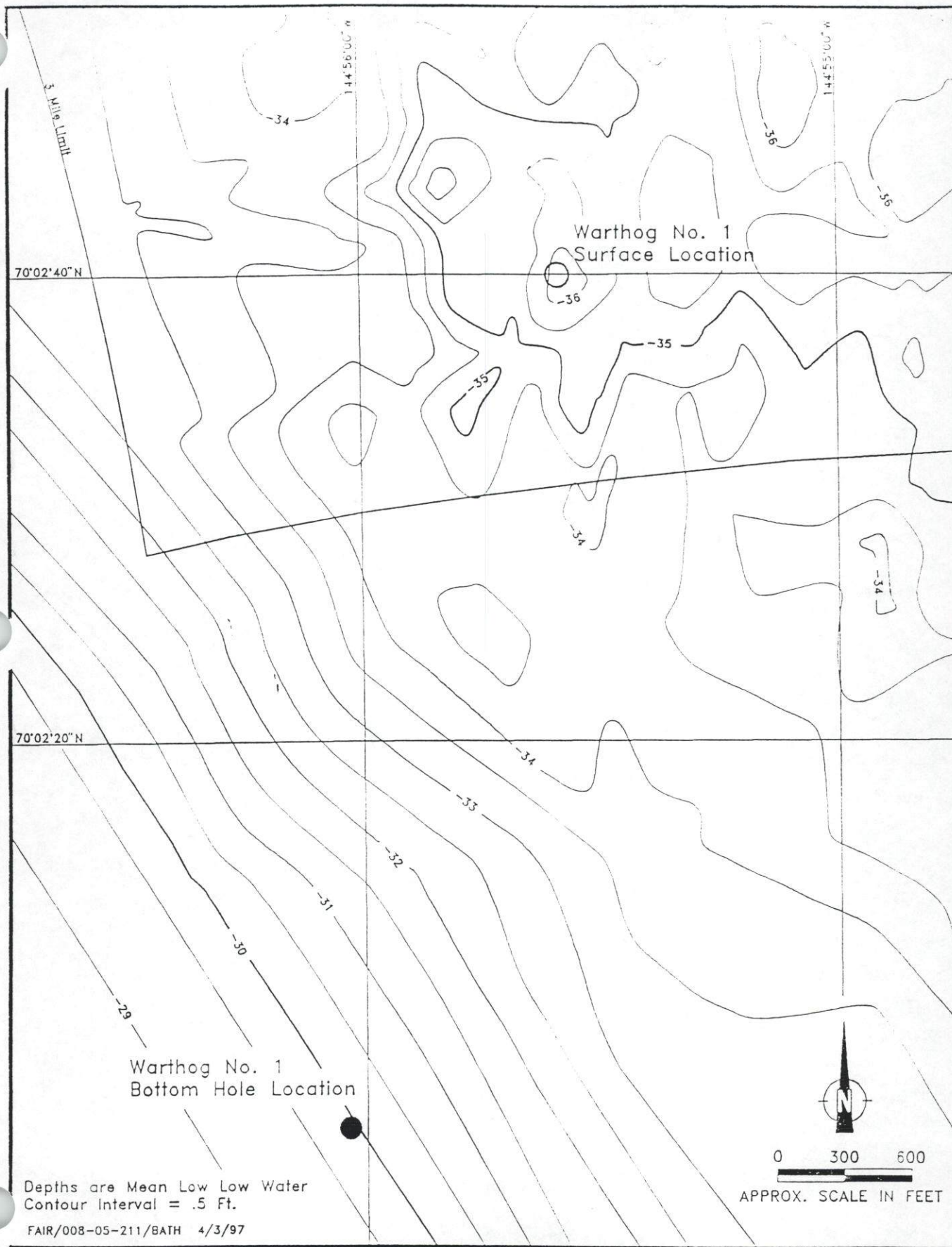
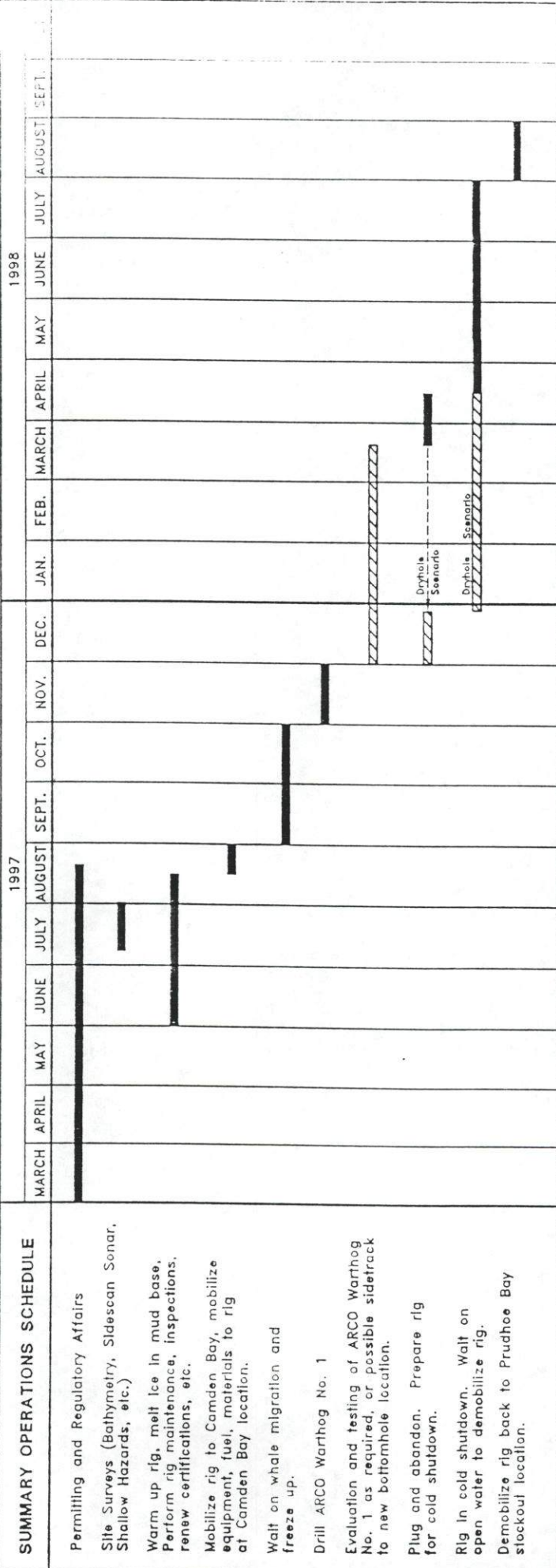


Figure 2-2
 Preliminary Bathymetric Map
 of ARCO Warthog No. 1 Location

Figure 2-3
Proposed ARCO Warthog No. 1 Project Schedule

ARCO Alaska Inc., ARCO Warthog No. 1

Prepared by Fairweather E&P Services, Inc.



scheduled to go aboard the CIDS on or about June 1, 1997. Pre-mobilization work will require approximately 2-1/2 months. Accumulated ice in the mud base will be melted during this period so the vessel can be deballasted.

Shallow Hazard Geophysical Surveys (July 15, 1997-July 31, 1997)

Site specific shallow hazard surveys are required at the ARCO Warthog No. 1 location before a Permit to Drill can be issued. The result of these surveys will become a Stand-alone Exhibit of this Exploration Plan when they are compiled. These surveys are scheduled to be run as soon as open water conditions allow. July 15, 1997 is the earliest estimated start of field operations for these surveys. Approximately two weeks will be required to run the surveys, reduce the data and prepare the report.

Rig Mobilization to ARCO Warthog No. 1 Location in Camden Bay (August 15, 1997-September 1, 1997)

In order to avoid the fall Bowhead whale migration, rig mobilization activities are scheduled to be completed by September 1, 1997. The mobilization period will include deballasting and towing the drilling vessel from the Prudhoe Bay area stack location to Camden Bay and ballasting the rig down on the ARCO Warthog No.1 location. Once the rig is secure on the Warthog site, several tug and barge voyages (estimate ≈5) will be made to the rig from West Dock in Prudhoe Bay to fully provision the rig with the consumables, materials and equipment required to drill the initial well and a possible sidetrack during the 1997-1998 drilling season. The tug and barge supply of the rig in Camden Bay is scheduled to be completed by September 1, 1997, though the schedule may be impacted by Beaufort Sea ice conditions. Tugs will remain in attendance of all barges during loading of consumables including fuel transfer activities at the CIDS. It is anticipated that the pre-spud MMS rig inspection would occur shortly after the rig was on station in Camden Bay.

Warm Shutdown During Whale Migration (September 1, 1997 - October 31, 1997)

At the conclusion of mobilization activities, the rig will be placed in a condition of warm shutdown during the approximate two month period of the Bowhead whale migration and while awaiting the development of full ice cover in Camden Bay. Native subsistence whaling activities, which traditionally occur in this same time frame, are not expected to be impacted by the presence of the rig in Camden Bay under a warm shutdown condition, since noise sources will be at a minimum.

ARCO is actively involved in ongoing negotiations regarding the prevention of unreasonable conflicts with subsistence activities on the North Slope. ARCO has met informally with the Chairman of the Alaska Eskimo Whaling Commission (AEWC), Mr. Thomas Napageak, on April 17, 1997 in Anchorage, AK and with the whaling captains of Kaktovik on May 14, 1997 in Kaktovik, AK. ARCO has also met with North Slope Borough personnel (Mr. Jon Dunham and Mr. Gordon Brower) and the executive director of the AEWC, Ms. Maggie Ahmaogak, on June 11, 1997 in Barrow, AK and with a combined group of Barrow, Kaktovik, and Nuiqsut whalers along with AEWC representatives in Deadhorse on June 28, 1997 to discuss the Warthog project. In summary, the issues discussed during these meetings included the following:

- Delay of drilling operations until winter freeze-up on or about November 1, 1997;
- Use of a bottom-founded drilling structure (CIDS);

- Involvement of onboard Inupiat communicators for vessel activities;
- Participation in communications network;
- Provision of emergency assistance if ARCO's and its contractor's vessels are in the vicinity and physically able to provide such assistance;
- Local hire when possible;
- Reactivation of the Kaktovik spill response team;
- Negotiation of a Conflict Avoidance Agreement with the whaling community;
- ARCO's best efforts to move the CIDS to location in Camden Bay by September 1;
- Flying helicopters at 1500 feet or higher and away from the Beaufort Sea coast until it is absolutely necessary to travel over water during whaling season; and
- Other assorted aid to be negotiated.

Additional meetings are scheduled to be held in Kaktovik and Nuiqsut to further discuss ARCO's planned operations and preventive measures to avoid conflicts with the subsistence communities of the North Slope. These preventive measures include, among others, ARCO's best efforts to move the CIDS rig to the Warthog surface location by September 1, 1997 and the delaying of drilling operations until after winter freeze-up in late October or November.

Since there will be no drilling activities conducted until after winter freeze-up, and ARCO's activities after September 1, 1997, if any, would consist entirely of vessel movement, the MMS has already determined that there is no need for the sight specific monitoring plan called for in Lease Stipulation 4 of Federal OCS Lease Sale 144 (MMS letter dated June 19, 1997).

Drilling the ARCO Warthog No. 1 Well (November 1, 1997-November 30, 1997)

After the Bowhead whale migration and the development of full ice cover, the Warthog well will be spudded and drilled in accordance with the program defined in the approved Application for Permit to Drill. The drilling operation is expected to take approximately 30 days to reach TD. This timeline is based on drilling data from the ARCO Stinson No. 1 and ARCO Wild Weasel wells through the correlative hole section.

Post-Drilling Evaluation Activities (Approximate Time Frame: December 1, 1997 - to no later than April 15, 1998)

At the conclusion of drilling and log evaluation, several options are presented, depending on what is discovered in the Warthog No. 1 well. If the well is a dry hole and the operator elects to cease all further work, the well would be permanently plugged and abandoned (P&A), and the rig placed in cold stack condition until demobilization the following summer during the open water season. If drilling results are encouraging, the operator may elect to flow test the well. This activity is anticipated to take between two and four weeks depending on the test program. At the conclusion of testing, the well will be either P&A'ed as in the previous scenario, or plugged back and redrilled to a different bottomhole location in order to gain additional reservoir information within the 1997-98 winter drilling season. The sidetrack well may or may not be tested at the election of the operator. Following evaluation, the sidetrack hole will be P&A'ed, and the rig placed in cold shutdown condition, as in the previous scenario.

During the evaluation phase of the original and/or sidetrack hole, the operator may elect to seismically profile the wellbore(s). The energy source for this activity will be an airgun, a vibroseis unit or other appropriate energy source, depending on ice thickness. Approval of this geological and geophysical exploration activity is being sought concurrently with the overall ARCO Warthog No. 1 permitting process.

Rig in Cold Shutdown (Conclusion of P&A Work to Approximately August 1, 1998)

Once the well(s) are permanently plugged and abandoned in accordance with 30 CFR 250.112, and applicable Alaska Oil and Gas Conservation Commission (AOGCC) regulations, the rig will be shut down and cold stacked until the open water season in the summer of 1998. The mobilization of tugs from Seattle to Camden Bay is the critical path to rig demobilization, and August 1, 1998 is the date estimated for arrival of these tugs at the Warthog location. Under this schedule, crews would re-occupy the CIDS in mid-July, 1998 to warm up the vessel and deballast in preparation for tow.

Demobilization of CIDS to Stack Out Location in Prudhoe Bay Vicinity (August 1998)

The rig will be demobilized back to the Prudhoe Bay vicinity as early as practicable in August 1998. A final site clearance side scan sonar survey will be made immediately following the departure of the rig from the Warthog location.

3.0 DESCRIPTION OF THE DRILLING UNIT INCLUDING SAFETY AND POLLUTION PREVENTION FEATURES

3.1 Mobile Drilling Unit Description

The Glomar Beaufort Sea I is a mobile offshore drilling unit designed specifically for year-round exploratory drilling in harsh offshore arctic environments in water depths ranging from 35 to 55 feet. The drilling unit is classified by the American Bureau of Shipping as a ⌘ A1 caisson drilling unit and is completely certified by the United States Coast Guard.

The Glomar Beaufort Sea I consists of six structural modules: a steel mud base, a center structure of honeycomb concrete referred to as the "Brick," two steel deck storage barges, the quarters unit and the drilling rig (See Figure 3-1). Combined, these modules form a drilling unit which can be towed to, and ballasted down at, the drill site. When required, the unit can be deballasted, refloated and towed to another drill site. The deballasting and refloating operation can be accomplished within approximately 72 hours under normal conditions.

The rig is completely self supporting and can operate without the resupply of major drilling consumables for periods of up to ten months. This freedom from resupply permits continuous drilling operations throughout the year in remote arctic regions.

3.1.1 Modular Components

The steel mud base consists of a series of large tanks which can be flooded with sea water thereby providing ballast control during the lowering or refloating of the platform. Once on the bottom, the tanks are completely filled to obtain the maximum gravity load. The mud base is the means by which the ice loads are transmitted from the Brick to the foundation soil. A five foot deep grid, which extends beneath the base, penetrates the soils to provide further resistance to sliding.

The concrete Brick, connected to the steel mud base, is the main structural element which resists the large ice forces prevalent in the arctic. The Brick supports the two deck storage barges. Combined, the two deck barges provide a total of more than 79,000 square feet of deck space as well as internal areas for machinery spaces and storage for fuel and consumables (See Figures 3-2 and 3-3).

The starboard barge houses a survival shelter which is outfitted to support all crew members for a period of up to three days in the event of a major on-board emergency. The quarters are installed on the starboard barge. The drill rig and all drilling support equipment are located on the port barge. Both the drill well located in the port barge and the service well located in the starboard barge run vertically through the barges, Brick and base. Multiple wells can be drilled at a single platform location.

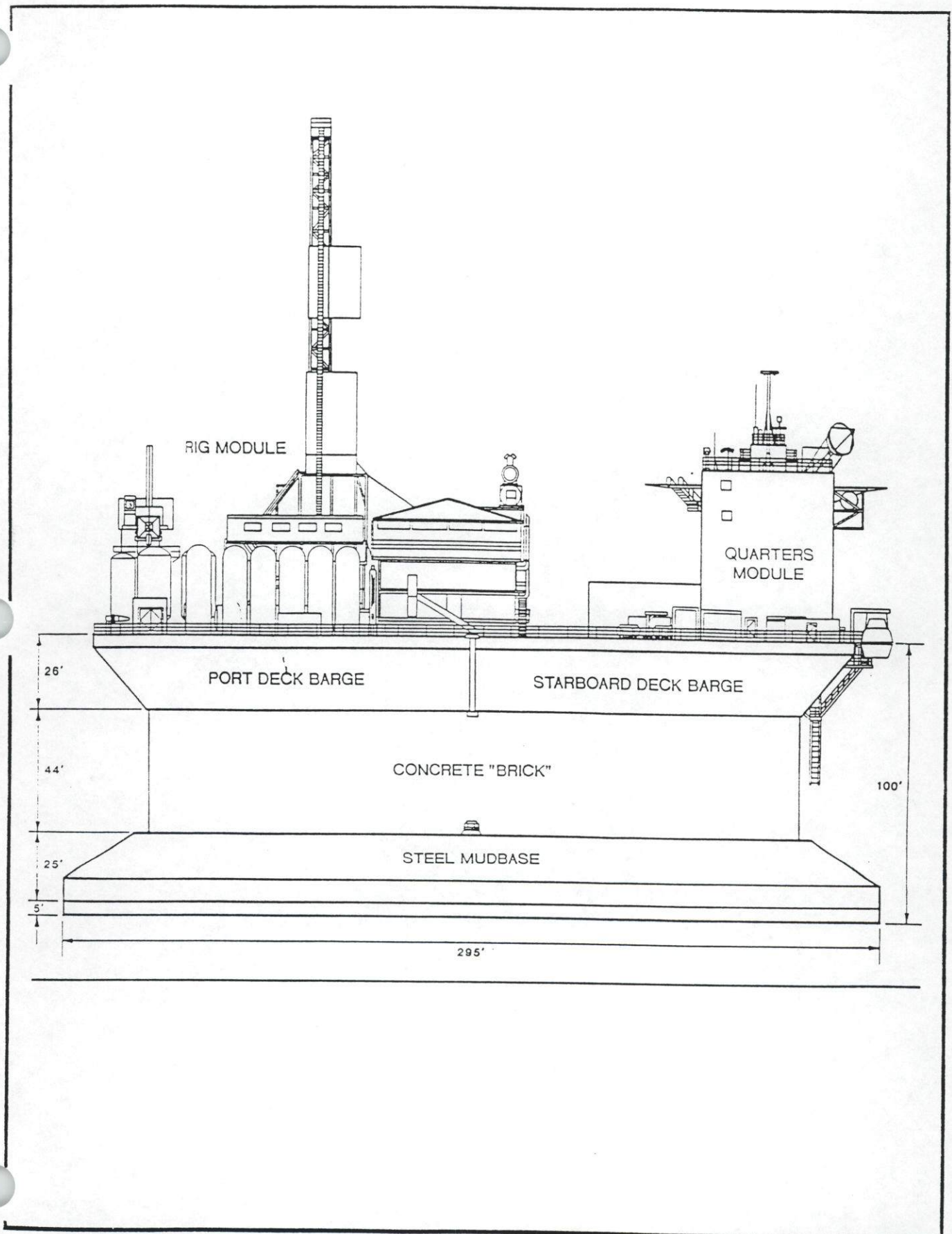


Figure 3-1
 Glomar Beaufort Sea I
 Concrete Island Drilling System (CIDS)
 (View Looking Forward)

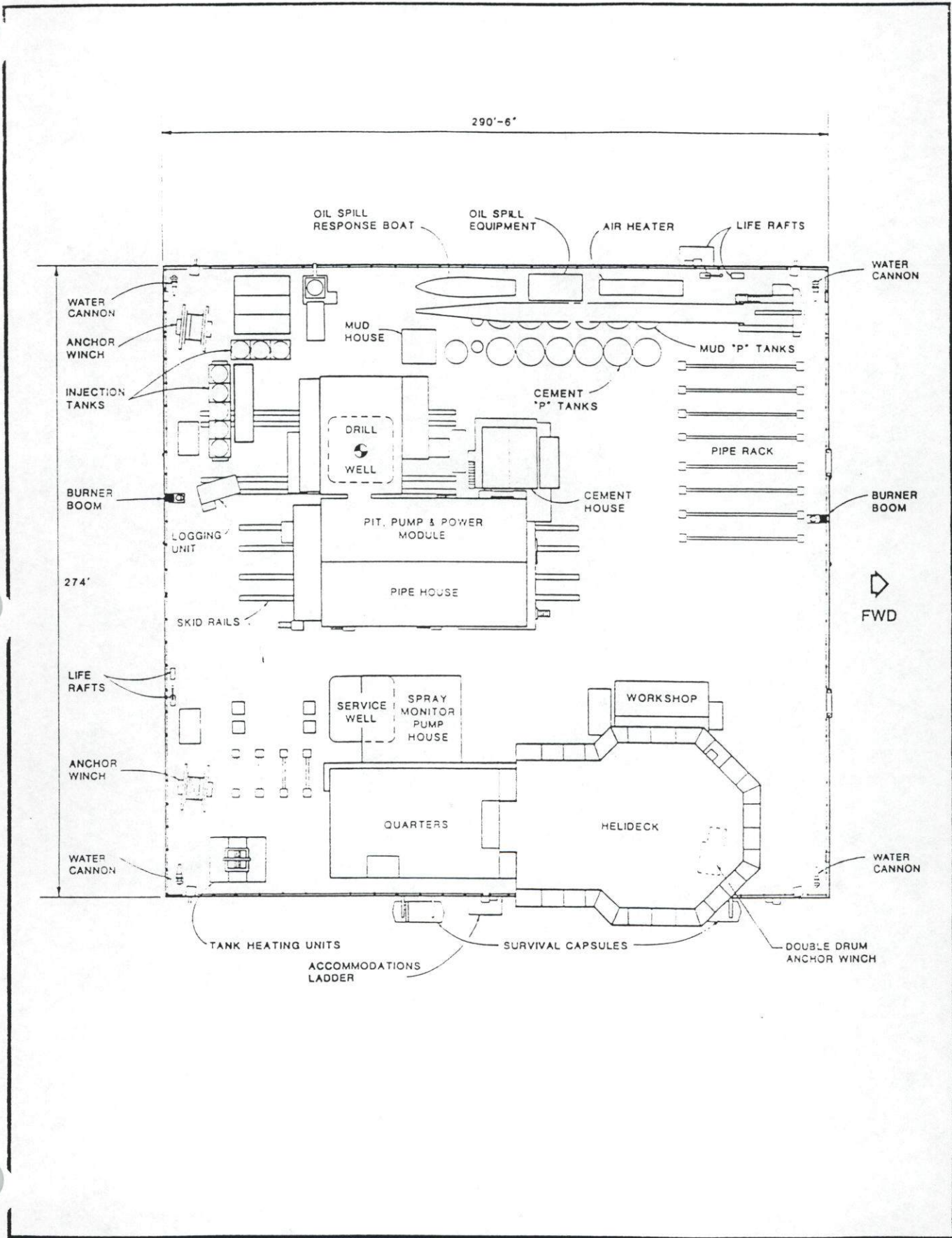


Figure 3-2
Main Deck Layout
Glomar Beaufort Sea I

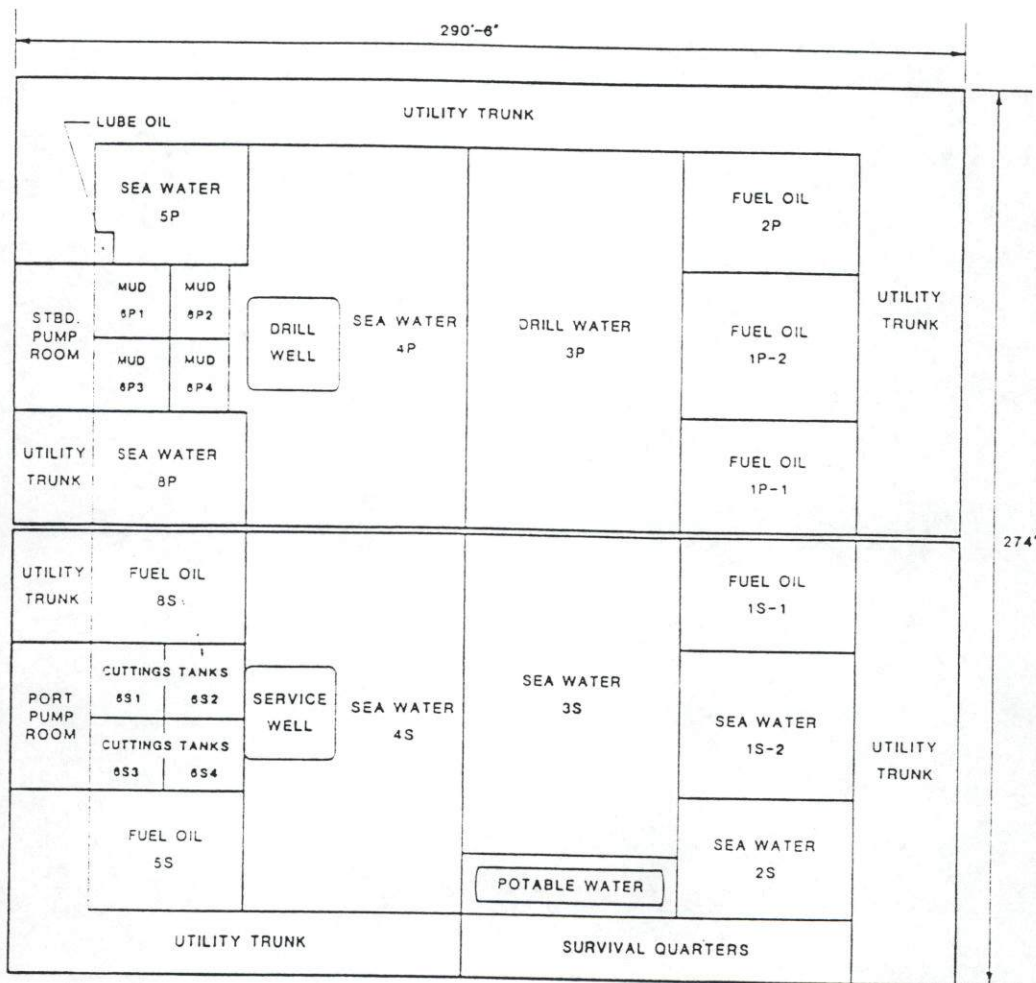


Figure 3-3
 Barge Tank Layout
 Glomar Beaufort Sea I

The five story quarters structure can accommodate up to 92 personnel. The quarters structure also houses the machinery spaces on the main deck, three floors of staterooms, mess hall and recreational facilities. The control and communications rooms are located on the fifth level. The helicopter landing facility is located on top of the fifth level.

The drilling rig is a standard 2,000 horsepower land rig which has been modified to meet the USCG MODU regulations for offshore operations. The rig, located on the port barge, is complete with a power generation system independent from the power system which supplies the quarters, marine systems and survival shelter. The drilling rig is equipped to comply with all current environmental regulations.

3.1.2 Vessel Specifications

General Specifications:

CLASSIFICATION: Certified by the USCG as a Mobile Offshore Drilling Unit (MODU). By ABS as a \boxtimes A1 caisson drilling unit.

DECK BARGES:

LENGTH OVERALL 290 ft. 6 in.
WIDTH (for two barges): 274 ft.
HEIGHT: 26 ft.

BRICK:

LENGTH OVERALL: 234 ft.
WIDTH: 234 ft.
HEIGHT: 44 ft.

BASE:

LENGTH OVERALL: 312 ft. 6 in.
WIDTH: 295 ft.
HEIGHT: (not including 5 ft. skirts) 25 ft.

OVERALL DIMENSIONS:

FROM BASELINE TO MAIN DECK: 95 FT.
HELIPORT: 73 FT X 73 FT.

Designed to support an S-61 or Super Puma helicopter in accordance with USCG specifications.

ACCOMMODATIONS: Quarters for 92 personnel. Seven-bed hospital. Galley, mess and recreational facilities.

DRILLING DEPTH: 25,000 ft.

OPERATING WATER DEPTH:

MAXIMUM: 55 FT.
MINIMUM: 35 FT.

Auxiliary Equipment

WATER DISTILLATION SYSTEM: One 15,000 gpd reverse osmosis and three 2,400 gpd waste heat distillers.

WASTE TREATMENT: One Omnipure System certified to accommodate 100 persons and one Vent-O-Matic waste incinerator unit.

AIR COMPRESSORS: Two 60 cfm, Ingersoll-Rand 1235 psi electric air compressors and one Ingersoll-Rand 17 cfm 125 psi diesel air compressor.

WELDING EQUIPMENT: One 400-amp Lincoln electric unit and one 300-amp portable diesel electric unit.

CRANES: One crawler crane with 120 ft boom, rated at 100 tons, one wheeled crane with 91 ft extended boom, rated at 18 tons and one pedestal crane with a 120 ft boom rated at 100 tons.

Storage Capacities

SACKED MATERIALS:	2,000 sacks
BULK CEMENT:	9,000 cu. ft.
DRY BULK MUD:	27,000 cu. ft.
LIQUID MUD:	4,190 bbls.
DRILL WATER:	34,736 bbls.
FUEL OIL:	48,712 bbls.
CUTTINGS STORAGE:	4,000 bbls.
POTABLE WATER:	730 bbls.
TUBULAR STORAGE:	Three 10,000 ft. wells
SALTWATER BALLAST:	116,925 s. tons

Power Systems

Starboard Barge Power System: (Provides power for quarters, marine systems and survival shelter.) Three (3) CAT D379 diesel engines driving three (3) 400 KW Kato 480 volt AC generators. Power conversion is two (2) 1,000 KVA 480 volt/120 volt transformers and three (3) 480 volt motor control centers and distribution panels.

Port Barge Power System: (Provides power for the drilling rig and drilling support equipment.) Four (4) CAT D399 diesel engines driving four (4) Kato 1050 KW AC generators. Power conversion is four (4) Ross Hill SCR power conversion units.

Emergency Power: One (1) CAT D379 diesel engine driving one (1) Kato 400 KW generator.

Miscellaneous Systems

Communications Equipment: Single side band radio telephone; VHF marine radio telephone; VHF aircraft radio; sound-powered telephone system; helicopter homing beacon; listen/talk amplified PA system; dial telephone system; INMARSAT, plus operator installed telephone and fax systems.

Water Spray System: One Gould deepwell turbine pump, 880 rpm, 21,500 gpm, 110

TDH driven by a CAT D399 diesel engine. Two Gould centrifugal pumps, 16 x 18. 10,600 gpm. driven by a CAT D399 diesel engine. Svenska skumslackening water cannons. 2,400 M³ per hour. electric remote control operators. heated for long term arctic operations.

Brick Instrumentation: 188 Altech strain gauges embedded in the concrete Brick. Two Validyne strain gauge readout panels.

Mooring System: Four-point mooring system with four 20,000 lb. anchors and four 3,000 ft 2-1/4 in., 6 x 37 IPS. IWRC wire lines.

3.1.3 Major Drilling Equipment

DRAWWORKS: OIME 2000E complete with Baylor-Elmagco 7838 electric auxiliary brake.

DRILLING LINE: 1-1/2 in. 6 x 19 extra improved plow steel IWRC 7,500 ft. arctic lube.

SANDLINE: 9/16 in. 6 x 7 20,000 ft.

DERRICK: Parco cantilevered mast with a hook load capacity of 1,250,000 lbs.

CROWN BLOCK: Parco crown block grooved for 1-1/2 in. Line with 60 in. sheaves.

TRAVELING BLOCK AND HOOK: Ideco 535 ton block with 6 sheaves and Ideco 535 ton hook.

SWIVEL: Continental Emsco LB 400.

ROTARY TABLE: 37-1/2 in. oilwell rotary table with 650-ton capacity.

KELLY SPINNER: International Tool A-6C.

WEIGHT INDICATOR: Martin-Decker E.

DRILL PIPE: 16,000 ft. 5 in. OD grade E and G; 1,085 ft. 5 in. OD hevi-wate.

DRILL COLLARS: Eighteen 6-1/2 in. OD and eighteen 8 in. OD.

IRON ROUGHNECK: Varco 2000.

MUD PUMPS: Three National Supply 12-P-160 triplex pumps.

MUD MIXING: Two Mission Magnum centrifugal pumps driven by 100-hp electric motors.

SHALE SHAKER: Three derrick flo-line cleaners mounted on sandtrap.

DESANDER: Two Brandt SRS-2 rated at 1,000 gpm each.

MUD CLEANER: Two Brandt mud cleaners rated at 400 gpm each.

CENTRIFUGES: Two Pioneer Mark I's.

DEGASSER: Swaco degasser rated at 1,000 gpm.

CEMENTING UNIT: Cementing unit with two diesel engines.

3.2 Safety Considerations

3.2.1 Ice Loading

The Glomar Beaufort Sea I is engineered to withstand the ice forces expected in the Arctic without sustaining detrimental structural damage. The unit is also designed to resist sliding on the ocean floor. For additional protection against the Arctic ice floes, the platform has been fitted with a Rubble Generation System (RGS) which if required, produces a grounded rubble field. The ice barrier which is created around the platform provides passive protection from the advancing ice. The ice barrier is built by the water cannons spraying a water stream between 250 and 300 feet from the platform. As the water is sprayed, the droplets freeze in air and fall to the surface forming a grounded ice barrier which protects the rig.

The deck barges and the mud base of the Glomar Beaufort Sea I are constructed of steel. These components are not exposed to the severe ice loads. Concrete was used where ice loads do act against the structure. The concrete Brick provides the necessary strength and durability for minimum structure weight per unit of enclosed volume. The concrete Brick consists of a field of honeycomb silos surrounded by an internal wall, a series of shear walls and an external wall. The silos are joined to each other by interconnecting walls. Thus the forces imposed on the structure by the ice are evenly distributed throughout the structure. The walls and silos are sandwiched between top and bottom slabs for additional structural stiffness thus forming internal tanks. Like the base, the tanks in the brick are used solely for sea water ballast.

The design ice load for the Glomar Beaufort Sea I is as follows: global is 460 kips/foot and the local, acting over a 5 ft by 5 ft area, is 900 psi.

3.2.2 Blowout Prevention Equipment

BOP SYSTEM: Certified for H₂S service.

STACK SIZE/RATING: 13-5/8 in. 10,000 psi wp.

ANNULAR PREVENTER: One Hydril GK 13-5/8 in. 5,000 psi wp annular preventer.

RAM PREVENTERS: One Cameron single U ram preventer 13-5/8 in. and one Cameron double U 13-5/8 in. 10,000 psi wp ram preventer.

CHOKE AND KILL VALVES: Two 3-1/16 in. x 10,000 psi wp opening gate valves. One 3-1/16 in. x 10,000 psi check valve. One 3-1/16 in. x 10,000 psi hydraulic full opening gate valve. One 3-1/16 in. x 10,000 psi full opening gate valve.

BOP CONTROL SYSTEM: NL Shaffer 3,000 psi accumulator with electric hydraulic triplex pump, two air operated hydraulic pumps, hydraulic pump control panel on drill floor, one removed from drill floor and proper manifolding valves and regulators for functioning BOPs, HCR valve and diverter control.

CHOKE AND KILL MANIFOLD: 10,000 psi wp with two 3-1/16 in. hydraulic chokes with remote panels, one manual adjustable choke, full control opening 4 in. bypass.

DIVERTER SYSTEM: One 21-1/4 in. 2,000 psi wp annular diverter with one 21-1/4 in. 2,000 psi wp drill spool with two 10 in. outlets. Two 10 in. 300 psi wp hydraulic diverter ball valves and two 10 in. diverter lines.

3.2.3 Firefighting and Safety Equipment

Fire Main with 38 external and 34 internal stations. Halon system in engine room, paint locker, pump rooms, and water spray pump room. Deluge system and portable dry chemical and CO₂ fire extinguishers. Complete first aid facilities. Helicopter deck is equipped with foam fire fighting system, fuel tank jettisoning and rescue equipment.

Survival System

Two 54-man Whittaker, USCG approved, arctic capsules with launch system and four USCG approved arctic life rafts sufficient to accommodate all on-board personnel. Sufficient arctic survival suits and sleeping bags to supply all personnel. Integral survival shelter outfitted with arctic survival gear and provisions to support the entire crew for up to three (3) days.

3.3 Pollution Prevention Features

All discharges from the rig will be in conformity with the provisions of the Arctic General NPDES Permit (No. AKG 284200). Request for coverage under this permit is being made to the U.S. Environmental Protection Agency as part of the overall Warthog Project permitting effort.

3.3.1 Environmental Control Equipment

The CIDS is equipped with a collection system for deck and rig drainage, such that all recovered fluids can be processed through an oily water separator. Specifications of this system are summarized below.

DRAIN SYSTEM: Every drain system can be diverted to the oily water separators to comply with environmental regulations.

OILY WATER SEPARATOR AND RECOVERY SYSTEM: Two Facet separators, 10 gpm capacity with fluid analyzer.

CUTTING TANKS: Four tanks with total storage capacity of 4,000 bbls.

3.3.2 Onboard Oil Spill Equipment

A van containing an inventory of oil spill containment and cleanup equipment will be on board the CIDS rig throughout drilling and testing operations. Additional oil spill preventative measures are discussed in the rig Oil Spill Contingency Plan, SPCC Plan and Shipboard Oil Pollution Emergency Plan, which are incorporated herein by reference.

The spill containment/cleanup van will be located on the port side of the CIDS, near the edge of the main deck (See Figure 3-2 "Main Deck Layout", P. 12). In this location the van is close to the rig (the most likely source of spills) and also next to the deck crane for ease of deployment of the van and/or its contents for cleanup of spilled fluids on the water or ice around the CIDS.

4.0 EMERGENCY PLANNING

MMS Alaska OCS Region requires that Exploration Plans contain a discussion of emergency planning including the drilling of a relief well, should a blowout occur; the actions taken in response to the loss or disablement of the drilling unit; and the course of action in the event of loss or damage to support craft. All contingency plans for these emergencies are founded on the following priorities and objectives:

- Protection and safety of personnel;
- Protection and safety of the environment;
- Minimization of rig and property damage; and
- Regulatory Agency and ARCO Alaska, Inc. notification.

ARCO considers the risk of a blowout occurring during drilling and testing operations at the Warthog site as extremely low due to the following conditions:

- The Global Marine Drilling Company crews are Surface Stack Certified in Well Control as per 30 CFR 250 Subpart O.
- Key personnel (i.e. toolpushers, operator's representatives, drilling engineers, mud engineers, and drillers) are Subsea and/or Surface Stack Certified in Well Control as per 30 CFR 250, Subpart O.
- The well design has been prepared based on data from other exploratory wells drilled in the Camden Bay vicinity (Kuvlum 1 and 2, Wild Weasel, Stinson No. 1, Corona No. 1).
- A mud logging unit will be employed on the Warthog well which will add a second pit level and flowline monitoring system, in addition to the one already provided for rig use. Mud logging unit equipment will include gas monitors to track background, connection and trip gas. This equipment will aid in the detection of impending kicks and assist in rapid well shut in response.
- ARCO has established formal internal procedures to ensure all well control situations are addressed immediately and that adequate personnel and equipment services are employed to prevent the total loss of well control (blowout).
- ARCO has contracted WELLCALL (The well control alliance between Halliburton Energy Services and IWC Services) to assist ARCO in the intervention and resolution of any well control emergencies. WELLCALL will be notified immediately in the event of any well control situation which has the potential to escalate.

4.1 Relief Well Discussion

In the unlikely event of a loss of primary and secondary well control, and a blowout occurred necessitating the drilling of a relief well, it is very doubtful that the CIDS rig could be used for this purpose. This is because access to the service well would be difficult, if not impossible, under blowout and/or fire conditions, and there are no other hull penetrations to accommodate a relief well. Given this constraint, there are three (3) options available for drilling a relief well, depending on the time of year and the availability of equipment:

- Use of another bottomfounded arctic drilling vessel (i.e., the Canmar SSDC);
- Construction of an ice island; or
- Construction of a gravel island.

The selection of the surface location from which to drill a relief well would be based on the relief well option selected, the water depth, safe distance and direction from the blowout and/or fire, and the planned point of intersection with the blowing well in order to optimize the kill.

Use of Another Bottom Founded Arctic Drilling Vessel: Due to water depth limitations, the only other bottom founded vessel in North America capable of drilling a relief well in the Warthog area is the Canmar SSDC, which is currently cold stacked in Port Clarence, Alaska. The unit is currently for sale and may be unavailable for Beaufort Sea assignments in the near future. Assuming that this rig was available for a relief well assignment, mobilization to the Warthog vicinity would be limited to open water and broken ice periods and would possibly require the assistance of ice management vessels which are only available from the Canmar fleet. Further assuming that the foregoing conditions could be met, it is estimated that warm-up of the SSDC would take approximately 30 days and mobilization from Port Clarence to Camden Bay would take about 15 days. Mobilization timing would be dictated by ice conditions at Point Barrow which normally clear up sufficiently to permit waterborne traffic on approximately August 1. The SSDC would therefore arrive on location in Camden Bay about August 7 and, after a week to load up with drilling supplies and prepare to spud, would commence drilling the relief well in mid-August. The relief well would require 20 to 30 days to drill. Allowing 1 to 2 weeks of additional time for well-killing operations on the blowing well, the SSDC would be demobed to McKinley Bay, NWT, Canada (Canmar's preferred stack site) in late September. The Canmar SSDC option is not considered the most viable approach to relief well planning.

Construction of an Ice Island: If a relief well was required after sufficient sea ice had formed to support rolligons and sleds, an ice island could be constructed in the area landward of the Warthog location. The time required to construct an ice island is both weather and water depth dependent. For purposes of this scenario, a 20 ft water depth is assumed, as bathymetric surveys have confirmed this depth south of the Warthog bottomhole location and still close enough to directionally drill to the Warthog wellbore. The earliest time the ice is sufficiently thick to commence ice island construction is generally late December. The time to construct a spray ice island with 15 feet of freeboard is estimated to be thirty (30) to forty-

five (45) days depending on temperature and other weather conditions during the construction period. This would place the finish of ice island construction at about mid-February. Once the island was constructed, a conventional modular land rig, equipment and materials could be transported to the island by rolligon. A rolligon-transportable rig such as Pool Rig #4 or Pool Rig #6 would require approximately two weeks to mobilize and rig up on the ice island. The relief well would then require 20 to 30 days to drill. Allowing 1 to 2 weeks of additional time for well killing operations on the blowing well and P&A of the relief well and 2 weeks to demobilize the relief well rig off the island, operations would terminate at approximately the end of April. This is the latest time in the season for safe operations on the sea ice. The construction of a spray ice island therefore offers a workable approach for relief well operations commencing before January.

Construction of Gravel Island: A gravel island could be constructed to support a relief well during either open water, when gravel would be placed by barge; or under winter conditions when gravel could be trucked to the site over an ice road. If required by emergency conditions, the island could be constructed during broken ice conditions with ice breaker/ice management vessel assistance. It is estimated that approximately 150,000 cubic yards of gravel would be required to construct an island with a 500 ft diameter base and 200 ft diameter work surface, with 15 ft of freeboard and in 20 ft water depth. Additional gravel would be required for slope protection (4 cubic yard gravel bags). Gravel for island construction could be obtained in the Pt. Thompson area, approximately twenty (20) miles west of Camden Bay, and trucked to the site over an ice road constructed for that purpose (winter scenario), or barged to the site (summer scenario).

The time required to construct a gravel island of the aforementioned dimensions under both the open water (summer) and winter scenarios is as follows:

<u>Activity</u>	<u>Open Water</u>	<u>Winter</u>
Mobilize gravel equipment to Point Thompson	2 weeks	4 weeks (includes ice road to Point Thompson)
Construct Gravel Island	30 days	6 weeks (includes ice road to Warthog location)
Set Conductor and Mob Rig, Equipment and Materials	2 weeks	2 weeks
Drill Relief Well	4 weeks	4 weeks

In the gravel island scenario, a modular land rig would be transported to the island by truck (winter), or by barge (open water). The gravel island approach offers the most flexible approach to supporting relief well operations and the greatest tolerance for seasonal operating restrictions.

Relief Well Drilling Considerations: The equipment and materials needed to drill a relief well are available from ARCO's drilling stocks on the North Slope or in Fairbanks. These items would be moved to the relief well site by truck, rolligon or barge, depending on the season. It is expected that extensive helicopter operations would support the drilling effort.

The time required to drill a relief well and kill a blowout is dependent on the depth required, directional considerations, the complexity of the kill itself, and weather. With this many variables, it is impossible to accurately forecast a time duration for relief well drilling; however, for planning purposes, a period of four (4) to seven (7) weeks is estimated.

Relief Well Drilling Rigs: The most readily available and transportable drilling rigs for relief well operations at Warthog are Pool Arctic Alaska's Rig #4 and Rig #6. Both of these rigs are transportable by truck, rolligon, barge or C-130 aircraft and are currently stacked at Deadhorse.

Relief Well Permitting: Soils, shallow hazards and environmental (ice) loading conditions at the relief well surface location will be established this summer (1997) so no site clearance work will be necessary before initiating any of the relief well options.

Most of the permit applications for the SSDC and ice island options will be very similar to those submitted for the original Warthog well and can be submitted and approved during the construction/mobilization phases of these options. Both of these options would be executed in State waters and, as such, the majority of the permits will fall within the Alaska Department of Governmental Coordination (DGC) - controlled Coastal Zone Consistency Review process. The DGC has in place provisions to expedite the review and approval of permit applications in emergency situations.

In the case of a gravel island, additional State and Federal permits would be required. In addition to the State permits required for the SSDC/ice island options and falling within the Coastal Zone Consistency Review process, DNR concurrence would be required for purchase of gravel at the Point Thompson mine site. This would be expedited by DGC along with the other State permits. A State Land Use Permit is not anticipated for any ice road construction since the entire length of the road would be constructed on State tidelands, offshore and outside any lagoon areas included in ANWR under US Fish and Wildlife Service jurisdiction. A map of the proposed ice road route is included in the OSCP, Appendix 1.6-B, Figure B-1. A Federal permit would be required from the USCOE for a Section 10 (Structures in Navigable Waters) permit. This permit can be obtained within 2 weeks. Staging of materials for the gravel island construction would be on State tidelands during winter or barges in summer.

4.2 Loss or Disablement of the Drilling Unit

As part of the Warthog Project planning process, ARCO has assessed the potential for loss or disablement of the drilling unit from cases other than a loss of well control. In the case of the CIDS, the possibility of the rig being moved off location by ice movement was evaluated. Such an occurrence is nearly impossible to visualize at the Warthog location, as it would require a massive floe of multi-year ice of sufficient mass to overcome the gravity load and sliding resistance of the CIDS. The CIDS maximum water depth rating is 55 ft and the Warthog surface location water depth is 35 ft. Any multi-year ice floe of sufficient mass to be a threat to the CIDS would ground due to its own draft well before reaching the CIDS location. CIDS environmental design criteria are shown below:

CIDS DESIGN CRITERIA

ENVIRONMENTAL CRITERIA	
○ Air Temperature	-60° F to +70° F
○ Wind Speed	70 Knots
○ Wave Height - Significant	17 Feet
○ Currents	4 Knots
○ Tide - Astronomical	12 Inches
- Storm	4 Feet
○ Water Depth	35 to 55 Feet
○ Ice Movement - Winter	0 to 400 Feet/Hour
- Summer	2 Knots
○ Ice Thickness - Winter	6.5 Feet First Year Ice Sheet
- Summer	25 Feet Multi-Year Floe
○ Floe Diameter	10,000 Foot Diameter
○ Design Global Ice Loads - Winter	460 Kips/Foot
- Summer	130,000 Kips
○ Design Local Ice Load	900 psi on 5 Feet x 5 Feet
○ Ice Defense	None

STRUCTURAL CRITERIA

○ External Hydrostatic Head	70 Foot Maximum
○ Factors of Safety:	
-Sliding Overall	1.5
-Ice Load Structural	1.3
-Hydrostatic Load	1.5
-Soil Bearing	2.5
○ Classification	- ABS ≠ A1 Caisson Drilling Unit - USCG Mobile Offshore Drilling Unit

A third party verification of the adequacy of the drilling unit for the ARCO Warthog No. 1 well is being conducted as part of the MMS permitting process. This verification will take into consideration geotechnical conditions at the site as well as design criteria of the drilling vessel and physical environmental conditions.

Should any condition develop during the drilling of the Warthog well that presents a potential threat to the integrity of the drilling vessel (i.e., fire), the well would be suspended by placing a cement or mechanical plug in the wellbore, leaving the hole filled with a minimum of 200 psi overbalance drilling fluid, and securing operations until the threat is past or overcome.

4.3 Loss or Damage to Support Craft:

The CIDS will require minimal support during the ARCO Warthog No. 1 project, as described earlier herein. Any transport of equipment, materials and fuel that could be required in the later stages of the program will be accomplished by rolligons owned and operated by CATCO, a wholly owned subsidiary of Crowley Marine Services. CATCO operates a fleet of this equipment and has a shop and full maintenance capability in Deadhorse. Sufficient backup equipment is available to accommodate any rolligon mechanical problems or breakdowns.

The rig will also have helicopter support throughout the duration of the Warthog project. A Bell 212 helicopter operated by ERA Helicopters will be dedicated to the job and crewed 24 hours per day. In the event of a mechanical breakdown or loss of this aircraft, a substitute helicopter can be made available from the ERA fleet. If any search and rescue operations are required, they would be provided by other helicopters operating on the North Slope, the North Slope Borough Search and Rescue Unit, and the military as necessary to the effort.

5.0 GEOLOGICAL AND GEOPHYSICAL INFORMATION (Stand-alone Exhibits "A" and "B" - both are Privileged and Proprietary Information)

The information submitted in these two (2) volumes is submitted in fulfillment of the requirements of 30 CFR 250.33 (b)(1)(i through ix). Exhibit "A" includes items described in Subparagraphs (I) through (viii) inclusive and Exhibit "B" includes the shallow hazard report required by subparagraph (ix).

Exhibit "B" will be prepared for submittal to the MMS in early August, 1997, as the shallow hazard surveys are planned to be run in July of 1997 or as early as ice conditions allow.

6.0 OIL SPILL CONTINGENCY PLAN (Stand-alone Exhibit "C")

The Oil Spill Contingency Plan (OSCP) submitted for the Warthog No. 1 drilling program is found in Exhibit "C", a stand-alone volume accompanying this Exploration Plan. The plan provides information on oil spill prevention and control procedures, response organization, risk analysis, and environmental sensitivity. It is designed to assist ARCO and contractor personnel in responding rapidly and effectively to oil spills that may result from exploratory drilling operations.

The OSCP provides a detailed description of appropriate actions and techniques for various spill circumstances, response times for mobilization of personnel and equipment from various locations, equipment operating characteristics, and the availability of equipment both on site and off site. This plan emphasizes the prevention of oil pollution by employing the best control mechanisms for blowout prevention and fuel transfer, and by implementing a mandatory program of personnel training. MMS Regulations (30 CFR 250, Subparts C and D) include specific requirements for oil spill and pollution prevention. ARCO will fully comply with these requirements.

All project personnel, including ARCO employees and contractors who will be involved in oil spill contingency response and will receive training as described in the OSCP. Training drills will be conducted periodically to familiarize personnel with on-site equipment, proper deployment techniques, and maintenance procedures.

7.0 DRILLING FLUIDS PLAN

The following mud plan was developed for the ARCO Warthog No. 1 well:

1. Type(s) of Mud Proposed for Discharge:
This well will be drilled with a modified generic Mud #2 from initial spud to the final total depth (TMD). The components of this mud system and their maximum concentrations are listed on Attachment "A" of this mud plan. Both seawater and/or freshwater will be used to maintain this mud system.
2. Well Name: ARCO Warthog No. 1.
3. Well Number: #1.
4. NPDES Permit Number: AKG284200.
5. Mud Types for Each Well: Warthog #1 - Modified Generic Mud #2.
(See attachment "A" to this Section.)
6. Details of Mud System: See attachment "A."
7. Determination of System Toxicity:
To insure drilling mud and cuttings discharges comply with the <30,000 ppm SPP toxicity limitation for operations in the Beaufort Sea, the following controls will be initiated:
 - a.) The primary mud plan is to use the additives as outlined on Attachment "A" from spud to TD. Mud bioassays provide certification that the system overall toxicity is well below the SSP permit limitation. Attachment "A", Section 1 outlines the maximum product concentration on all products. Attachment "A", Section 2 outlines the base mud and contingency products at the "Most Likely" concentrations.
 - b.) Pipe-Lax ENV is a water-dispersible, low toxicity spotting fluid used in place of mineral oil spotting pills. Pipe-Lax Env will be used on this well if required. A mineral oil pill will not be used if a spotting fluid is required on this drilling project. The Pipe-Lax ENV pill will be recovered when circulated out of the hole per the permit requirements and the residual content will not exceed 2% by volume. In the event a spotting fluid is required, appropriate sampling will be done before and after the spot to confirm effluent toxicities.
8. Procedure for Determining if New Additives May be Used:
While it will be the intent of this drilling program to use only the products which are included in Attachment "A", if any additional additive is required, the process outlined below will be used prior to the use of the product.

To insure the drilling mud does not exceed the 30,000 ppm SPP limit for Beaufort Sea discharges when adding a product or products that were not originally planned, this mud will incorporate one of three mechanisms to estimate final mud toxicities as listed below:

- a.) Perform a Drilling Fluid Toxicity Test (Petrazzuolo, 1993) on the complete base mud system with all mud additives at maximum concentrations.
 - b.) Calculate the resulting mud toxicity using the computer model outlined in the article "Computer Model Gauges Drilling Fluid Toxicity," Offshore, April 1989, which is incorporated into this Mud Plan by reference.
 - c.) In some cases, based upon a detailed review of the product and a determination of the relative non-toxic nature of the additive, use of the product may proceed without actual LC50 data. Examples of these products may include lost circulation materials such as walnut hulls or mica flakes.
9. Outline of the Mud Planning Process:

This Mud Plan has been established based upon standard procedures for previous mud system approvals for discharge in state and federal waters offshore Alaska. The mud system toxicity is based upon actual bioassay data, consequently no problems are anticipated in terms of compliance with permit requirements. Also, the product mix in Attachment "A" has been used on several offshore operations including Kuvlum #1, Kuvlum #2, Kuvlum #3, Wild Weasel #1, and Liberty #1. This Mud Plan is designed to tie into the other requirements of the current Arctic General Permit which in combination, provides a comprehensive mechanism to insure minimal impact to the receiving waters.

The personnel responsible for the development and implementation of this Mud Plan are:

Bill Penrose, Fairweather E&P Services, Inc.	(907) 258-3446
Bob Gardner, Fairweather E&P Services, Inc.	(907) 258-3446
Lee Dewees, M-I Drilling Fluids	(907) 274-5564

ATTACHMENT "A", SECTION I
Maximum Proposed Concentrations of Mud Additives
Generic Mud No. 2 with Additives

MUD ADDITIVES Generic Name	Section 1 M-I Trade Name	Maximum Proposed Concentrations in (PPB)	
Bentonite/Sepiolite	M-I Gel/Duragei	50.00	GM#2
Barite	M-I Bar	575.00	GM#2
Lignosulfonate	Spersene CF	15.00	GM#2
Lignite	Tannathin	10.00	GM#2
Caustic Soda	Caustic Soda	5.00	GM#2
Soda Ash	Soda Ash	2.00	GM#2
Lime	Lime	2.00	GM#2
Cellulose Polymers	Polypac/Drispac	5.00	GM#2
Xanthan Gum	XCD Polymer/Xanvis/Flovis	3.00	
Aluminum Stearate	Aluminum Stearate	0.20	
Modified Lignin	Resinex	4.00	
Sulfonated Asphalt	Soltex	6.00	
Detergent	D.D.	0.40	
Defoamer	Defoam X	0.30	
Tannin	Desco CF	0.50	
Sodium Acid Pyrophosphate	SAPP	0.50	
PHPA (dry)	Poly Plus/Alcomer 60	3.00	
Starch	FLOTROL	4.00	
Sodium Bromide	Sodium Bromide	2.00	
Bentonite extender	Gelex	1.00	
Acrylic copolymer	Tackle	1.00	
Citric Acid	PH-6	1.00	
Vegetable Oil/Alcohol Blend	Lube 167	6.00	
Sodium Polyacrylate	SP101	3.00	
Vegetable Plus/Polymer Flakes and Granules	Kwik Seal	50.00	
Mica	Mica	45.00	
Nut Hulls	Nut Plug	as required	
Cellulose Fibers	Liquid Casing	12.00	
Zinc Oxide	Sulfx ES	as required	

NOTES:

- 1) Make up water will be either seawater or freshwater or combination of the two
- 2) Trade name substitutions may occur based on availability of product
- 3) Stuck pipe pill will consist of Pipe-Lax ENV and weight materials.

ATTACHMENT "A", SECTION 2
"MOST LIKELY" CONCENTRATIONS OF MUD ADDITIVES
Generic Mud No. 2 with Additives

Mud Additives Generic Name	Section 2 M-I Trade Name	"Most Likely" Concentrations in (PPB)
<u>Base Mud</u>		
Bentonite/Sepiolite	M-I Gel/Duragel	20.00
Barite	M-I Bar	125.00
Caustic Soda	Caustic Soda	1.50
Soda Ash	Soda Ash	1.00
Lime	Lime	0.25
Lignite	Tannathin	4.00
Cellulose Polymers	Polypac/Drispac	2.00
Xanthan Gum	XCD Polymer/Xanvis/Flovis	1.50
Modified Lignin	Resinex	3.00
Detergent	D.D.	2.00
Defoamer	Defoam X	0.10
PHPA (dry)	Poly Plus/Alcomer 60	1.50
Acrylic copolymer	Tackle	0.50
Sodium Polyacrylate	SP101	1.00
<u>Lost Circulation Contingency Products</u>		
Vegetable Plus/Polymer Flakes and Granules	Kwik Seal	50.00
Mica	Mica	45.00
Nut Hulls	Nut Plug	As Required
Cellulose Fibers	Liquid Casing	12.00
<u>H₂S Contingency Products</u>		
Zinc Oxide	Sulfx ES	As Required
<u>Chemical Contingency Products</u>		
Lignosulfonate	Spersene CF	5.00
Aluminum Stearate	Aluminum Stearate	0.10
Sulfonated Asphalt	Soltex	5.00
Tannin	Descoc CF	0.50
Sodium Acid Pyrophosphate	SAPP	0.20
Starch	Flotrol	3.00
Sodium Bromide	Sodium Bromide	2.00
Bentonite Extender	Gelex	0.20
Citric Acid	PH-6	0.50
Vegetable Oil/Alcohol Blend	Lube 167	2.00

8.0 HYDROGEN SULFIDE INFORMATION AND PRECAUTIONARY MEASURES

A Hydrogen Sulfide (H₂S) Contingency Plan for drilling and testing operations in the Warthog area is found in Appendix I accompanying this Exploration Plan. This H₂S Plan will be present in multiple copies on the drilling unit and rig personnel will be trained in the physical and chemical characteristics of the gas, safety procedures, and the use and maintenance of breathing equipment. H₂S drills will be conducted frequently. The CIDS rig will be equipped with H₂S detectors, alarms and personal protective equipment.

8.1 Classification of the Warthog Prospect as to the Probability of Encountering H₂S

Hydrogen Sulfide was not encountered in the Kuvlum wells, at Wild Weasel or in the Stinson No. 1 well. Based on these drilling histories, ARCO feels that the chances of encountering H₂S in the Warthog well(s) is minimal but cannot be completely ruled out. Communication with the MMS has indicated the Warthog Prospect will be classified as a "Zone where the presence of H₂S is unknown," as per 30 CFR 250.67(c), therefore drilling operations will initially be subject to the provisions of 30 CFR 250.67 (h).

9.0 NEW AND UNUSUAL TECHNOLOGY

ARCO does not plan to use any new or unusual technology on this well. Given the time constraints of the winter ice season, the risks associated with experimental or new technology are not acceptable. All technology to be used on this project has been proven on past exploration wells, and/or is currently being used successfully in other ARCO North Slope drilling operations. The use of the Concrete Island Drilling System is simply the continued use of a technology which has been proven in the past.

10.0 OPERATIONS SUPPORT AND FACILITIES

10.1 Project Management and Administration

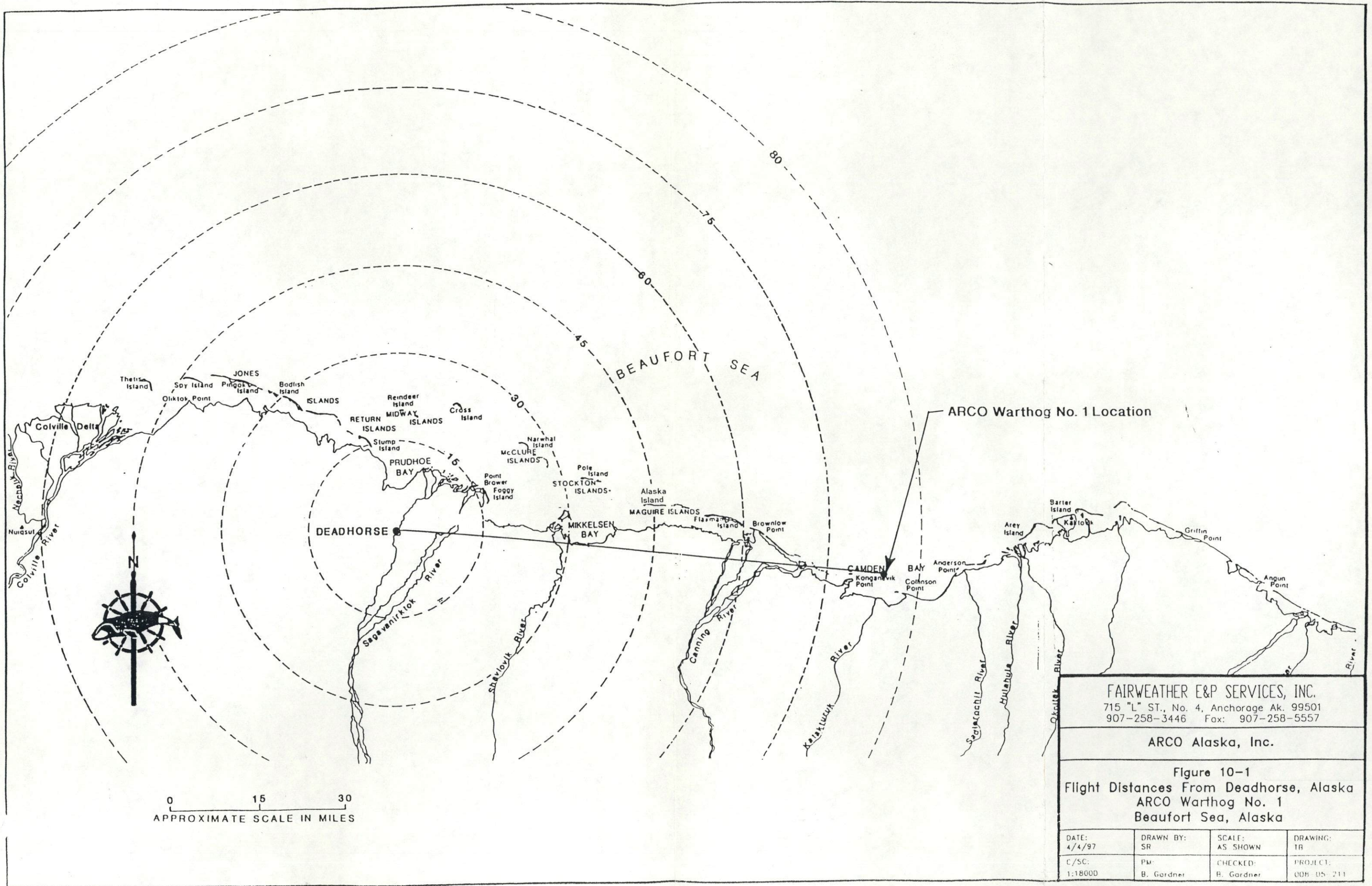
The ARCO Warthog No. 1 drilling operations and any subsequent related activities will be directed from the ARCO Alaska, Inc. offices at 700 G Street, Anchorage, Alaska. Logistics support for the operations will be provided by helicopter services and, if required, by rolligon. The support functions will utilize existing facilities at Deadhorse, Alaska. No new facilities will be constructed.

10.2 Helicopter Support

Rig crews, operator personnel and third party personnel who are not already on the North Slope will be flown to the Deadhorse Airport from Anchorage or Fairbanks by commercial scheduled or chartered aircraft. Personnel will then be transported by helicopter to the drilling unit. Personnel will be housed in a Deadhorse casual camp (i.e. Prudhoe Bay Hotel) in the event weather causes a lengthy delay in helicopter operations.

Helicopter support will consist of a Bell 212 helicopter certified for IFR operations. This aircraft will be based at the Deadhorse Airport at the ERA Helicopters hangar. Helicopter flights are expected to average one (1) per day. Flight routes will follow a more or less direct route from the Deadhorse Airport to the ARCO Warthog No. 1 location (See Figure 10-1). The estimated distance is 78 statute miles, which will require approximately 45 minutes flying time. Helicopter crews and support personnel will number 6 or 7 persons and will be housed in Deadhorse in existing facilities.

The Deadhorse Airport will be the principal base for helicopter operations. If weather prevents landing in Deadhorse, alternate airports at Kuparuk, ARCO PBOC, or Barrow are available for diverted flights. Sufficient fuel will be carried on all flights under inclement weather conditions to return to the CIDS as an additional alternate destination.



ARCO Warthog No. 1 Location

FAIRWEATHER E&P SERVICES, INC.
 715 "L" ST., No. 4, Anchorage Ak. 99501
 907-258-3446 Fax: 907-258-5557

ARCO Alaska, Inc.

Figure 10-1
 Flight Distances From Deadhorse, Alaska
 ARCO Warthog No. 1
 Beaufort Sea, Alaska

DATE: 4/4/97	DRAWN BY: SR	SCALE: AS SHOWN	DRAWING: TR
C/SC: 1:18000	PM: B. Gardner	CHECKED: B. Gardner	PROJECT: 00B 05-211

10.3 Rolligon Support

The CIDS rig will have materials and consumables required for both the ARCO Warthog No. 1 well and a sidetrack well put aboard during the initial rig mobilization phase of the program. Unless well operations extend much longer than anticipated, fuel resupply should not be required. If specific items of large equipment have to be replaced, or specialized downhole tools which were not anticipated in the original well proposal are brought to the rig, or if fuel resupply becomes necessary, these items will be transported by rolligon on an as needed basis. Overland travel time from Deadhorse to the ARCO Warthog well site (no ice road) is expected to be approximately twelve (12) hours. Rolligons are currently based in Deadhorse, as are operators and support personnel. No additional personnel or facilities are required for the Warthog project.

10.4 Emergency Support

Necessary medical, fire, spill, and evacuation support infrastructure is located in Prudhoe Bay, Deadhorse, and Endicott. Any medivac situations on the rig will be made by helicopter. ARCO will employ an EMT III/Environmental Technician on-site who will have Advanced Life Support capabilities. A spill van will be onboard to provide ready access to equipment in the event of a spill. In the event of a massive spill beyond the rig crew's capability to control, the Emergency Response Network will be activated and personnel and equipment from across the North Slope and all Alaska can be accessed if necessary (See Oil Spill Contingency Plan, provided as a stand-alone exhibit).

10.5 Project Staffing

Labor requirements will vary during the ARCO Warthog No. 1 project. Estimated project staffing for operational phases of the program are shown below:

<u>Project Activity</u>	<u>Estimated Number of Personnel</u>
Pre-mobilization rig maintenance and warmup	25
Mobilization	55-65
Warm Shutdown	20-30
Drilling	60-70
Evaluation	60-70
Testing	55-65
Demobilization	20-30

11.0 WASTE MANAGEMENT

ARCO has developed a waste management plan for this exploratory drilling program to ensure compliance with applicable federal, state and local regulations. Figure 11-1 illustrates the waste management methods that will be used on the Warthog Project, and Figure 11-2 shows the waste management flow diagram.

ARCO is requesting coverage under the Arctic General NPDES Permit for Oil and Gas Exploration (No. AKG 284200) for discharges that are authorized under that permit. As part of this request for General NPDES coverage, ARCO is preparing a Best Management Practices Plan that describes methods to minimize discharges to the sea ice and any impacts related thereto, defines measures to be taken to ensure upset-free discharge operations, and establishes specific objectives for the control of pollutants.

11.1 Estimated Waste Quantities

Based on a single well scenario, the following quantities of waste are anticipated to be generated from the Warthog Project:

<u>Waste</u>	<u>Quantity</u>
Drilling Mud and Cuttings	5,900 bbls
Deck Drainage	7,000 bbls
Sanitary and Domestic Liquid Waste	7,500 bbls
Desalination Unit Waste	21,000 bbls
Boiler Blowdown	350 bbls
Fire Control System Test Water	350 bbls
Combustible Solid Waste	1,000 cubic feet
Sewage Sludge	500 cubic feet
Non-Combustible Solid Waste	700 cubic feet
Produced Reservoir Fluids	0-20,000 bbls
Used Oil	25 bbls
Excess Cement Slurry and Washdown	100 bbls

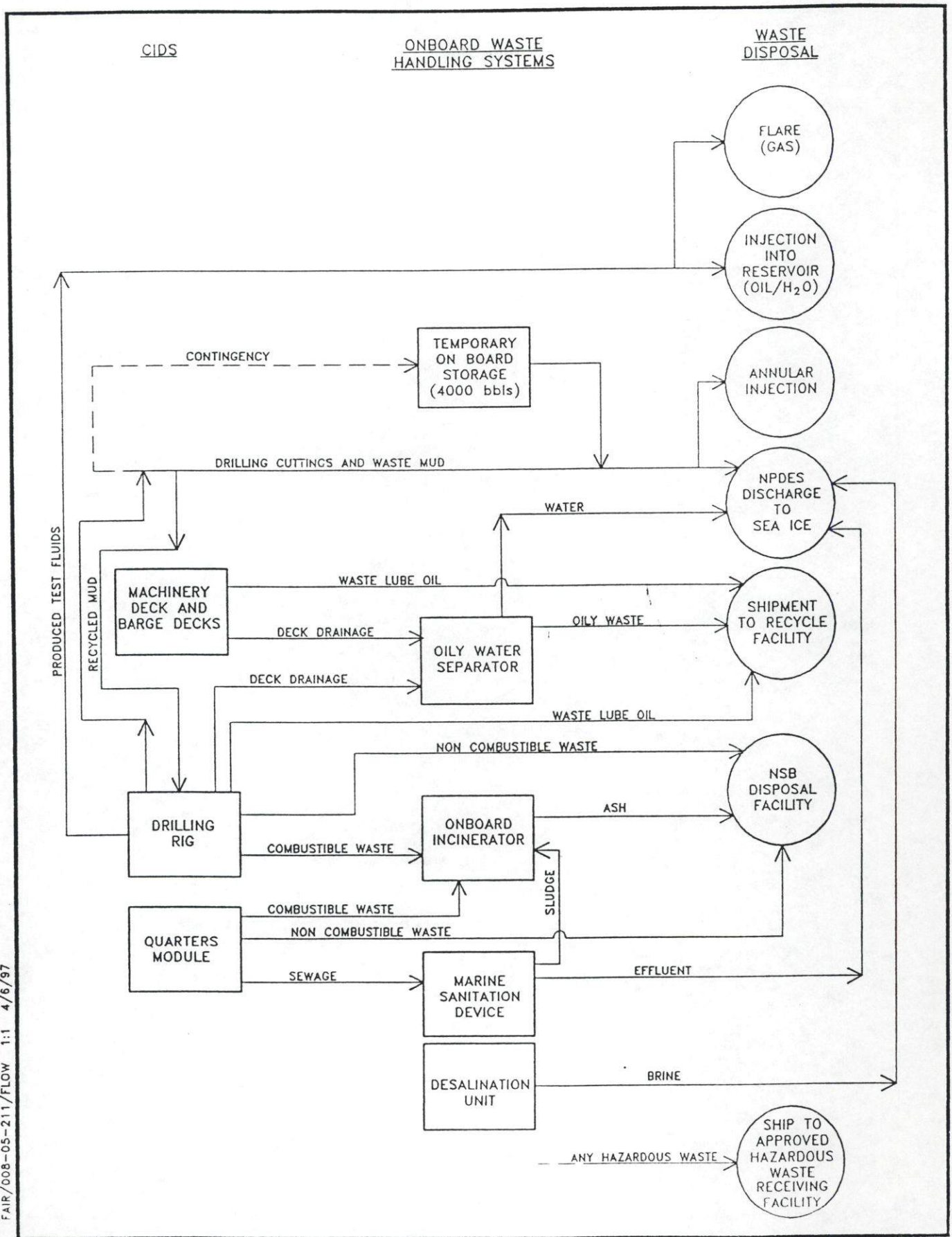
11.2 Waste Disposal and Treatment

Drill cuttings and drilling fluids will be discharged to the sea ice surface under the terms of the general NPDES permit. Discharges of these materials are limited to 500 bbls per hour by the Arctic General Permit due to water depth considerations. As a contingency for mechanical problems, cuttings may be temporarily stored in tanks in the hull of the drilling rig, and later injected or discharged to the sea ice. Discharge of drilling fluids will be minimized by on-site reuse where possible. As an alternative to discharge, drilling fluids could be disposed of down an injection annulus when this becomes available on the well. A waiver will be requested in the Application for Permit to Drill in order to establish this injection annulus. Produced reservoir fluids will be reinjected downhole and gas will be

Waste Description	WASTE DISPOSITION									
	To Onboard Marine Sanitation Device	To Sea Ice as per NPDES Permit	To Onboard Incinerator	To NSB Waste Disposal Facility	To Recycle or Disposal Facility	To Annular Injection Contingency	Inject Back Into Reservoir	To Flare	To Hazardous Waste Receiving Facility	
Drill Cuttings		•				•				
Waste Mud		•								
Raw Sewage	•									
Treated Sewage Effluent		•								
Treated Sludge			•							
Combustible Waste			•							
Non Combustible Waste				•						
Waste Lube Oil				•						
Incinerator Ash				•						
Produced Test Fluids (Oil and Water)							•			
Produced Gas								•		
Waste Cement		•								
Desalination Unit Brine		•								
Briller blowdown Water		•								
Fire System Test Water		•								
Deck Drainage (after separation)										
Oily Waste Water		•							•	

F.A.P./008-05-211/WASTE 1:1 4/6/97

Figure 11-1
ARCO Warthog No. 1
Waste Management Methods



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Figure 11-2
 ARCO Warthog No. 1
 Waste Management Flow Diagram
 (Schematic - No Scale)

flared. Used oil will be recycled back to the rig or packaged in drums and hauled to Prudhoe Bay at the end of the project for shipment to an approved recycle facility. No hazardous wastes are expected to be generated as a result of this project. However, if any hazardous wastes are generated, they would be temporarily stored, then transported off-site for disposal in an approved facility.

Sewage from the quarters module will be processed in the onboard approved marine sanitation device and effluent from the unit will be chlorinated. Treated effluent will be discharged to the sea ice under the general NPDES permit. Sewage sludge, kitchen trash, and non-metallic trash from the rig quarters will be incinerated, and ash from the incinerator will be stored on board until project completion and then hauled to the North Slope Borough waste disposal facility as soon as conditions allow. The flow paths of waste treatment, disposal or recycle are illustrated in Figure 11-2.

12.0 ENVIRONMENTAL REPORT

The environmental report for the ARCO Warthog No. 1 project is submitted herewith as Appendix II to this Exploration Plan.

13.0 COMPLIANCE WITH LEASE STIPULATIONS

The drilling activities described in this Exploration Plan will be conducted within two (2) lease tracts: The surface location is on OCS Lease Y-1663 which was leased under Federal Sale 144, and the bottomhole location is on State Lease ADL 371014 which was leased in State of Alaska Lease Sale 50. This section describes how ARCO will comply with the lease stipulations for these two sale areas.

13.1 Federal OCS Lease Sale 144 (OCS Y-1663)

Stipulation No. 1: Protection of Biological Resources

The Regional Supervisor may require the lessee to conduct biological surveys needed to determine the extent and composition of biological populations and habitats requiring additional protection. As a result of these surveys, the Regional Supervisor may require the lessee to modify the operation and/or establish that operations will not have adverse effects, or that special biological resources do not exist. In addition, the lessee is required to report any areas of biological significance discovered during the conduct of any operations on the lease, and make every effort to preserve and protect the biological resources from damage until the Regional Supervisor provides direction with respect to resource protection.

ARCO Actions: Previous survey work on nearby federal and state acreage has not identified any hard bottom (i.e. "boulder patch") areas. Prior to rig mobilization, and as required by 30 CFR 250.33 (b)(1)(ix), ARCO will run a thorough shallow hazard survey including detailed bathymetry and side scan sonar. These surveys will identify any presently unknown biological communities in a 4800 meter x 6000 meter area centered on the drilling location. These surveys, and their interpretations will be made available to the Regional Supervisor as part of the Shallow Hazard report.

Stipulation No. 2: Orientation Program

The lessee must develop a proposed orientation program for all personnel involved in the exploration program.

ARCO Actions: All ARCO and contractor project personnel will receive North Slope cultural awareness training, and specific training in environmental awareness and safety, including polar bear avoidance. This training will include appropriate parts of video materials currently in the ARCO library that were prepared for the Kuvlum and Stinson projects. A formal Polar Bear Interaction Plan is in preparation and will be submitted to the Regional Supervisor for review and approval prior to mobilization.

Stipulation No. 3: Transportation of Hydrocarbons

This stipulation states that pipelines are the preferred mode of transporting production. This stipulation is not applicable to this exploratory drilling program.

Stipulation No. 4: Industry Site-Specific Bowhead Whale Monitoring Program

A monitoring program is required for drilling and seismic operations conducted during the Bowhead whale migration.

ARCO Actions: The eastern fall Bowhead whale migration has been defined by the MMS as August 1 through October 31. No drilling or seismic activities are scheduled during this period. Nevertheless ARCO has opened dialogue with the Alaska Eskimo Whaling Commission (AEWC) and the North Slope Borough (NSB) and local villages concerning a whale observation program during the warm shutdown period between late August and October 31, 1997. Mobilization activities will be coordinated with the MMS Bowhead Whale Aerial Survey Project.

Stipulation No. 5: Subsistence Whaling and other Subsistence Activities

Exploration, development and production operations must be conducted in a manner that prevents unreasonable conflicts between the oil industry and subsistence activities (including, but not limited to, Bowhead whale subsistence hunting).

ARCO Actions: ARCO has, and is continuing to consult with the AEWC, the NSB and local villages concerning the timing of the Warthog project and to identify any subsistence concerns. The Warthog well lies outside the Katovik subsistence whaling zone. Since no drilling activities are scheduled to begin prior to the end of the whale migration, impacts on subsistence whaling are expected to be non-existent.

Stipulation No. 6: Agreement Between the United States of America and the State of Alaska

This stipulation is advisory as to the Outer Continental Shelf Lands Act and the ownership of disputed tracts. No compliance activity is required.

Stipulation No. 7: Agreement Regarding Unitization

This stipulation is also advisory in nature and identifies those blocks subject to the "Agreement Regarding Unitization for the Outer Continental Shelf Oil and Gas Lease Sale 144 and State Oil and Gas Lease Sale 86 Between the United States of America and the State of Alaska". No compliance action is required.

13.2 State of Alaska Lease Sale 50 (ADL 371014)

Stipulation No. 1: Discovery of Historic or Archaeological Objects and Measures Taken to Preserve Such Objects

This stipulation relates to the discovery and preservation of any site, structure or object of

historic or archaeological interest during the conduct of lease operations. Since the subject leases lies entirely offshore, if any such objects are present they will most certainly be of shipwreck related origin.

ARCO Actions: If any ancient shipwrecks or other marine objects are present in the area of the Warthog well, they will be discovered during the side scan sonar survey which will be run as part of the Shallow Hazard Survey described in 13.1 (Stipulation No. 1) herein. Any such objects observed will be reported to the Director, Division of Oil and Gas, and the objects will be avoided during lease operations. Other than the shallow hazard survey, no other surface work is scheduled on ADL 371014, as the drillsite is on adjoining federal acreage. Lease operations are limited to directional drilling in the subsurface.

Stipulation No. 2: Seasonal Drilling Restrictions

This stipulation defines seasonal drilling restrictions in Sale Area 50 in order to minimize interference with the Bowhead whale migration and subsistence hunting activities. Subject to provisions to minimize noise during the whale migration, and conditions that must be implemented in order to drill in periods of broken ice, drilling from bottom founded structures is allowed year round.

ARCO Actions: ARCO does not plan to drill during broken ice conditions, and well spud will be delayed until after the Bowhead whale migration. Issues related to a whale monitoring program and subsistence whaling are addressed in Section 13.1 (Stipulations 4 and 5) herein.

The State of Alaska Lease Sale 50 fact sheet lists several additional mitigation measures which are specific permit conditions for conducting operations in the sale area. Since these measures are permit specific, they are not addressed in this Exploration Plan.

14.0 CERTIFICATE OF COASTAL ZONE CONSISTENCY

ARCO has submitted the following Coastal Project Questionnaire (CPQ) and Certification Statement to the office of the Governor, Division of Governmental Coordination. Several State permits are being sought concurrently with the Federal permits for the Warthog project. This CPQ is also the coordination document for these State Permits.

Coastal Project Questionnaire and Certification Statement

Please answer all questions. To avoid a delay in processing, please call the department if you answer "yes" to any of the questions related to that department. Maps and plan drawings must be included with your packet.

An incomplete packet will be returned.

■ **APPLICANT INFORMATION**

1. ARCO Alaska, Inc
 Name of Applicant
P O Box 100360
 Address
Anchorage Alaska 99510
 City State Zip Code
Paul Mazzolini 907-263-4603
 Daytime Phone
907-265-6224
 Fax Number

2. Fairweather E&P Services, Inc.
c/o R. C. Gardner, President
 Agent (or responsible party if other than applicant)
715 L Street, No. 4
 Address
Anchorage AK 99501
 City State Zip Code
907-258-3446
 Daytime Phone
907-258-5557
 Fax Number

■ **PROJECT INFORMATION**

- | | | |
|---|------------------------------|-------------------------------------|
| | Yes | No |
| 1. This activity is a: <input checked="" type="checkbox"/> new project <input type="checkbox"/> modification or addition to an existing project | | |
| If a modification do you currently have any State, federal or local approvals related to this activity? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| <i>Note: Approval means any form of authorization. If "yes," please list below:</i> | | |
| Approval Type | Approval # | Issuance Date |
| Expiration Date | | |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| 2. Has this project ever been reviewed by the State of Alaska per the ACMP? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Previous State I.D. Number: AK _____ | Previous Project Name: _____ | |

■ **PROJECT DESCRIPTION**

1. Attach the following: ● a detailed description of the project and all associated facilities; ● a project timeline for completion of all major activities in the proposal; ● a site plan depicting all proposed actions; ● other supporting documentation that would facilitate review of the project. Note: If the project is a modification, identify existing facilities as well as proposed activities on the site plan.
 Proposed starting date for project: 1-Nov-97 Proposed ending date for project: 1-Sep-98
2. Provide a brief description of your entire project and ALL associated facilities (access roads, caretaker facilities, waste disposal sites, etc.).
ARCO Alaska, Inc. plans to drill the Warthog No. 1 exploration well during the winter of 1997/1998. The well will be located in Camden Bay of the Beaufort Sea and drilled with the Glomar Beaufort Sea I Concrete Island Drilling System (CIDS). See the attached Plan of Operations for additional details.

■ **PROJECT LOCATION**

Attach a copy of the topographical map with the project location marked on it.

2. Location of project (include nearest community or name of the land feature or body of water. Identify township, range and section): Three miles north of Collinson Point in Camden Bay, Beaufort Sea.
 Township 8N Range 29E Section 20 Meridian UM Lat./ Long.: 70° 02' / 44° 55'
3. The project is on: State Land* Federal Land Private Land Municipal Land
 *State land can be uplands, tidelands, or submerged lands to 3 miles offshore. See Question #1 in DNR section.
 **Well surface location is on the Federal OCS. The well will be directionally drilled to a bottomhole location on State tidelands.
4. The project is located in which region (see attached map): Northern Southcentral Southeast
 State Pipeline Coordinator's Office
5. Is the project located in a coastal district? Yes No
 If yes, please contact the district representative listed on the attached sheet.
6. Identify the communities closest to your project location: Kaktovik, Deadhorse

■ **FEDERAL APPROVALS**

1. Is the proposed project on U.S. Forest Service (USFS) land or will you need to cross USFS lands for access? Yes No
 Does the cost of the project exceed \$250,000? Yes No
 If yes, have you applied for a USFS permit or approval? Yes No
 Date of submittal: _____
2. Is the proposed project on Bureau of Land Management (BLM) land or will you need to cross BLM lands for access? Yes No
 Does the cost of the project exceed \$250,000? Yes No
 If yes, have you applied for a BLM permit or approval? Yes No
 Date of submittal: _____
3. Will you be constructing a bridge over tidal (ocean) waters, or navigable rivers, streams or lakes? Yes No
 If yes, have you applied for a U.S. Coast Guard permit for a bridge? Yes No
 Date of submittal: _____
4. Will you be dredging or placing structures or fills in any of the following:
 tidal (ocean) waters? streams? lakes? wetlands*? Yes No
 If yes, have you applied for a U.S. Army Corps of Engineers (COE) permit? Yes No
 Date of submittal: 21-March-97

(Note: Your application for this activity to the Corps of Engineers also serves as your application to DEC.)
 *If you are not certain whether your proposed project is in a wetlands, contact the U.S. Corps of Engineers, Regulatory Branch at (907) 753-2720 for a wetlands determination (outside the Anchorage area call toll free 1-800-478-2712.)

5. Have you applied for a **U.S. Environmental Protection Agency** National Pollution Discharge Elimination System (NPDES) permit? Yes No
 Date of submittal: 23-April-97
 (Note: For information regarding the need for an NPDES permit, contact EPA at (907) 271-5083.)
 Application has been made for coverage under the Arctic General NPDES Permit, AKG248200.
6. Will you have a putrescible waste discharge within 5 miles of any public airport? Yes No
 If yes, please contact the Airports Division of the **Federal Aviation Administration** at (907) 271-5440.
7. Does the project include a nonfederal power project affecting any navigable body of water or located on federal land? Or, is utilization of surplus water from any federal government dam proposed? Yes No
 (Power projects consist of dams, water conduits, reservoirs, powerhouses, and transmission lines.)
 If yes, have you applied for a permit from the **Federal Energy Regulatory Commission (FERC)**? Yes No
 Date of submittal: _____
 (Note: For information, contact FERC, Office of Hydropower Licensing, at (202) 208-0200.)
8. Have you applied for permits from any other federal agency? Yes No
- | AGENCY | APPROVAL TYPE | DATE SUBMITTED |
|---|---|---------------------------------|
| <u>U.S. Environmental Protection Agency</u> | <u>Air Quality (Part 55)</u> | <u>24-April-97</u> |
| <u>U.S. Environmental Protection Agency</u> | <u>SPCC PLAN</u> | <u>10-June-97</u> |
| <u>U.S. Coast Guard</u> | <u>Shipboard Oil Pollution Emer. Plan</u> | <u>1-May-97</u> |
| <u>U.S. Minerals Management Service</u> | <u>Exploration Plan</u> | <u>28-April-97</u> |
| <u>U.S. Minerals Management Service</u> | <u>Oil Spill Contingency Plan</u> | <u>28-April-97</u> |
| <u>U.S. Minerals Management Service</u> | <u>Geological & Geophysical</u> | <u>28-April-97</u> |
| <u>U.S. Minerals Management Service</u> | <u>Permit to Drill</u> | <u>24-April-97</u> |
| <u>U.S. Minerals Management Service</u> | <u>3rd Party Rig Stability Cert.</u> | <u>1-August-97</u> |
| <u>U.S. Fish & Wildlife Service</u> | <u>Polar Bear LOA</u> | <u>21-April-97</u> |
| <u>U.S. National Marine Fisheries Service</u> | <u>Marine Mammal IHA</u> | <u>by ARCO (date uncertain)</u> |
| <u>U.S. Federal Aviation Administration</u> | <u>IFR Certification</u> | <u>1-June-97</u> |

■ DEPARTMENT OF ENVIRONMENTAL CONSERVATION (DEC) APPROVALS

1. Will a discharge of wastewater from industrial or commercial operations occur? Yes No
 Will the discharge be connected to an already approved sewer system? Yes No
 Will the project include a stormwater collection/discharge system? Yes No
2. Do you intend to construct, install, modify, or use any part of a wastewater (sewage or greywater) disposal system? Yes No
 The CIDS has an approved marine sanitation device onboard.
- a) If so, will the discharge be 500 gpd or greater? Yes No
 b) If constructing a domestic wastewater treatment or disposal system, will the system be located within fill material requiring a COE permit? Yes No

- | | | Yes | No |
|----|--|-------------------------------------|-------------------------------------|
| h. | If you have answered "yes" to any of the above questions (6 a-g), have you installed, replaced or modified any fuel burning or processing equipment since 1977? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 7. | Will you be developing, constructing, installing, or altering a public water system? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 8. | a. Will your project involve the operation of waterborne tank vessels or oil barges that carry crude or non-crude oil as bulk cargo, or the transfer of oil or other petroleum products to or from such a vessel or a pipeline system? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| | b. Will your project require or include onshore or offshore oil facilities with an effective aggregate storage capacity of greater than 5,000 barrels of crude oil or greater than 10,000 barrels of non-crude oil? | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| | c. Will you be operating facilities on the land or water for the exploration or production of hydrocarbons? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

If you answered NO to ALL questions in this section, continue to next section.

If you answered YES to ANY of these questions, contact the DEC Regional office for information and application forms. Please be advised that all new DEC permits and approvals require a 30-day public notice period.

Based on your discussion with DEC, please complete the following:

Approval Type: Oil Discharge Prevention and Contingency Plan
Food Service Permit

Date Submitted: 28-April-97
May-97

- | | | Yes | No |
|--|---|-------------------------------------|--------------------------|
| | Does your project qualify for a general permit for wastewater or solid waste? | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

10. If you answered yes to any questions and are not applying for DEC permits, indicate reason below:
- _____ (DEC contact) told me on _____ that no DEC approvals are required on this project. Reason: _____
- Other: _____

■ DEPARTMENT OF FISH & GAME (DFG) APPROVALS

- | | | Yes | No |
|----|--|--------------------------|-------------------------------------|
| 1. | Will you be working in, or placing anything in, a stream, river or lake? (This includes work in running water or on ice, within the active flood plain, on islands, the face of the banks or the tidelands down to mean low tide.)(Note: If the proposed project is located within a Federal Emergency Management Agency Zone, a Floodplain Development Permit may be required. Contact the local municipal government for additional information and a floodplain determination.) | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| | Name of <input type="checkbox"/> stream, <input type="checkbox"/> river, or <input type="checkbox"/> lake: _____ | | |

2. Will you do any of the following?

Yes No

Please indicate below:

- Build a dam, river training structure or instream impoundment?
- Use the water?
- Pump water out of the stream or lake?
- Divert or alter the natural stream channel?
- Block or dam the stream (temporarily or permanently)?
- Change the water flow or the water channel?
- Introduce silt, gravel, rock, petroleum products, debris, chemicals, or other organic/inorganic waste of any type into the water?
- Alter or stabilize the banks?
- Mine or dig in the beds or banks?
- Use explosives?
- Build a bridge (including an ice bridge)?
- Use the stream as a road (even when frozen), or crossing the stream with tracked or wheeled vehicles, log-dragging or excavation equipment (back-hoes, bulldozers, etc.)?
- Install a culvert or other drainage structure?
- Construct a weir?
- Use an in-stream structure not mentioned here?

3. Is your project located in a designated State Game Refuge, Critical Habitat Area or State Sanctuary?

Yes No

4. Does your project include the construction/operation of a salmon hatchery?

5. Does your project affect, or is it related to, a previously permitted salmon hatchery?

6. Does your project include the construction of an aquatic farm?

If you answered "No" to ALL questions in this section, continue to next section.

If you answered "Yes" to ANY questions under 1-3, contact the Regional DFG Habitat Division Office for information and application forms.

If you answered "Yes" to questions 4-6, contact the DFG at the CFMD division headquarters for information and application forms.

Based on your discussion with DFG, please complete the following:

Approval Type: _____ Date Submitted: _____

7. If you answered yes to any questions and are not applying for DFG permits, indicate reason below:

- _____ (DFG contact) told me on _____ that no DFG approvals are required. Reason: _____
- Other: _____

■ DEPARTMENT OF NATURAL RESOURCES (DNR) APPROVALS

1. Is the proposed project on State-owned land or will you need to cross State-owned land for access? ("access" includes temporary access for construction purposes)

Yes No

Note: In addition to State-owned uplands, the State owns almost all land below the ordinary high water line of navigable streams, rivers and lakes, and below the mean high tide line seaward for three miles.

*The well will be located partially on State tidelands.

- | | | Yes | No |
|-----|---|-------------------------------------|-------------------------------------|
| 2. | Do you plan to dredge or otherwise excavate/remove materials on State-owned land? <input type="checkbox"/>
Location of dredging site if other than the project site: _____
Township _____ Range _____ Section _____ Meridian _____ | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 3. | Do you plan to place fill or dredged material on State-owned land? <input type="checkbox"/>
Location of fill disposal site if other than the project site: _____
Township _____ Range _____ Section _____ Meridian _____
Source is on: <input type="checkbox"/> State Land <input type="checkbox"/> Federal Land <input type="checkbox"/> Private Land <input type="checkbox"/> Municipal Land | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 4. | Do you plan to use any of the following State-owned resources: <input type="checkbox"/>
<input type="checkbox"/> Timber: Will you be harvesting timber? Amount: _____
<input type="checkbox"/> Materials such as rock, sand or gravel, peat, soil, overburden, etc.:
Which material? _____ Amount: _____
Location of source: <input type="checkbox"/> Project site <input type="checkbox"/> Other, describe: _____
Township _____ Range _____ Section _____ Meridian _____ | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 5. | Are you planning to use or divert any fresh water? <input type="checkbox"/>
Amount (gallons per day): _____
Source: _____ Intended Use: _____ | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 6. | Will you be building or altering a dam? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 7. | Do you plan to drill a geothermal well? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 8. | At any one site (regardless of land ownership), do you plan to do any of the following? <input type="checkbox"/>
<input type="checkbox"/> Mine five or more acres over a year's time?
<input type="checkbox"/> Mine 50,000 cubic yards or more of materials (rock, sand or gravel, soil, peat, overburden, etc.) over a year's time?
<input type="checkbox"/> Have a cumulative unreclaimed mined area of five or more acres?
If you plan to mine less than the acreage/amount stated above and have a cumulative unreclaimed mined area of less than five acres, do you intend to file a voluntary reclamation plan for approval? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 9. | Will you be exploring for or extracting coal? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 10. | Will you be drilling for oil/gas? <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| 11. | Will you be investigating or removing historical or archaeological resources on State-owned land? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| 12. | Is the proposed project located within a known geophysical hazard area? <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

Yes No

Is the proposed project located in a unit of the Alaska State Park System?

If you answered "No" to ALL questions in this section, continue to certification statement.

If you answered "Yes" to ANY questions in this section, contact DNR for information.

Based on your discussion with DNR, please complete the following:

Approval Type: Lease Operations Permit & Plan of Operations
Geophysical Exploration Permit

Date Submitted: 28-April-97
28-April-97

14. If you answered yes to any questions and are not applying for DNR permits, indicate reason below:

_____ (DNR contact) told me on _____ that no DNR approvals are required.

Reason: _____

Other: _____

Please be advised that the CPQ identifies permits subject to a consistency review. You may need additional permits from other agencies or local governments to proceed with your activity.

Certification Statement

The information contained herein is true and complete to the best of my knowledge. I certify that the proposed activity complies with and will be conducted in a manner consistent with, the Alaska Coastal Management Program.

Signature of Applicant or Agent

Date

R. C. Gardner
FAIRWEATHER E&P SERVICES, INC.

April 25, 1997

Note: Federal agencies conducting an activity that will affect the coastal zone are required to submit a federal consistency determination, per 15 CFR 930, Subpart C, rather than this certification statement.

This certification statement will not be complete until all required State and federal authorization requests have been submitted to the appropriate agencies.

■ To complete your packet, please attach your State permit applications and copies of your federal permit applications to this questionnaire.

15.0 EPA PART 55 AIR PERMIT

On April 3, 1997, ARCO submitted a "Notice of Intent to Operate an Outer Continental Shelf Source for Oil Exploration Drilling, Beaufort Sea, Alaska", to the U.S. Environmental Protection Agency (EPA). This Notice advised the EPA that ARCO intends to amend its existing Part 55 OCS permit for the Beaufort Sea (Permit No. PSD/OCS X93-01) to accommodate the Warthog activity. The Notice of Intent is consistent with an agreement reached with the EPA on March 20, 1997 at a meeting in Seattle, Washington, concerning the approach toward permitting the emissions from Warthog Project drilling operations. The formal application to amend the existing permit, including emission inventories and modeling data is being prepared concurrently with the review of the Exploration Plan.

16.0 ENVIRONMENTAL MONITORING

Meteorological, oceanographic and vessel response data will be monitored as specified in 30 CFR 250.33 (b)(16). A daily log of meteorological and oceanographic data, collected every 3 hours, will be maintained. The log form (Figure 16-1, P. 51) is derived from the suggested format contained in the MMS "Alaska Outer Continental Shelf Guidelines for Collection and Submission of Meteorological, Oceanographic and Performance Data." The log form was modified from the suggested format to make it more applicable to the Glomar Beaufort Sea I, a submersible MODU operating mostly in solid sea ice conditions. Any vessel response would result solely from lateral ice loading. The vessel's responses, or lack thereof, to any natural conditions, including ice loading, will be recorded in the "Remarks" section of the log form.



April 3, 1997

Mr. Raymond Nye
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101

Subject: Notice of Intent to Operate an Outer Continental Shelf
Source for Oil Exploration Drilling, Beaufort Sea, Alaska

Dear Mr. Nye:

Oh behalf of ARCO Alaska, Inc. (AAI), we respectfully notify the U.S. Environmental Protection Agency of AAI's intent to conduct oil exploration drilling in the Outer Continental Shelf (OCS) of the Beaufort Sea, Alaska. This notice of intent (NOI) provides information related to exploratory drilling in accordance with the notice requirements of 40 CFR 55.4. Please note that AAI proposes to amend its existing Part 55 OCS permit for the Beaufort Sea (Permit No. PSD/OCS X93-01) to accommodate the proposed drilling operations.

1. General Company Information

AAI's designated agent for this project is the following:

Mr. Mark Major
Exploration Permits Director
ARCO Alaska, Inc.
P.O. Box 100360
Anchorage, Alaska 99510-0360
Phone: (907) 265-6136

The facility site contact has not yet been determined. This information will be forwarded to EPA prior to the commencement of operations.

2. Facility Description

AAI proposes to conduct exploratory drilling in the OCS near shore waters of the Beaufort Sea on the Warthog Prospect in the vicinity of Camden Bay, Alaska. The proposed exploration rig is the GLOMAR Beaufort Sea I (see brochure attached), which is owned and operated by Global Marine Drilling Company, and would be under contract to AAI. A complete facility description is provided in the attached "Executive Summary of Exploration Plan." The proposed operation would be classified under SIC Code 1300.



Mr. Raymond Nye
 April 3, 1997
 Page 2

AAI currently has a Part 55 permit to conduct such drilling in OCS waters in an area bounded by Brownlow Point on the west and Konganevik Point on the east. The proposed Warthog surface location is approximately 6 miles east of Konganevik Point at about 144° 55' 35" west longitude, 70° 02' 40" north latitude. AAI's requested permit amendment would allow exploratory drilling as far east as 144° 45' 00", as far north as 70° 05' 00", and as far south and west as the Alaska territorial waters limit.

The corresponding onshore area (COA) is in the Simpson Cove area of Camden Bay. The Beaufort Sea coast is uninhabited between the Endicott oil production facility about 60 miles west of Warthog and the Alaska Native settlement of Kaktovik about 30 miles east. The nearest PSD Class I area is Denali National Park about 450 miles south. The nearest nonattainment area is for carbon monoxide in the Fairbanks and North Pole urban area approximately 350 miles south.

3. Project Emissions

The Beaufort Sea I has about 40 combustion sources which include internal combustion engines, boilers, heaters, well test flares, and a refuse incinerator. All combustion equipment will be diesel-fired except for the well test flares which will burn field natural gas. There are also 5 vented tanks on the Beaufort Sea I. Tug boats used to tow the Beaufort Sea I to and from the Warthog Prospect will each have two to four diesel-fired internal combustion engines plus a fuel tank. Three tugs are expected to be used during mobilization to, and demobilization from, the Warthog Prospect.

The diesel fuel burned would be Arctic grade No. 1 diesel with a typical sulfur content of 0.1-0.2% by weight. The fuel would be purchased from one of the two topping plants on the North Slope located at Prudhoe Bay and Kuparuk. The quantity of diesel fuel consumed is expected to average less than 5,000 gallons per day. The gas flared will be field gas which is expected to have a low sulfur content. The maximum flare rate is expected to average less than 10 MMCF per day for the maximum of 45 well test days.

Estimated air emission for the project are currently under review, but they will be based on anticipated maximum operations. In its Part 55 permit amendment application, AAI will request federally enforceable permit limits from EPA which establish the maximum allowable operating limits for the Warthog drilling program. Reasonable estimates on the upper limit on emissions is provided below. These estimates are based on full-time operation of all equipment on the Beaufort Sea I for five months, full-time operation for all tender vessels for one month, and well testing for 45 days.

	<u>NO_x</u>	<u>CO</u>	<u>SO₂</u>
Upper Bound Emission Estimate (tpy)	1,000	300	180



Mr. Raymond Nye
April 3, 1997
Page 3

As part of its permit amendment application to the EPA, AAI will propose the best available control technology (BACT) for significant sources of air pollutants. Further information on parameters affecting emissions, including stack parameters, flow rates, and equipment and facility dimensions, was filed at EPA Region X in 1993 as part of the initial AAI OCS permit application. This information will be updated in the forthcoming permit amendment application.

4. Billing Procedures

As we understand your policy, EPA bases permit fees on the COA fee system. Therefore, based on your guidance, we are submitting to EPA a check payable to the U.S. Department of Treasury in the amount of \$2,000. This amount is consistent with the Alaska Department of Environmental Conservation's permit fee retainer for miscellaneous permit amendments as set forth in 18 AAC 50.400(b).

5. Part 55 Permit Amendment Application

AAI expects to file the Part 55 permit amendment application in April 1997 at least 6 months in advance of the anticipated commencement of drilling operations on November 1, 1997. It is AAI's understanding that this letter satisfies the NOI requirements under Part 55 and that no other information is required prior to the submittal of the amendment application. Please advise us as soon as possible if our understanding is not correct. Otherwise, AAI requests written concurrence from EPA of the NOI receipt and acceptance.

Should you have any further questions, please contact myself at the telephone number above or our consultant, Brian Hoefler, at (907) 563-2139.

Sincerely,

R.C. Gardner
President

cc: M. Major/ARCO Alaska, Inc.
B. Hoefler/Hoefler Consulting Group

Attachments:

1. GLOMAR Beaufort Sea I Brochure
2. Executive Summary of Exploration Plan: ARCO Warthog No. 1 Exploration Well
3. Check to the U.S. Department of Treasury for \$2,000.00

**APPENDIX I
TO THE
EXPLORATION PLAN**

HYDROGEN SULFIDE CONTINGENCY PLAN

**Prepared for
ARCO ALASKA INC.
ANCHORAGE, ALASKA**

**ARCO WARTHOG NO. 1
EXPLORATION WELL**

**Prepared by
FAIRWEATHER E&P SERVICES, INC.
715 L Street, #4
Anchorage, Alaska 99501
Tel: 907-258-3446
Fax: 907-258-5557
April, 1997**

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SUB-TABS

- I. Hydrogen Sulfide Emergency Action Plan
- II. Procedures, Training, Drills and Checklists
- III. Considerations During the Drilling of a Sour Gas Well

1.0 INTRODUCTION

The area in which the ARCO Warthog No. 1 exploration well is being drilled is not known to contain Hydrogen Sulfide (H_2S) gas in any of the formations penetrated by the wellbore. However, because this is an outpost exploration well and previous drilling density in the eastern Beaufort Sea is minimal, the MMS has classified the Warthog location as a "Zone where the presence of H_2S is unknown." This means that sufficient information is not available to conclusively confirm the absence of H_2S , and therefore plans and equipment must be available to ensure personnel safety and protection. This H_2S Contingency Plan has been developed in response to the risk of encountering H_2S at the Warthog location. The plan covers the following subjects:

- The properties and characteristics of H_2S ;
- Symptoms, Protection and Rescue in H_2S Emergencies;
- H_2S Rescue and Detection Equipment; and
- H_2S Emergency Action Plan.

The principal purpose of this plan is to train personnel about working in an H_2S environment. Every person whose work could result in an exposure to H_2S must be sure they know how to recognize the presence of H_2S , how to protect themselves and how to avoid the lethal effects of the gas. They must also know how to rescue and perform first aid on victims who are overcome by H_2S .

The next three (3) sections (Sections 2.0, 3.0, and 4.0) of this Contingency Plan present H_2S awareness and background material that give the reader an information base from which to better understand the ramifications of the H_2S Emergency Action Plan presented in Sub-tab Section I, herein.

2.0 HYDROGEN SULFIDE - PROPERTIES AND CHARACTERISTICS

2.1 What is H_2S ?

Hydrogen Sulfide is a colorless, flammable gas giving an offensive odor and a sweetish taste. It is highly toxic and very hazardous because it is heavier than air (specific gravity = 1.19). The principal hazard to personnel is asphyxiation or poisoning by inhalation. Its offensive odor, like that of a rotten egg, has been used as an H_2S indicator by many old timers in the oil fields, but smell is not a reliable warning of the presence of gas in a dangerous concentration because people differ greatly in their ability to detect smells. Where high concentrations are encountered, the olfactory nerves are rapidly paralyzed, defeating the sense of smell as a warning indicator. A concentration of a few hundredths of one percent higher than that causing irritation, can cause asphyxiation and death. In other words, there are very narrow margins between consciousness and unconsciousness and between unconsciousness and death.

Because high concentrations cause respiratory paralysis, spontaneous breathing does not return unless artificial respiration is applied. Although breathing is paralyzed, the heart may continue beating for up to ten minutes after a person is overcome by H_2S .

H_2S is formed by the decomposition of organic matter by bacteria. It is found in some oil and gas wells, sewers, septic tanks, and in some stagnant waters such as swamps. It is also produced as a by-product of a variety of industrial processes. The chemical formula H_2S means that each molecule of the gas is composed of two hydrogen atoms and one sulfur atom.

In the oil and gas industry, hydrogen sulfide is referred to by a variety of names:

- H_2S
- Rotten Egg Gas
- Sulfurated Hydrogen
- Stink Damp
- Sour Crude
- Hydro Sulfuric Acid
- Sulfur Hydride

2.2 Characteristics of Hydrogen Sulfide

- Extremely toxic.
- Heavier than air. Specific gravity = 1.19.
- Colorless, has odor of rotting eggs in low concentrations.
- Burns with a blue flame and produces Sulphur Dioxide (SO_2) gas, which is very irritating to eyes and lungs. Sulfur Dioxide is also toxic and can cause serious injury.
- H_2S forms explosive mixtures, with air between 4.3% and 46% by volume.
- H_2S is more toxic than carbon monoxide.
- Produces irritation to eyes, throat and respiratory tract.
- Threshold Limit Value (TLV) maximum of eight hours exposure without protective respiratory equipment is 20 PPM.
- Highly corrosive to certain metals.

2.3 Properties of Gases

Natural gas that contains H_2S , normally contains methane and carbon dioxide as well. When gas containing H_2S is burned, sulfur dioxide is one of the combustion products. These gases have different characteristics.

- Methane (CH_4): Methane is colorless, odorless, tasteless and lighter than air (SG = 0.6). It forms an explosive mixture with air (5-15% by volume). Methane is not considered toxic but is a simple asphyxiant.

- Carbon Dioxide (CO₂): Carbon dioxide is usually considered inert, and is commonly used to extinguish fires. It is heavier than air (1.5 times) and it will concentrate in low areas of still air. Humans cannot breathe air containing more than 10% CO₂ without losing consciousness. Air containing 5% CO₂ will cause disorientation in a few minutes. Continued exposure to CO₂ after being affected will cause convulsions, coma, and respiratory failure. The threshold limit of CO₂ is 5,000 ppm. Short-term exposure to 50,000 ppm (5%) is reasonable. This gas is colorless and odorless and can be tolerated in relatively high concentrations.
- Hydrogen Sulfide (H₂S): Hydrogen sulfide is a colorless, transparent and flammable gas. It is heavier than air; hence, it may accumulate in low places. Sulfur dioxide (SO₂) will form when hydrogen sulfide is burned. Even though the slightest presence of H₂S in the air is normally detectable by its characteristic "rotten egg" odor, it is dangerous to rely on the odor as a means of detecting excessive concentrations which have accumulated without warning. The following table indicates the poisonous nature of hydrogen sulfide:

<u>CONCENTRATIONS</u>		<u>EFFECTS</u>
<u>% H₂S</u>	<u>PPM</u>	
0.000013	0.13	Minimal perceptible odor.
0.00046	4.60	Easily detectable odor.
0.001	10.0	Safe for 8 hours without respirator. Obvious and unpleasant odor. Beginning eye irritation.
0.002	20.0	Safe for 4 hour exposure without respirator.
0.0027	27.0	Strong unpleasant odor, but not intolerable.
0.01	100	Kills sense of smell in 2 to 5 minutes; will sting eyes and throat, cause coughing.
0.02	200	Kills sense of smell quickly; stings eyes and throat. Respiratory tract irritation after 1 hour exposure.
0.05	500	Dizziness; breathing stops in a few minutes; need prompt artificial respiration. Loss of consciousness and possible death in 30 minutes to 1 hour.
0.07	700	Unconscious quickly; death will result if not rescued promptly.
0.1	1000	Unconscious at once; followed by death within minutes.

- Sulfur Dioxide (SO₂): Sulfur dioxide is a colorless, transparent, non-flammable gas. It is produced by the burning of H₂S. Although SO₂ is heavier than air, it will be picked up by the breeze and carried downwind, particularly at elevated temperatures. SO₂ is extremely irritating to the eyes and mucus membranes of the upper respiratory tract. These symptoms are good warning signs of the presence of SO₂. The following table indicates the toxic nature of SO₂:

<u>CONCENTRATIONS</u>		<u>EFFECTS</u>
<u>% SO₂</u>	<u>PPM</u>	
0.0005	3 TO 5	Pungent odor - normally a person can detect SO ₂ in this range. Safe for 8 hours without a respirator.
0.0012	12	Throat irritation, coughing, constriction of the chest, tearing and smarting of the eyes.
0.015	150	So irritating it can only be endured a few minutes.
0.05	500	Causes sense of suffocation, even with first breath.

2.4 Toxicity of Various Gases

The following gases are potentially present in oilfield operations. They all can be toxic under varying concentrations and conditions:

<u>Common Name</u>	<u>Chemical Formula</u>	<u>Gravity Air = 1</u>	<u>Threshold Limit</u>	<u>Hazardous Limit</u>	<u>Lethal Concentration</u>
Hydrogen Sulfide	H ₂ S	1.19	10 ppm	250 ppm/hr	600 ppm
Sulfur Dioxide	SO ₂	2.21	5 ppm	--	1000 ppm
Carbon Monoxide	CO	0.97	50 ppm	400 ppm/hr	1000 ppm
Carbon Dioxide	CO ₂	1.52	5000 ppm	5%	10%
Methane	CH ₄	0.55	90000 pm (9%)	Combustible Above 5% in air	--

1. Threshold Limit - Concentration at which it is believed that all workers may repeatedly be exposed, day after day, without adverse effect.
2. Hazardous Limit - Concentration that may cause death.
3. Lethal Concentration - Concentration that will cause death with short-term exposure.

2.5 How Does H₂S Affect Individuals?

When a person breathes H₂S, it goes directly through the lungs and into the bloodstream. To protect itself, the body oxidizes (breaks down) the H₂S as rapidly as possible into a harmless compound. If the individual breathes in so much H₂S that the body cannot oxidize all of it, the H₂S builds up in the blood and poisons the individual. The nerve centers in the brain which control breathing are paralyzed, the lungs stop working and the person is asphyxiated.

The way in which H₂S can physically affect an individual depends upon the following factors:

- **Duration** - The length of time the individual is exposed.
- **Frequency** - How often the individual has been exposed.
- **Intensity** - How much (concentration) the individual was exposed to.
- **Individual Susceptibility** - The individual's physiological makeup.

Individuals who have consumed alcohol within 24 hours of exposure have often been overcome by unusually small concentrations of H₂S. Alcohol and H₂S not mix, and persons who will be working in a known or potential H₂S environment should refrain from consuming alcoholic beverages 24 hours before returning to the job site.

Acceptable H₂S exposure limits are as follows:

- **Acceptable Eight-Hour Time-Weighted Average (TWA)** - to avoid discomfort, the time-weighted average concentration of H₂S shall not exceed 10 ppm.
- **Short Term Exposure Limit (STEL)** - 15 ppm of H₂S is the 15-minute time-weighted average exposure which shall not be exceeded at any time during a work day.

3.0 HYDROGEN SULFIDE - SYMPTOMS, PROTECTION AND RESCUE PROCEDURES

3.1 Physiological Symptoms of H₂S Exposure

Acute Symptoms: A few seconds of inhalation of H₂S in high concentrations will result in panting respiration, pallor, cramps, paralysis and almost immediate loss of consciousness with loss of speech. A person experiencing acute H₂S poisoning symptoms is often unable

to utter more than a cry before losing consciousness. Acute symptoms result in instantaneous asphyxiation and respiratory paralysis. Death may follow shortly. One breath of H₂S in high concentrations can have this result.

Subacute Symptoms: Subacute exposure to H₂S results in irritation of the eyes, persistent cough, tightening or burning in the chest and skin irritation. These symptoms are often followed by depression of the central nervous system. The irritation of the eyes ranges from mild conjunctivitis and photophobia (abnormal intolerance to light) to temporary blindness.

3.2 Safe Practices

When working in an area where H₂S is present, the following safe practices are mandatory:

- Be sure all personnel who are working in an H₂S environment know where H₂S is present and are familiar with the hazards of H₂S.
- Know how to use and maintain a respirator and resuscitator.
- Know how to give rescue breathing.
- Post warning signs in H₂S area.
- Be sure new employees and visitors are trained in H₂S procedures.
- Teach all personnel to avoid H₂S areas if possible - work on the windward (upwind) side and have breathing equipment available.
- Never let bad judgement guide you - **WEAR RESPIRATORY EQUIPMENT.** Never try to hold your breath in order to enter a contaminated atmosphere.
- In areas of high concentration, use a buddy system.
- Never enter a tank, cellar or other enclosed place where gas can accumulate without wearing proper respiratory protective equipment and a safety belt secured to a life line held by another person outside.
- Always check out dangerous areas first with H₂S detectors before allowing anyone to enter. **DO NOT TRY TO DETERMINE THE PRESENCE OF GAS BY ITS ODOR.**
- Wear proper respiratory equipment for the job at hand. Never take a chance with equipment with which you are unfamiliar. If in doubt, consult your supervisor.
- Carry out practice drills every week with emergency and maintenance breathing equipment. Telling or showing a group how to operate equipment is not enough - make them show you.

- Communications such as radios, telephones, and/or chalkboards should be provided for those people employed where H₂S may be present. Communication is difficult while wearing breathing equipment.

3.3 Detection of Hydrogen Sulfide

There are many ways you can be alerted to the presence of H₂S gas. Your nose is usually the first, and, unfortunately, sometimes the last. You can smell as little as one part of H₂S in a million parts of air; however, if the concentration of gas is in the 100 - 150 ppm range, the sense of smell is quickly lost, giving a false sense of security. **Remember: You cannot rely on your nose to tell how much H₂S is present.**

One or more of the following means of detection should be used to determine the concentration of H₂S present:

- **Lead Acetate, Ampules or Coated Strips** - These change color (usually turn brown or black) in the presence of H₂S. The degree of color indicates the concentration. They are not always quantitatively accurate and should be used only as an indicator for the presence of H₂S.
- **Electronic Portable Detectors** - This type of personal device is belt-mounted or hand-held and gives an audible alarm (and in some cases a readout) upon exposure to a pre-determined level of H₂S.
- **Air Sampling Gas Detector Tubes** - The concentration of H₂S is registered by the length of discoloration when air is drawn through the detector tube. There are several reliable types available, but their accuracy will depend on the training and practice of the operator. Tubes must be NIOSH certified.
- **Fixed Electronic H₂S Sensors** - On drilling rigs, a fixed system of continuous monitoring is often used. Where these units monitor an area continuously, an alarm system, actuated by a sensing unit, will give warning when the H₂S concentration gets above certain fixed limits.

3.4 Protection Against Hydrogen Sulfide Hazards

Working in a possibly contaminated H₂S environment requires certain safety precautions to provide maximum protection of human lives. These precautions include:

- Personnel training programs
- Personnel drills
- Adequate and proper placement of safety equipment
- Contingency plans
- Emergency procedures
- Adherence of all safe work practices

When there is a potential H₂S hazard, the employee shall use the provided respiratory protection in accordance with instructions and training received.

FEDERAL REGULATION - 1910.134 Respiratory Protection OSHS (29CFR 1910)

Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protective program which shall include the requirements outlined in this section. For additional requirements refer to OSHS (29CFR 1910.134) paragraph (b) and Occupational Safety and Health Standards (OSHS) Code of Federal Regulations (CFR).

If, in the course of drilling operations, H₂S gas in dangerous concentrations is released into the air, respiratory protection in the form of breathing apparatus must be available and worn immediately. All forms of breathing apparatus have limitations, and every user needs to know these limitations. In addition, when workers wearing breathing apparatus are required to work in confined spaces, there must always be an attendant or helper who will have rescue equipment available and ready for use. Approved safety harnesses and lifelines must be worn and when entry is from the top, it is recommended that there be at least two helpers or attendants. Workers in H₂S areas must know how to perform rescue breathing.

3.4.1 Breathing Apparatus (Respirators)

Self Contained Breathing Equipment:

This type of breathing equipment supplies air from a cylinder worn on the back. A commonly used cylinder will supply air for 30 minutes while the wearer is engaged in heavy physical work. Other cylinders are available for longer usage. Duration of air supply is dependent on the type of work performed and the individual's physical condition.

Supplied Air Breathing Equipment:

This is a variation of the self-contained apparatus where the back-mounted tank is replaced by a large cylinder connected by a hose line to a demand valve on the wearer's body. While supplied air apparatus is lighter to wear, it restricts the user's movements to the length of the hose. The hose also forces the user to return by the same route taken when entering the area. An escape bottle must be worn with this type of equipment.

Escape Air Capsule:

The air capsule was designed with one purpose in mind...**EMERGENCY ESCAPE.** It takes only seconds to don, it has no belts, straps, face piece or valves to turn on. Duration is five minutes.

3.4.2 Special Problems in Respirator Use

- **Facial Hair** - Facial hair lying between the sealing surface of the respirator face piece and the wearer's skin will prevent an effective seal. Even one day's growth of stubble will permit excessive contaminant penetration and/or loss of air.
- **Fit Testing** - Breathing mask fit testing will be required of all personnel who may be required to wear SCBA and a record will be maintained onboard of each individual's breathing mask size. In addition, any persons who are not able to use SCBA due to medical reasons will not be assigned jobs where use of SCBA may be necessary.
- **Contact Lenses** - Contact lenses are a definite hazard and should not be worn while wearing a respirator in a contaminated atmosphere.
- **Corrective Spectacles** - Corrective spectacles with temple bars or straps that interfere with the respirator face seal should not be worn as they will permit excessive contaminant penetration.
- **Psychological Disturbances** - Psychological disturbances, such as claustrophobia, are a definite hazard to the wearer of a respirator.
- **Miscellaneous Sealing Problems** - Sealing problems vary according to the individual; some are pronounced, others are not detected until a fit test is performed. The more noticeable ones are scars, hollow temples, very prominent cheek bones, deep skin creases and the lack of teeth or dentures.

3.5 Rescue Procedures

Every worker in an H₂S environment can potentially be involved in the rescue of someone who has been overcome by the gas. The following rescue procedures need to be understood by all personnel.

- Put on your full rescue unit (minimum 30-minute breathing apparatus) before attempting a rescue, or you too can become a victim.
- Remove the victim immediately to fresh air.
- If breathing, maintain the victim at rest and administer oxygen if available.
- If the victim is not breathing, start rescue breathing immediately. If a resuscitator is not available, continue rescue breathing and send another employee to get it and prepare it for use.
- Call the onboard medical technician and get the victim medical treatment. Set up a medivac flight if necessary. In all cases, victims of H₂S poisoning should receive medical attention.

- Keep the victim lying down with a blanket, coat, etc. under shoulders to keep airway passage open. Conserve the victim's body heat and do not leave unattended. Treat for shock.
- If eyes are affected by H₂S, wash them thoroughly with clear water. For slight eye irritation, cold compresses are helpful.
- In case a victim has only minor exposure and does not lose consciousness totally, keep under observation. It is best if he or she does not return to work until the following day.

Remember, do not panic, but there is no time to waste when breathing stops. Rescue breathing must be started immediately.

After breathing is stopped for:

1 minute
2 minutes
3 minutes
4 minutes
5 minutes
6 minutes
7 minutes
8 minutes
9 minutes
10 minutes
11 minutes
12 minutes

The Chances for Life are:

98 out of 100
92 out of 100
72 out of 100
50 out of 100
25 out of 100
11 out of 100*
8 out of 100*
5 out of 100*
2 out of 100*
1 out of 100*
1 out of 1,000*
1 out of 10,000*

*Irreparable brain damage starts at about fifth minute.

4.0 HYDROGEN SULFIDE DETECTION AND RESCUE EQUIPMENT AT ARCO WARTHOG NO. 1

The following lists of equipment will be aboard the rig prior to spud of the Warthog well.

4.1 Breathing Air Equipment for Work Areas

4.1.1 (Pressure Demand Air mask - 30 Minute Supply)

LOCATION

RM 435 ARCO Office
RM 436 ARCO Office
RM 446 Rig Engineer

RM 503 Bargemaster Office
RM 503 Safety Representative Office
RM 507 Bargemaster Room
Control Room
Electrical Shop
Welding Shop
Fire Pump Room
Global Superintendent Office
Machine Shop
Doghouse - 3 ea
Engine Room - 2 ea
RM 437 Drilling Office
Entrance to Living Quarters
Schlumberger Shack - 2 ea
Switch Gear Room - 2 ea
Warehouse

Additional 30-Minute Air-Packs:

6 ea 30 minute air packs located in hospital on 4th level.
1 ea 30 minute air pack located in Fire Box on Main Deck.
1 ea 30 minute air pack located in Fire Box on Heliport.
4 ea 30 minute air packs located in Spare Generator Room on Main Deck.
12 ea 45 cubic foot spare cylinders located in Spare Generator Room on Main Deck.

4.1.2 (Pressure Demand Air Mask - 5 Minute Supply Escape Packs)

LOCATION

Accumulator Room - 2 ea
Cellar Area - 2 ea
Cement Room
Derrick
Dog House
Mud Pump Room - 2 ea
Mud Logger Shack - 2 ea
Survival Quarters
Pipe House - 2 ea
Engine Room
Rig Floor - 5 ea
Engine Room
Shaker Room - 3 ea

**4.2 Breathing Air Equipment for Living Quarters
(5-Minute Escape Packs)**

<u>LOCATION</u>	<u>NUMBER OF UNITS</u>	<u>LOCATION</u>	<u>NUMBER OF UNITS</u>
RM 301	2	RM 317	2
RM 303	2	RM 319	2
RM 305	2	RM 321	2
RM 307	2	RM 323	2
RM 309	2	RM 325	2
RM 311	2	RM 327	2
RM 313	2	RM 329	2
RM 315	2	RM 330	2
RM 331	2	RM 402	1
RM 333	2	RM 403	1
RM 335	2	RM 404	1
RM 337	2	RM 405	2
RM 339	2	RM 406	2
RM 341	2	RM 407	2
RM 343	2	RM 409	2
RM 345	2	RM 410	2
RM 347	2	RM 411	2
RM 349	2	RM 412	2
RM 351	2	RM 413	2
RM 353	2	RM 414	2
RM 364	2	RM 430	2
RM 402	1	RM 431	2
RM 443	1	RM 444	1
RM 446	1	RM 447	1
RM 505	2	RM 507	2

4.3 Safety/Rescue Equipment

In Global Marine Control Room

<u>Qty.</u>	<u>Description</u>
2	MSA Model 261 gas detectors
1	MSA Model 2A gas detectors
1	Rexnard Model 922 gas detectors
2	Biosystem Model 100 gas detectors
1	Scott Model 011 gas detector
1	J W Sniffer Model G gas detector

In Global Marine Hospital 4th Level

1 Oxygen powered resuscitator with 4 spare cylinders

In Control of Room or in Onboard Safety Representative Room

2 Colormetric tube detector, Model 31
6 Medium range H₂S tubes
6 Low range H₂S tubes
2 MSA explosimeter/sampling hose and spare batteries
1 First aid cabinet
1 Stokes litter
4 Red warning flags, 3' x 2'
2 Wind socks and holders
8 Wind streamers
4 Warning signs, 8' x 4' yellow signs with 12" black lettering "DANGER-HYDROGEN SULFIDE - H₂S" hinged in middle
12 Operating condition signs for all work areas and living quarters
100 Hydrogen Sulfide ampoule detectors
24 Del Mar H₂S Spot Check detectors
12 Tape refills for Spot Check detectors
3 Safety harnesses
3 150' safety lines with hooks
3 Chalk boards with chalk
3 (Sets) Note pads
2 Bull horn with spare batteries
2 Yellow portable flashing lights with spare batteries
120 (Sets) ear plugs
3 Flashlights with spare batteries
2 Lanterns with spare batteries
2 (Each) Signs: "Primary Safe Briefing Area"
"Secondary Safe Briefing Area"
Set MY-6 Flag warning systems and poles

SUB-TAB I
HYDROGEN SULFIDE EMERGENCY
ACTION PLAN

**HYDROGEN SULFIDE EMERGENCY ACTION PLAN
ARCO ALASKA INC.
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1.0 INTRODUCTION

This plan specifies precautionary measures, safety equipment, emergency procedures, responsibilities, and duties pertaining to drilling at the ARCO Warthog No. 1 location with the Glomar Beaufort Sea I. This plan was developed because of the potential hazards involved when drilling formations that may contain hydrogen sulfide (H₂S). It was written in compliance with the rules and regulations of the MMS and the Alaska Oil and Gas Conservation Commission.

To be effective, this plan requires the cooperation and effort of each individual participating in the drilling of the Warthog No. 1 well. Each individual should know his responsibilities and duties in regard to normal drilling operations and emergency procedures. He should thoroughly understand and be able to use, at a moment's notice, all safety equipment on board the rig. He should familiarize himself with the location of all safety equipment and see that his equipment is properly stored, easily accessible, and routinely maintained.

ARCO intends to make every effort to provide adequate safeguards against harm to persons both on location and in the immediate vicinity from the effects of H₂S if released to the atmosphere. The ideas and suggestions of each individual involved in the drilling of a potential sour gas well are highly welcomed and are an asset for providing the safest working conditions possible.

2.0 LOCATION, LAYOUT, AND SAFETY EQUIPMENT LISTS

The following procedures will be observed, and the following safety equipment will be maintained at the ARCO Warthog No. 1 location:

2.1 Safe Briefing Areas

Two areas are designated as "Safe Briefing Areas." The primary area is the galley. If the primary area cannot be used, the helideck will be used as the secondary area, (weather permitting). If weather conditions preclude use of the helideck, personnel will gather in the Safe Room in the utility trunk.

If H₂S is detected in concentrations equal to or in excess of 10 ppm, all personnel not assigned emergency duties are to assemble in the Galley for instructions.

2.2 Wind Direction Indicators

Wind socks and streamers will be installed in strategic points on the Glomar Beaufort Sea I. They will be positioned so as to be seen from any location on the main deck and rig floor.

2.3 Danger Signs

For 4' x 8' operational danger signs will be displayed from all sides of the rig in a manner visible to watercraft and aircraft if H₂S is detected in concentrations equal to or exceeding 10 ppm. The signs for Conditions II and III will be yellow with the following warning painted in 12" high black, block lettering:

“DANGER - HYDROGEN SULFIDE - H₂S”

The MY-6 flag system will be used for H₂S concentrations of 20 ppm or greater (See Figure 2-1). In addition, if H₂S concentration exceeds 20 ppm at the surface, two 2' x 3' red flags will be displayed from high points on the facility. All signs and flags shall be illuminated under conditions of poor visibility and at night. Signs (Station Bills) indicating the designated safe briefing areas and Conditions II and III signals as described herein, will be posted in the following locations:

- Each level of the living quarters
- Rig floor
- Mud pit area
- Engine room
- Work areas on the main deck
- Mud pump area
- Galley
- Recreation room

2.4 H₂S Detectors and Alarms

Continuous monitoring type H₂S detectors, capable of sensing a minimum of 5 ppm H₂S in air, will be located at each of the following points:

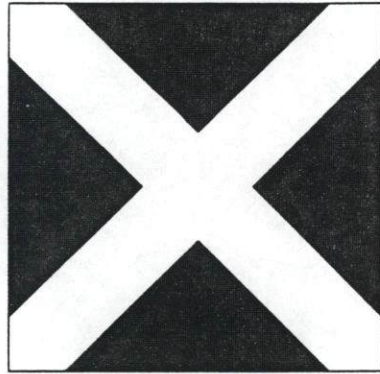
SENSOR LOCATION

- Rig floor
- Bell Nipple
- Upper Cellar Deck
- Lower Cellar Deck
- Flow Line
- Shale Shaker at Mud Pits
- Outside entrance to living quarters

Automatic H₂S alarms (visual and audible) will be located at the following points:

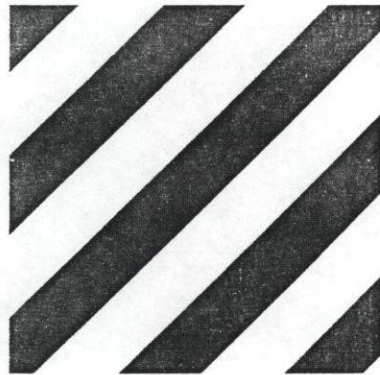
ALARMS AND LIGHTS

- Rig floor
- Shaker and mud pit area
- (Mud logger's alarm, same as shaker area)
- Mud pump rooms (2)



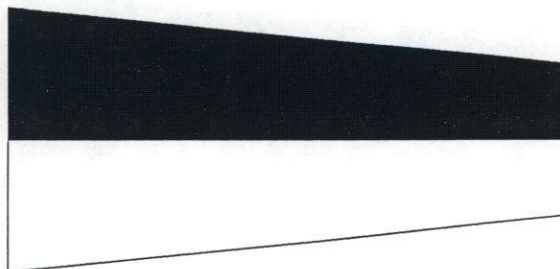
WHITE CROSS ON
ROYAL BLUE BACKGROUND

M



ALTERNATING RED AND
YELLOW STRIPES

Y



TOP HALF BLACK
BOTTOM HALF WHITE

6

Fig 2-1 11 4/9/97

Figure 2-1
International Maritime Code
Designation MY-6

- SCR room
- Engine room
- Cellar deck
- Outside rig by quarters

The monitor will be situated in the Control Room. Activation of the general alarm for the living quarters will be by the Global Superintendent/Toolpusher or ARCO Drilling Representative (if necessary), and will be announced over the facility PA system.

2.5 Flare Line Piping

The degasser and the mud-gas separator will be rigged so the gas can be flared if H₂S is encountered in concentrations equal to or exceeding 10 ppm.

2.6 H₂S Service Equipment

The remote controlled adjustable choke (body and trim) and hand adjustable chokes on the choke and kill manifold are designed for H₂S service, in case it becomes necessary to circulate out a kick.

2.7 H₂S Scavengers

A supply of zinc basic carbonate or an equivalent scavenger will be stored aboard the rig in case the mud becomes contaminated with H₂S. A detailed mud treating procedure is included in the Sub-tab II Section, herein. A sufficient volume of scavenger will be maintained aboard the rig to treat the entire system twice with 2 lbs. per barrel.

2.8 Breathing Air Cascades and Manifolds

There are 46 ea 300 cubic foot bottles of high pressure breathing air located as follows:

<u>Location</u>	<u>Number of Bottles (Cascades)</u>
Rig floor	12
Cellar	4
Shaker and Mud Pits	4
Primary Safe Briefing Area -Galley	6
Secondary Safe Briefing Area-Survival Quarters	12
Pipe Storage Area	4
Cement Room	4
Total	46

The cascades are manifolded together to supply breathing air to twenty-one (21) quick connection manifolds in the areas shown below.

<u>Location</u>	<u>Manifolds</u>
Primary Safe Briefing Area	8
Shaker and Mud Pit Area	2
Cement Room	1
Pipe Storage Area	1
Engine Room	1
Rig Floor	2
Secondary Safe Briefing Area	2
Mud Logging Unit	1
Cellar Area	2
Derrick	1
Total	21

See Figures 2-2 and 2-3.

2.9 Portable Radios

Eight (8) portable radios are located in the Control Room.
Six (6) portable radios are located in the Drilling Office.

2.10 List of Safety Equipment

The location and quantity of all safety equipment (including breathing air equipment, resuscitators, H₂S and SQ detectors, explosimeters, flare guns, etc.) are listed in the Equipment Inventory, herein.

2.11 Additional H₂S Hardware

- Choke manifolding and vent lines for ARCO's H₂S specifications.
- All choke manifold lines must be "targeted" at 90 degree turns.
- Drill pipe safety valves and kelly valves for H₂S service for each size drill pipe
- Remote control for hydraulic choke.
- Inside of BOP stack must be trimmed of H₂S service.
- Inside BOP's for each size drill pipe.

2.12 Fans

Electric fans (with explosion-proof motors) are to be installed as necessary.

Fig 2-2 1:1 4/9/97

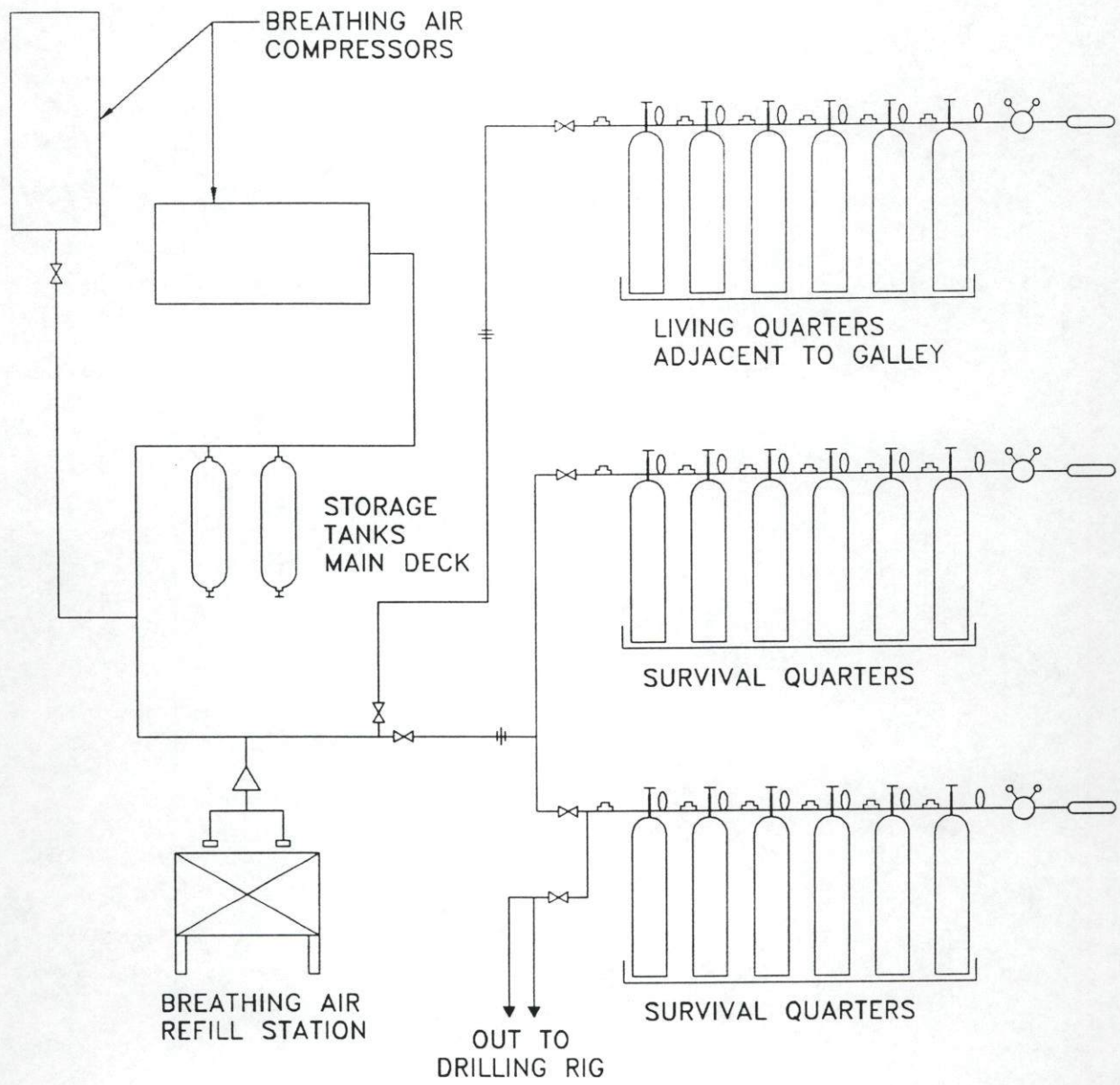


Figure 2-2
High Pressure Breathing Air Schematic
Quarters and Main Deck Areas, Glomar Beaufort Sea 1 (CIDS)

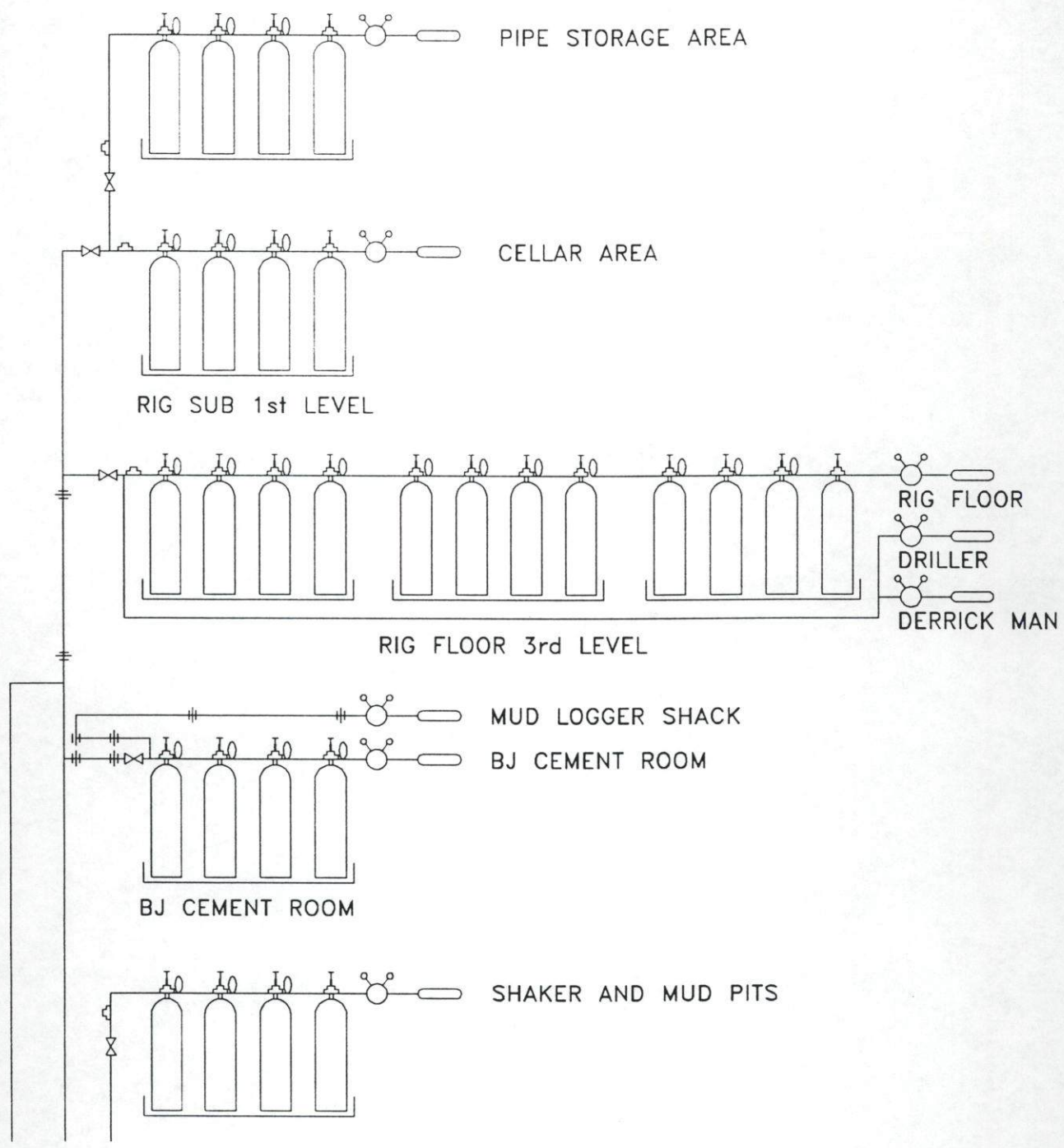


Fig 2-3 1:1 4/9/97

Figure 2-3
 High Pressure Breathing Air Schematic
 Drilling Rig Area, Glomar Beaufort Sea 1 (CIDS)

3.0 NORMAL OPERATING PROCEDURES

This H₂S Emergency Action Plan will be operational prior to startup of drilling operations.

3.1 Prior to spud.

- Lists of emergency phone numbers will be sent to the rig and should be posted at the following places:
 - ARCO Drilling Representative's office
 - Global Superintendent's office
 - Toolpusher's office
 - Control house
 - Shorebase dispatcher's office
 - Contractor's Safety Representative's office
 - Radio communications room

- All safety equipment and H₂S related hardware must be set up as outlined under Section 2.0 "LOCATION, LAYOUT, AND SAFETY EQUIPMENT LIST"/ All safety equipment must be inspected routinely, paying particular attention to resuscitators and breathing air equipment.

- All personnel on board will be assigned breathing air equipment and, if needed, H₂S detectors. ARCO/Contractor personnel required to work in the following areas will be provided with work/escape type air line equipment:
 - Rig floor
 - Pipe rack area
 - Shaker and mud pit area
 - Mud pump room
 - Engine room
 - Monkey board
 - Cementing area
 - Cellar area
 - Mud loggers shack

- All rig contractor personnel, ARCO personnel, and necessary service company personnel must be thoroughly trained in the use of breathing air equipment, emergency procedures, responsibilities, and first-aid for H₂S victims. A list of all who have been through the special training programs will be maintained on board the rig. H₂S training for service personnel is the responsibility of the service company. Documentation of training must be provided by the service company. All personnel should be given a copy of "CONSIDERATIONS DURING THE DRILLING OF A SOUR GAS WELL" which is included in Sub-tab Section III, herein. This document summarizes the steps to be taken during the four conditions under which the rig may operate. It lists general information about toxic gases, explains the physiological effects of H₂S, and classifies operating conditions. A list of all persons that have copies of this Emergency Action Plan, with their signatures, verifying that they have read and understand it thoroughly, will be maintained on the rig.

3.2 Following Spud

- After spud, the H₂S detection system will be calibrated every 24 hours under normal conditions. In the event that H₂S is detected, or when drilling in a zone containing H₂S, the units will be tested at least once every 12 hours. The time and results of each test will be logged and reported each day to the ARCO Drilling Representative. The ARCO Drilling Representative will ensure that the H₂S detection equipment calibrations and tests are recorded on the IADC Daily Drilling Report Form and Morning Report. In the event that an H₂S detector does not test successfully, drilling will cease until the detector is (1) repaired, or (2) approval to proceed is received.
- When boarding the facility, all personnel, without exception, must proceed directly to the onboard Safety Representative for assignment of breathing air equipment and, if needed, an H₂S detector. An instruction and orientation briefing will also be held, if needed. Each person arriving on the facility will sign for equipment received and will return such equipment when departing. The onboard Safety Representative will be responsible for assigning such equipment to the individuals and instructing them in its use.
- Upon boarding the facility, each person should pick up a copy of "CONSIDERATIONS DURING THE DRILLING OF A SOUR GAS WELL" from the onboard Safety Representative and verify that he has read it by signing the last page if he has not done so in the past. The signed page should be forwarded to the ARCO Drilling Representative or his designated representative.
- Blowout prevention drills will be held as often as necessary to acquaint the crews and service company personnel with their responsibilities when shutting in the well. After the ARCO Drilling Representative is satisfied that all crews are trained, drills will be conducted weekly.
- Each person aboard the rig will be instructed in the use of breathing air equipment until supervisory personnel are satisfied that each is capable of using the equipment. This training must include all additional personnel that are allowed aboard the rig during testing operations.
- Along with normal weekly fire drills and safety meetings, weekly breathing air equipment drills and H₂S training of personnel must be maintained. An explanation of these drills and training sessions and a list of what they should include are given in Sub-tab Section II, herein.

Rig crews and service company personnel should be made aware of the location of spare breathing air bottles, resuscitation equipment, portable fire extinguishers, and H₂S detectors. Knowledge of the location of H₂S monitors are vital to understanding the "emergency conditions."

H₂S detectors shall be available for use by all working personnel. After H₂S been initially detected by any device, periodic inspections of all areas of poor ventilation shall be made with a portable H₂S detector instrument.

All personnel on the location should become "wind-conscious" and be aware at all times of the direction of the prevailing winds. They should remember that H₂S is heavier than air and will collect in low places in still air.

There shall be no welding if H₂S is detected at the surface until the surrounding air is thoroughly tested with explosimeter. Field welding on casing is prohibited unless approved by the onboard Drilling Supervisor.

After penetration of an H₂S bearing zone, increased monitoring of the working area should be provided when drilling, circulating bottoms-up from a drilling break, cementing, logging, or circulation while not drilling. If the H₂S concentration reaches 10 ppm in the air, breathing air equipment should be immediately available to all working personnel, and all personnel not assigned specific tasks should report to the Galley.

4.0 OPERATING CONDITIONS PROCEDURES

NOTE:

ARCO has elected to use the MY-6 (DO NOT APPROACH) flag communication system in addition to the other warning signs for Conditions II and III.

4.1 Condition I: Possible Hazardous Conditions (H₂S Not Present)

- Warning Signs (for notification of general public): None
- Alarm (for notification of rig crew): None
- Characterized by: Drilling operations under control. Routine drilling operations in zones that may contain hydrogen sulfide. This condition will be in effect continuously from spud to total depth unless it is necessary to go to a Condition II Alert. This condition remains in effect until H₂S is detected.
- General Action:
 - Be alert for a condition change. There will be no smoking except in designated areas.
 - Check safety equipment for proper functioning. Keep it available. No welding or open fires without permission from the ARCO Drilling Representative.

- Perform all drills for familiarization and proficiency.

4.2 Condition II - Potential Danger to Life (H₂S Present at 10 to 20 PPM)

- Warning Sign: MY-6 Flag System. "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of rig (yellow with black lettering to be illuminated at night).
- Alarm: Working Area: Amber flashing light signal will continue as long as the H₂S concentration is present at 10 to 20 ppm or until deactivated by the Operator's Drilling Representative.
- Living Qtrs: 1 long - 1 short ring of general alarm followed by PA announcement.
- Characterized by: Drilling operations under control. Routine drilling operations in zones containing H₂S. Poisonous gases present in concentrations at threshold levels and may or may not be detectable by odor.

This condition will be in effect continuously from the time H₂S is first detected at concentrations of 10 ppm to a total depth unless it is necessary to go to Condition III Alert. This condition remains in effect up to H₂S concentrations greater than 20 ppm.

- General Action:
 - Be alert for a condition change. Observe wind direction regularly.
 - Check safety equipment for proper functioning; keep it available. "No Smoking" except in area designated by vessel's Barge Engineer. No welding or burning without permission from onboard Drilling Superintendent.
 - Follow instructions of supervisors.
 - Perform all drills for familiarization and proficiency.

4.3 Condition III - Moderate to Extreme Danger to Life (H₂S Present at or above 20 ppm)

- Warning Sign: MY-6 Flag System. A Flag System consisting of four (3' x 2') red flags will be placed at key locations. "DANGER - HYDROGEN SULFIDE - H₂S signs on all sides of vessel, etc.
- Alarm: Sirens and strobe lights will be activated at seven (7) rig locations. Global bell system sounded in rig quarters, followed by PA announcement when H₂S concentration reaches 20 ppm.
- Characterized by: Critical well operations, well control problems, and in the extreme, loss of well control. Poisonous gases may be present at or above threshold levels.
- General Actions:
 - Go to the Galley with breathing equipment if not specifically assigned to correct or control the situation.
 - Follow the instructions of the Global Superintendent/Toolpusher and the ARCO Drilling Representative.
 - The Global Superintendent/Toolpusher and the ARCO Drilling Representative shall initiate emergency action as provided in this plan.
 - All persons working in the hazard area will wear breathing air equipment. All personnel will restrict their movements as directed by the Global Superintendent/Toolpusher and the ARCO Drilling Representative.
 - All persons in the living quarters will pick up their self-contained breathing equipment and proceed to the Galley.
 - If gas is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide (SO₂) which is also poisonous. Therefore, DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES. FOLLOW THE INSTRUCTIONS OF SUPERVISORS.

4.4 Condition IV - Extreme Danger to Life - (H₂S Present At Greater Than 50 ppm)

- Warning Sign: MY-6 Flag System. Two 2' x 3' red flags at bow and stern. "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of rig (yellow with black lettering to be illuminated at night).
- Alarm:
Working Area Continuous sounding of the H₂S horn and H₂S siren and amber and red lights flashing. All alarm signals will continue as long as the H₂S concentration is present at greater than 50 pm or until deactivated by the Safety Representative or ARCO Drilling Representative.
- Living Quarters. 1 long - 2 short rings of general alarm bell followed by PA announcement.
- Characterized by: Loss of well control or the H₂S concentration is greater than 50 ppm.
- General Action:
 - All non-essential personnel, or all personnel if the situation warrants, shall be evacuated. Radio and other available communications shall be used to alert all known air and land craft in the immediate vicinity of the rig. The ARCO Drilling Representative will advise the Drillsite Development Supervisor of the plans to evacuate the rig. Notification of local civil authorities will be made by the ARCO Drillsite Development Supervisor.
 - All people not specifically assigned to correct or control the situation shall, after being moved from the Galley, shall move to the appropriate debarkation point to await evacuation. A suggested list of essential personnel to be left aboard is on page 19. The number of essential personnel may be increased at the request of the ARCO Drilling Representative or on order of the Global Marine Superintendent/Toolpusher.
 - If the alarm sounds and it has not been preceded by Conditions II and III, the actions of Condition IV shall be taken. Circulation will be stopped, breathing air equipment shall be donned by all working personnel. Drilling Contractor Safety Representative shall check all personnel by roster. The Rig and Shore dispatcher will also be notified of the condition and will continually monitor the radio.

- The Global Marine Superintendent/Toolpusher and the ARCO Drilling Representative shall jointly determine if ignition is necessary as outlined under "IGNITING THE WELL", Section X herein, and will conduct any necessary operations with an absolute minimum of personnel. Final decision to ignite the well shall rest with the ARCO Drilling Representative.
 - If the well is ignited, the burning H₂S will be converted to sulfur dioxide (SO₂) which is also poisonous. DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES. FOLLOW THE INSTRUCTIONS OF SUPERVISORS.

4.5 Emergency Telephone List

Phone List:

Fairweather E&P Services, Dispatcher, Deadhorse	TBA
Fax	TBA
ERA Helicopter, Deadhorse	(907)659-2465
Fax	(907)659-2298
Global Marine, Anchorage	TBA
Fax	TBA
US Coast Guard, Anchorage	(907)271-5137
North Slope Borough, Anchorage	(907)561-5144
AOGCC	(907)279-1433
Department of Environmental	
Conservation, Anchorage	(907)269-7500
Fairbanks	(907)451-2177
Minerals Management Service	(907)271-6190
Department of Natural Resources,	
Division of Oil an Gas	(907)269-8800
Federal Aviation Administration	(907)271-5936
ARCO Alaska, Inc.	
Mike Zhangi	(907)265-6206
Paul Mazzolini	(907)263-4603

Medical Personnel and Facilities & Emergency Medical Evacuation
Emergency Medical Evacuation

Requests for medical assistance should be directed to the shore base. Transportation and medical facility notification will be handled by the shore base operator.

ERA Helicopters	Deadhorse	(907) 659-2465
	Anchorage	(907) 243-6633

ARCO North Slope Clinic (907) 659-5300
ARCO MCC Hospital, Deadhorse (907) 659-5239
BP North Slope Clinic (907) 659-4315

Fairbanks Medical & Surgical Clinic (907) 452-1761
Medical Center Building
522 Fifth Avenue
Fairbanks, Alaska 99701

Hospitals - Initial contact to ERA Anchorage office and request MEDIVAC.
Hospital notification will be made by ERA.

Providence Hospital (907) 562-2211
3200 Providence Drive
Anchorage, Alaska 99504

5.0 EMERGENCY PROCEDURES FOR CONDITIONS II, III, & IV

- The person detecting the H₂S must IMMEDIATELY notify the driller. He must then notify the ARCO Drilling Representative, Global Superintendent and the Toolpusher.
- The driller will shut down the mud pumps, pick up off bottom and prepare to secure the well.
- The following personnel will immediately put on their breathing air equipment:
 - ARCO Drilling Representative
 - Global Superintendent
 - Global Toolpusher
 - Driller
 - Derrick Man
 - Three Floor Hands
 - Mud Pit Personnel (including Mud Engineer)
 - Mud Logger
 - Any other personnel in the high concentration H₂S area should evacuate to a safe area. Breathing air equipment will be worn until the situation is fully diagnosed and it has been determined that it is safe to remove the equipment.
- Once breathing air equipment is on, the driller should:
 - Stop rotary table
 - Pick kelly up above rotary table
 - Be ready to close the BOP's
 - If the well control problems develop, follow the "WELL CONTROL

PROCEDURE" in the Sub-tab II Section, herein.

- The Global Superintendent/Toolpusher or the ARCO Drilling Rep. Will alert all personnel that a Condition II, III or IV exists. The Toolpusher should ventilate rig and close all deck hatches.
- All personnel outside of the living quarters and not listed above must get their assigned self-contained breathing air equipment and report to the Galley for further instructions. If both your assigned self-contained breathing apparatus and the Galley are upwind of the wellbore, the self-contained breathing apparatus may be carried to the Galley. However, if there is any doubt, don and activate the unit immediately. If it becomes necessary to go through the rig floor or wellhead area to get to the Galley, the breathing air equipment should be put on as soon as the equipment is reached. If you are located on the downwind end of the rig or below the main deck when the Condition II, III or IV alarm is sounded, hold your breath, don the nearest breathing air equipment available and proceed to the Galley. Those personnel inside the living quarters will don their self-contained breathing apparatus and proceed to the Galley.
- Always put on a breathing air unit before proceeding to assist anyone affected by the gas and utilize the "Buddy System." If the affected person is stricken in a high concentration area, put on a safety belt with 50' of tail line and obtain stand-by assistance before entering the area. Always use the "Buddy System" when entering possible contaminated areas.
- Notify all air and land craft to go up wind and maintain a 24-hour radio and visual watch.
- Fly the MY-6 warning flags and display the "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of the rig. Display the 2' x 3' red flags at bow and stern of the rig if Condition III is reached.
- Tell the Rig and Shore Dispatcher to establish a 24-hour radio and phone watch.
- The ARCO Drilling Representative will designate when to evacuate all non-essential personnel.
- The ARCO Drilling Rep. And the Global Superintendent/Toolpusher will assess the situation and assign duties to each person needed to bring the situation under control. When the severity of the situation has been determined, all persons will be advised. The ARCO Drilling Representative and Global Superintendent/Toolpusher will:
 - Direct corrective action.
 - Notify the appropriate senior supervisory personnel.

- The ARCO Drillsite Development Supervisor will be responsible for notifying the following regulatory agencies:
 - Minerals Management Service (907)261-6065 (day)
(907)261-6065 (nite)
 - U.S. Coast Guard (907)271-5137
(800)424-8802 (day)
 - Alaska Oil & Gas Conservation Commission (907)279-1433
 - Alaska Dept. Of Environmental Conservation (907)465-5232
(800)478-9300
 - Alaska Department of Nautural Resources,
Division of Oil and Gas (907)269-8800
 - North Slope Borough (907)561-5144
- If an H₂S concentration exceeding 20 ppm in the air is recorded at the outer perimeter of the rig, notify all appropriate regulatory agencies and alert all known air and land craft in the immediate vicinity of the drilling location by radio communication.

6.0 SPECIAL OPERATIONS

6.1 Coring

- During drilling operations, it may be decided to core. This operation takes on critical complexities when attempted in a sour gas well. The following practices should be followed during coring operations:
 - After a core has been cut, circulate bottoms up and monitor mud for H₂S prior to pulling out of the hole with the core.
 - Put on breathing air equipment 10 stands before core barrel reaches the surface. If well conditions dictate or the H₂S concentration reaches 10 ppm, breathing air equipment should be put on earlier. Breathing air equipment should be worn by all personnel in the area while the core barrel is pulled, broken out, and opened. Colormetric tube type detectors should be used to monitor for H₂S around the core barrel. When these detectors indicate a safe atmosphere, the breathing air equipment may be removed.
- The following practices must be followed for every core barrel pulled:

- Due to the difficulty in communicating while wearing breathing air equipment, it is required that a chalkboard and chalk or note pads be available during the coring operations.
- The importance of continuously wearing the breathing air equipment must be stressed to personnel connected with the coring operations. The most critical moment is when the core barrel is opened.
- All personnel on location not wearing breathing air equipment should stay a safe distance upwind from the core barrel.
- If the core barrel contains H₂S, the cores must be sealed and marked for the presence of H₂S, prior to transport.
- The cores must not be transported in a closed vehicle.

6.2 Well Testing

- Well testing must be performed with the minimum number of personnel and all necessary equipment required to safely and adequately perform the test.
- Prior to initiation of the test, special safety meetings must be conducted for all personnel who will participate with particular emphasis on use of personnel safety equipment, first-aid procedures, and the H₂S Emergency Action Plan.
- During the test, the use of H₂S detection equipment will be intensified. All produced gases must be vented and burned through a flare system equipped with continuous pilot and an automatic ignitor. Back-up ignition for each flare must be provided.
- "No Smoking" rules will be rigorously enforced.

7.0 WELL CONTROL

The following well control practices should be initiated below protective casing:

- If high trip gas or high drill gas concentrations are encountered, the degasser should be used and the gas separated and flared. The vent line from the degasser to the derrick vent line will be opened so that the gas can be burned through the flare vent line.

If gas is breaking out at the rotary, consider closing the annular BOP and routing the flow through the mud-gas separator. Gas will be burned through the flare vent line.

- Assume any influx of formation fluid into the wellbore may contain H₂S. If the decision is made to circulate out the influx, personnel may be required by the onboard drilling supervisor to wear breathing air equipment until it is known that H₂S is not present. The following steps should be taken when the influx occurs:
 - Shut in the well using normal techniques. Record drill pipe pressure, casing pressure, and volume of influx.
 - Notify the ARCO Drillsite Development Supervisor and the rig contractor's Superintendent.
 - If directed to circulate out the influx, proceed as outlined in the "WELL CONTROL PROCEDURES". in the Sub-tab II Section, herein.
- If the mud has been contaminated with H₂S it may be necessary to treat it with zinc basic carbonate (or equivalent) to treat out the H₂S. A "MUD TREATING" procedure is given in the Sub-tab II Section, herein. If H₂S is known to be present and an influx occurs, the size of the influx, the casing depth, the leak-off test results, the amount and type of open hole, and the weather conditions will enter into the management decisions of whether to circulate out the influx or to "pump away" the influx back into the formation.

8.0 LOST CIRCULATION

If lost circulation occurs, proceed as outlined in the "Lost Circulation Procedure" in the Sub-tab II Section herein.

9.0 PARTIAL EVACUATION PROCEDURE

In the event that it becomes necessary to evacuate the rig, (due to well control problems or fire), the Drilling Rig Fire and Abandonment Platform Procedure posted in the galley, crewquarter hallways and toolpusher's office will be used.

Key personnel to remain on board during a partial evacuation are:
Rig Crew On-duty:

- 1 Driller
- 3 Floormen
- 1 Derrick Man
- 1 Trip Tank Hand

Others:

- 1 Safety Representative
- 1 Crane Operator
- 1 Electrician
- 1 Rig Mechanic
- 1 Mud Engineer
- 1 Cementer
- 1 Motorman
- 1 Drilling Contractor Safety Representative

Supervisory Personnel:

- 1 ARCO Drilling Representative
- 1 Global Superintendent
- 1 Rig Toolpusher

10.0 IGNITING THE WELL

- Responsibilities for Decision

Deliberate ignition of a blowout would be evaluated by ARCO's Drilling Supervisor in consultation with Global Marine drilling personnel and the CIDS Superintendent if there is serious immediate danger to personnel. In such an event, the Drilling Supervisor will have the ultimate on-site responsibility while relying on the CIDS Superintendent for all input regarding personnel safety. The well will be ignited only after evaluation of the alternatives available and after discussion with ARCO management and the proper government agencies.

In all cases, an attempt should be made to notify the ARCO Drillsite Development Supervisor and the Rig Contractor's Superintendent as soon as possible and prior to igniting the well, if possible.

If the well is ignited, the burning H₂S will be converted to sulfur dioxide (SO₂) which is also highly toxic and heavier than air. Hence, do not assume the area is safe after the well is ignited.

- Method of Ignition

- The primary method of igniting the well will be with a 25mm flare gun, which has a range of approximately 500 feet. Always ignite the well from upwind and do not approach the well any closer than is necessary. BEFORE firing the flare gun or igniting flammable material, check the atmosphere at your location for combustible gases with an explosimeter.
- If the above method of ignition fails or well conditions are such that a safer or better

method is apparent, then an alternate method should be used.

11.0 RESPONSIBILITIES AND DUTIES

11.1 All Personnel

- It is the responsibility of all personnel on the rig as well as any other personnel assisting in the drilling of the well to familiarize themselves with the procedures outlined in the "H₂S Contingency Plan."
- Each individual is responsible for seeing that his assigned safety equipment is properly stored, easily accessible and routinely maintained.
- Each person must familiarize himself with the location of all safety equipment aboard the rig and be able to use all safety equipment at a moment's notice.
- All personnel must read and understand the "CONSIDERATIONS DURING THE DRILLING OF A SOUR GAS WELL."
- Report any indications of H₂S to those in the area and to the ARCO Drilling Representative.

11.2 ARCO Drilling Representative

- The ARCO Drilling Representative is responsible for thoroughly understanding and enforcing all aspects of the "H₂S Contingency Plan."
- The ARCO Drilling Representative is responsible for seeing that all safety and emergency procedures outlined in the "H₂S Contingency Plan" are observed by all the personnel participating in the drilling of the H₂S well.
- The ARCO Drilling Representative will advise the ARCO Drillsite Development Supervisor whenever the procedures as specified, herein, cannot be complied with.
- The ARCO Drilling Representative in conjunction with the Global Marine Toolpusher is responsible for seeing that all hardware and replacement parts in the choke manifold lines, flare lines, and all other piping which may be required to carry H₂S contaminated fluids under high pressure, are suitable for H₂S service.
- The ARCO Drilling Representative in conjunction with the Global Marine Superintendent/Toolpusher are responsible for scheduling personnel training.

- If the presence of H₂S is reported and confirmed, the ARCO Drilling Representative is responsible for immediately advising the Global Superintendent/Toolpusher and the ARCO Senior Management.
- The ARCO Drilling Representative shall restrict the number of personnel on the rig to a minimum during expected hazardous operations.

11.3 Global Marine Superintendent/Toolpusher

- The Global Marine Superintendent/Toolpusher is responsible for thoroughly understanding the contents of the "H₂S Contingency Plan". In the absence or the incapacitation of all ARCO Representatives, the Global Marine Superintendent/Toolpusher will assume responsibilities designated therein to the ARCO Drilling Representative.
- It is the responsibility of the Global Marine Superintendent/Toolpusher, along with the ARCO Drilling Representative, to see that all safety and emergency procedures outlined in the "H₂S Contingency Plan" are observed by all personnel aboard the rig.
- The Global Marine Superintendent/Toolpusher in conjunction with the ARCO Drilling Representative is responsible for seeing that all hardware and replacement parts in the choke manifold lines, flare lines, and all other piping which may be required to carry H₂S contaminated fluids under high pressure, are suitable for H₂S service.
- The Global Marine Superintendent/Toolpusher shares the responsibility of the ARCO Drilling Representative in scheduling training for personnel aboard the rig.
- The Global Marine Toolpusher should ventilate the rig and close all deck hatches.
- The Global Marine Superintendent/Toolpusher in conjunction with the ARCO Drilling Rep. will be responsible for inspecting the rig to make sure that all passageways remain unobstructed.
- The Global Marine Superintendent/Toolpusher is responsible for alerting personnel during a "Condition II, III or IV" alert and for displaying warning signs and flags as outlined under Section 4.0, "OPERATING CONDITIONS - CLASSIFICATION."
- The Global Marine Superintendent/Toolpusher is responsible for notifying all personnel in the area of the rig (including any landcraft and/or helicopter) of a change in conditions.

11.4 Safety Representative

- The Safety Representative is responsible for performing a weekly inventory to assure that all safety equipment is being properly stored and maintained.
- The Safety Representative is responsible for the H₂S training, which includes the use, maintenance, and storage of the safety equipment.
- The Safety Representative is responsible for issuing H₂S safety equipment to arriving personnel on the rig and for collecting same from departing personnel.
- The Safety Representative is responsible for the maintenance and repairs of all personnel safety equipment.
- The Safety Representative is responsible for the required inspection, calibration and sanitizing of the H₂S safety equipment.
- The Safety Representative is responsible for the maintenance of H₂S safety training class attendance records, fit testing and other recordkeeping required. He shall furnish the ARCO Drilling Representative a copy of all class attendance records.
- The Safety Representative will observe and assist during weekly H₂S drills.
- The Safety Representative will observe testing of the H₂S monitors daily for response. A copy of the results will be given to the ARCO Drilling Representative.

11.5 Driller

- The Driller must be completely familiar with the steps he must take during a Condition II, III or IV emergency as outlined under Section 5.0, "H₂S EMERGENCY PROCEDURES."
- The Driller must be completely familiar with his special duties while coring and testing an H₂S well as outlined under Section 6.0, "SPECIAL OPERATIONS."
- The Driller must be completely familiar with his special duties during well control and lost circulation problems as outlined under Section 7.0, "WELL CONTROL" and Section 8.0, "LOST CIRCULATION."
- In the absence or incapacitation of all ARCO Supervisors and Global Marine Superintendent/Toolpusher, the senior Driller will assume their responsibilities as designated herein.

11.6 Mud Logger

- Will act on directions of ARCO Supervisor.

11.7 Mud Engineer

- The Mud Engineer must be familiar with the "Barite Plug Setting Procedure" listed in the Sub-tab II Section, herein.
- The Mud Engineer must have one Garrett Gas Train Kit and a hot roll test unit for measuring the sulfides in the mud.
- The Mud Engineer must be familiar with the "Mud Treating" procedure for H₂S cut mud in the Sub-tab II Section, herein.
- The Mud Engineer is responsible for assuring that the rig has a sufficient supply of zinc basic carbonate.

11.8 Cementer

- The Cementer must be familiar with the "Barite Plug Setting Procedure" listed in the Sub-tab II Section, herein.

12.0 PROCEDURE FOR INFORMING PERSONNEL OF H₂S EMERGENCY ACTION PLAN

- There will be five (5) copies of the complete "H₂S Contingency Plan" available in the ARCO Drilling Representative's office.
- All personnel arriving at the rig will report immediately to the Safety Representative for training and familiarization with the "Considerations During Drilling of a Sour Gas Well" printed material. Each person will be required to sign a log indicating that they have read and do understand the "Considerations."
- A copy of the "H₂S Contingency Plan" will be loaned to anyone servicing the facility. They will be required to sign a log indicating that they have read and do understand the plan. Loaned copies of the Plan must be returned to the Safety Representative.

**SUB-TAB SECTION II
PROCEDURES, TRAINING, DRILLS
AND CHECKLISTS**

WELL CONTROL PROCEDURES

All efforts should be made to prevent a well kick, which may result from gas cut mud, abnormal pressure, lost circulation, or swabbing. Should any of the following conditions occur, the well will be checked for flow:

- Increase in flow across shale shaker.
- Gain in pit volume.
- Hole does not take correct fill on trips.
- Significant drilling break.
- Decrease in pump pressure.
- Significant increase in connection gas.

If well flow is confirmed, the following actions will be taken:

Shut-in Procedure While Drilling

- Sound kick alarm.
- Pull kelly out of preventers while stopping pumps. Position tool joints, clear of sealing elements but so connections are accessible from floor.
- Close annular preventer and make certain well is shut-in.
- Adjust regulator valve to permit drill pipe reciprocation with the least wear to annular preventer element.
- Read and record:
 - Shut-in drill pipe pressure.
 - Shut-in casing pressure.
 - Mud volume gained.

Shut-in Procedure While Tripping

- Sound kick alarm.
- Install full open safety valve.
- Close annular preventer and safety valve.

- Read and record:
 - Shut-in drill pipe pressure.
 - Shut-in casing pressure.
 - Mud volume gained.

The handling of the H₂S kick will normally involve one of two techniques:

- Pumping it away; or
- Circulating it out.

The technique selected must be based on the conditions existing at the time of the occurrence. The selected technique will have as its objective, the protection of human life, protecting of the environment, and protecting of property, in that order.

When high concentrations of H₂S are suspected, and it is operationally feasible, H₂S kicks will be pumped away rather than circulated out. This plan of action has the advantage of minimizing the surface risk to personnel, environment and service equipment.

In some cases, it will be necessary to set a barite or cement plug over the H₂S bearing formation to accomplish proper well control.

Where the decision is made to circulate out the H₂S kick, operations should not be initiated until briefings have been held with personnel involved, equipment is made ready, and alert warnings signs displayed.

All personnel on the rig floor and all personnel working in other susceptible areas should put on their breathing air equipment when kick is to be circulated out.

The ARCO Drilling Representative should make sure all non-essential personnel are evacuated.

LOST CIRCULATION PROCEDURE

If lost circulation is experienced during any phase of the drilling operations, every effort will be made to fill the hole. The driller should:

- Pick up the kelly above the rotary table and shut down the mud pumps. Space out to insure that a tool joint is not in the BOP's.
- Notify the ARCO Drilling Representative and Global Marine Superintendent/Toolpusher as soon as practical.
- Fill trip tank with water (seawater or drill water may be used). Consideration should be given to keeping one side of the trip tank filled with water during drilling operations.
- Begin filling hole from the trip tank.

NOTE: It is very important to know the volume of water used to fill the hole.

- Switch the mud pumps to the kill line and line up to pump water if necessary. Reset stroke counters on remote control choke panel.
- If hole will not fill from the trip tank begin pumping water into the annulus with the mud pumps.
- When hole fills, determine and record the volume of water required to fill the hole.
 - Check well for flow. If well is static and hole stands full, monitor for possible flow. Keep trip tank on the hole.
 - If well is flowing, shut well in per "WELL CONTROL PROCEDURE".
- Procedure to regain circulation will be developed based on hole conditions. **DO NOT PULL INTO CASING UNTIL APPROVED BY ARCO DRILLSITE DEVELOPMENT SUPERVISOR.** One or more of the following methods will be used:
 - Introducing lost circulation materials into the mud system and minimizing required mud weight.
 - Spotting lost circulation pills opposite the suspected thief zone.
 - Bull-heading cement into the thief zone.
 - Pulling up into the casing to allow the hole to heal.

an additional casing string through the thief zone.

Mud Treating

- Zinc carbonate will be used to treat out H₂S in the mud system. It should not be added to the system until approval is given by the ARCO Drilling Representative to add the zinc carbonate.
- After H₂S is detected, the initial treatment of zinc carbonate should be sufficient to treat the soluble sulfides (as determined by the Garrett gas Train) to approximately zero. Treatment in excess is not recommended.
- The mud system could very well contain H₂S and/or sulfides in the mud if the agitation is not adequate to remove all of it.
- The Mud Engineer will have readily available aboard the rig his Garrett Gas Train kit to determine the presence and approximate amount of soluble sulfides in the mud filtrate. He will also have a hot roll unit.
- From spud to total depth, the Mud Engineer will test for sulfides at least every 12 hours using Garrett Gas Train methods. Detailed instructions for performing these tests will be maintained on the rig. (API RP13B).
- The results of these checks or any other indication of H₂S in the mud system will be included as a routine part of the Mud Engineer's daily reports.
- Pilot test and hot roll mud samples are required to know in advance the effect of ½, ¾, 1 and 2 lb./bbl. concentrations of zinc carbonate on the rheological properties of the mud system.

BARITE PLUG INFORMATION

A. Pressure Control

A very critical situation can arise when a well begins kicking and losing circulation at the same time. Increasing the mud weight to control pressure zone will only complicate the problem of lost circulation. When the high pressure zone lies below the thief zone, barite plugging may be used to control the well.

An extremely heavy, high water-loss slurry is required for this technique. Barite settling and deposition will form a solid plug in the open hole and seal off the high pressure zone. The high filter loss results in rapid dehydration, bridging the hole and sealing off the high pressured zone. Once a barite plug is in place, normal steps for regaining circulation may be taken with relative safety.

Barite plugs weighing from 18 to 24 ppg may be prepared using barite, fresh water, phosphate (SAPP) and caustic soda. No viscosifiers are used, and care must be taken to prevent contamination of the slurry with mud because settling of the barite once it is spotted, is a necessity. The plug should be set as close to bottom as possible and pumped rapidly. The drill pipe then should be withdrawn to avoid sticking. Coarse grind barites are not recommended because the settling rate is reduced drastically.

A cementing unit should be used to mix the slurry. Barite is mixed with fresh water containing 0.8 ppb phosphate (SAPP), and 0.25 ppb caustic soda. The lines from the cementing unit can be connected directly to the drill pipe through a plug valve. To minimize the possibility of stuck pipe, the derrickman should be in the derrick and the elevators ready to come out of the hole immediately after pumping is completed. A barite slurry may be mixed in the slugging pit where continuous and violent agitation is possible.

B. Procedures for Setting Plug

- We will use an 18 ppg slurry and try to set a 150' "settled out" barite plug in the open hole. (Research has shown that an 18 ppg slurry has a faster settling rate than heavier weight barite slurries.)
- Calculate the sacks of barite required. Assuming 15 sacks of barite equals one barrel, calculate the amount of barite needed to fill 150' of open hole.
- Calculate the slurry volume required assuming 5.3 sacks of barite per barrel of 18 ppg slurry.
- Calculate the amount of phosphates (SAPP), caustic soda, and fresh water required. Assume 0.8 ppb of phosphates, 0.25 ppb of caustic soda, and 27 gallons of fresh water per barrel of slurry.
- Add the phosphates and caustic soda to the mixing water and mix thoroughly before

adding any barite to the slurry. This is best accomplished by using the chemical hopper.

- To mix the barite into slurry, use a Halliburton Twinjet mixer (or equivalent) with two No. 6 or No. 7 jets or one No. 6 jet and one No. 7 jet. The slurry should be mixed with a jet pressure of between 600 and 1000 psi. (A recirculating cementing unit should not be used to mix the barite slurry. Instead it should be converted to a twin jet mixer.)
- After mixing, the barite slurry should be pumped as rapidly as possible downhole. It is critical that the cementing unit be supplied with mud at a high enough rate to displace the barite plug without settling out in the drill pipe. Underdisplace the capacity of the drill pipe by two barrels of mud.
- After displacing the barite plug, pull the drill pipe out of the hole until you are two stands above the top of the slurry. Circulate until the gas dissipates and then proceed cautiously with normal operations.

MAKE UP OF BARITE AND WATER SUPPLY

<u>Slurry Weight</u>	<u>Sx Barite/Bbl.</u>	<u>Gal. Water/Bbl.</u>
14 #/gal.	3.1 sacks	33.2 gallons
15	3.7	31.7
16	4.2	30.1
17	4.8	28.6
18	5.3	27.0
19	5.9	25.5
20	6.4	23.9
21	7.0	22.4
22	7.4	21.3
23	8.1	19.3

BARRELS OF PLUG

$$\begin{aligned} &(\text{Length Barite Plug}) \times (\text{Bbl./Ft. Open Hole}) = (\text{Bbl. of Plug}) \\ &(\quad \text{Ft.}) \times (\quad \text{Bbl./Ft.}) = (\quad \text{Bbl.}) \end{aligned}$$

SACKS OF BARITE

$$\begin{aligned} &(\text{Bbl. of Plug}) \times (15 \text{ Sacks Barite/Bbl. of Volume}) = (\text{Sx. of Barite}) \\ &(\quad \text{Bbl.}) \times (15 \text{ Sacks Barite/Bbl. of Volume}) = (\quad \text{Sx.}) \end{aligned}$$

BARRELS OF SLURRY

$$\begin{aligned} &(\text{Sx. of Barite}) / (\text{Sx. Barite/Bbl. Slurry}) = (\text{Bbl. of Slurry}) \\ &(\quad \text{Sx.}) / (\quad \text{Sx./Bbl.}) = (\quad \text{Bbl.}) \end{aligned}$$

GALLONS OF WATER

$$\begin{aligned} &(\text{Bbl. of Slurry}) \times (\text{Gal. of Water/Bbl. of Slurry}) = (\text{Gal. of Water}) \\ &(\quad \text{Bbl.}) \times (\quad \text{Gal./Bbl.}) = (\quad \text{Gal.}) \end{aligned}$$

POUNDS OF PHOSPHATE (SAPP)

$$\begin{aligned} &(\text{Bbl. of Slurry}) \times (\text{Lb. of SAPP/Bbl. of Slurry}) = (\text{Lb. of Phosphate}) \\ &(\quad \text{Bbl.}) \times (\quad \text{Lb./Bbl.}) = (\quad \text{Lb.}) \end{aligned}$$

POUNDS OF CAUSTIC SODA

$$\begin{aligned} &(\text{Bbl. of Slurry}) \times (\text{Lb. of Caustic Bbl. of Slurry}) = (\text{Lb. of Caustic}) \\ &(\quad \text{Bbl.}) \times (\quad \text{Lb./Bbl.}) = (\quad \text{Lb.}) \end{aligned}$$

**BREATHING AIR EQUIPMENT DRILLS
FOR
ON-DUTY PERSONNEL***

*To Include: Rig and Roustabout crew, Mudlogger, Mud Engineer, Global Marine Superintendent/ Toolpusher, Contractor Safety Representative, H₂S Safety Technician, and ARCO Drilling Representative.

An H₂S drill and training session must be given once a week to all on-duty personnel.

The purpose of the drill is to instruct the crews in the operation and use of breathing air and H₂S related emergency equipment and to allow them to become acquainted with using the equipment under working conditions. The crews should be trained to put on their breathing air equipment within one minute after an H₂S emergency has been alerted.

The following procedure should be used for weekly drills. The ARCO Drilling Representative and Global Marine Superintendent/Toolpusher must be satisfied that the crews are proficient with the equipment.

NOTE: The drill will not be made with drill pipe in open hole. It is conducted as outlined under "EMERGENCY PROCEDURES FOR CONDITIONS II, III AND IV", Section 5.0, herein.

- All drills will be unannounced (after sufficient training is complete).
- The Toolpusher should initiate the drill by signaling as he would if he detected H₂S .
- The driller should pick up off bottom and continue to rotate the drill pipe while he and the crew put on their breathing air equipment. The Mudlogger, Mud Engineer, Toolpusher, and all ARCO personnel also should don their breathing air equipment.
- Once the breathing air equipment is on, the driller should pick up the kelly and check for flow.
- The driller should proceed as if the well was flowing; stimulate closing the well in, BUT do not actually close the BOP's.
- The Mudlogger should continue to monitor his mudlogging equipment with his breathing air equipment on.
- The Mud Engineer should perform a flowline check for mud weight and funnel viscosity and catch a mud sample for a sulfides test on the mud. (This part of the drill is important - as ARCO wants to make it a standard practice that a sulfides test be run every time anything unusual happens.) In a drill only, it may not be necessary to perform the sulfides test on the mud.
- During the drill, the ARCO Drilling Representative, Global Marine Superintendent/

Toolpusher, and Safety Representative will observe to make sure that everyone is using their equipment properly.

- Resume normal operations.
- The Global Marine Superintendent/Toolpusher, ARCO Drilling Representative and the Safety Representative will hold a review to discuss results of the drill with those participating.

BREATHING AIR EQUIPMENT DRILLS & TRAINING SESSIONS
FOR
OFF-DUTY PERSONNEL*

*To Include: All personnel aboard the rig except on-duty Rig and Roustabout Crew, Mudlogger, Mud Engineer, Global Marine Superintendent/Toolpusher, Safety Representative, and ARCO Drilling Representative.

An H₂S drill and training session must be given once a week to all off-duty personnel.

This training will be conducted to instruct personnel in the operation and use of self-contained breathing apparatus and H₂S related emergency equipment and to review various operating procedures in the "H₂S CONTINGENCY PLAN".

Initial drills should include:

- General information about the self-contained breathing apparatus supply time limit, and proper packing and storage.
- How to put the mask on and test for leaks around face and hose connections.

These drills should be conducted as often as necessary to acquaint the crews with the equipment. After the ARCO Drilling Representative, Global Marine Superintendent/Toolpusher are convinced that all personnel are trained, a weekly drill must be conducted. This drill may be initiated any time. Prior to the drill, the rig crew on duty must be informed that it is only a practice drill. The drill will be initiated by the Condition II or III general alarm signal given by the Global Marine Superintendent/Toolpusher or ARCO Drilling Representative. At this time, all off-duty personnel will immediately get their assigned self-contained breathing apparatus and report to the Galley with their emergency equipment within three minutes after the alarm is sounded.

A training and information session will be conducted after each drill to answer any H₂S related questions and to cover one or more of the following:

- Condition II and III alerts and steps to be taken by all personnel.
- The importance of wind direction when dealing with H₂S.
- Proper use and storage of all types of breathing equipment.
- Proper use and storage of oxygen resuscitation.
- Proper use and storage of H₂S detectors colorimetric tube-type Del Mar "spot checks".
- The "Buddy System" and the procedure for rescuing a person overcome by H₂S.

- Responsibilities and duties.
- Location of H₂S safety equipment.
- Other parts of the “H₂S CONTINGENCY PLAN” that should be reviewed.

NOTE: A record of attendance must be kept for weekly drills and training sessions. These drills and training sessions must also be documented on the IADC Report and the ARCO Morning Report.

DRILLING REPRESENTATIVE'S CHECK LIST: HARDWARE

Items to be ready before spud

Item	Quantity	Description	Date Checked OK	Remarks	Date Checked OK	Remarks
1	1	Choke manifold as required by ARCO				
2	1	Degasser				
3	-	All choke manifold lines targeted at 90° turns				
4	2	Inside blowout preventers for each size drill pipe for H ₂ S service				
5	2	Safety valves for each size drill pipe and kelly valves for H ₂ S service				
6	1	Remote control for hydraulic choke				
7	-	Inside of BOP stack must be trimmed for H ₂ S service				
8	-	H ₂ S service trim for all valves on the choke manifold				
9	-	H ₂ S service trim for hand adjustable chokes				
10	6	Portable radios (walkie-talkie)				
11	2	Stretchers				

SAFETY EQUIPMENT CHECKLIST - SAFETY REPRESENTATIVE

Item	Quantity	Description	Date Checked	Remarks	Date Checked	Remarks
1	8	Continuous type monitoring units as described in this plan				
2	10	H ₂ S Alarm System as described in this plan				
3	-	Self-contained breathing apparatus as described in this plan				
4	-	100% zinc basic carbonate				
5	1	Garrett gas train unit				
6	1	Hot roll test units				

ARCO CHECK LIST OF ROUTINE DUTIES

Perform each week:

- Check volume of propane supply for flare ignitors and make sure lines are not plugged. Light each burner to verify system.
- Check all S.C.B.A.'s for operation: pressure demand regulator, escape bottle air volume, supply bottle air volume.
- Check breathing equipment mask assembly to see that straps are loosened and turned back ready to put on.
- Check pressure on breathing equipment air bottles to make sure they are charged to full volume.
- Check breathing equipment air bottles to make sure all pressure demand regulators are working. This requires that the bottle be opened and the mask assembly be put on tight enough so that air flows when inhaling. Open one side of mask to be sure air is pressured.
- Confirm pressure on all air supply bottles.
- Perform breathing equipment drills with all on-board personnel.
- Check oxygen resuscitators for pressure in oxygen bottle and make sure demand regulator is working.
- Check the following supplies for availability.
 - Stretcher
 - Ampoule Detectors
 - Safety Belts and Ropes
 - Flare guns and Flares
 - Emergency Telephone Lists
 - Spare air bottles
 - Spare oxygen bottles
- Test the explosimeter to verify that batteries are good.
- BOP drills
- Check nitrogen supply pressure on BOP Accumulator back-up source.

SUB-TAB SECTION III

**CONSIDERATIONS DURING THE
DRILLING OF A
SOUR GAS WELL**

CONSIDERATIONS DURING THE DRILLING OF A SOUR GAS WELL

1.0 INTRODUCTION

This memorandum is intended to familiarize you with the conditions that can exist when drilling a well into formations that may contain H₂S as well as the precautions the operator and Rig Contractor have taken in designing the well program to provide maximum safety.

You should become familiar with all safety equipment on the rig, its use and availability. The wind sock and wind streamers are provided to show which direction the wind is blowing so that the "SAFE BRIEFING AREA" can be easily defined. You should become "wind conscious" and frequently observe these wind direction indicators. All persons aboard the rig will receive instructions on the use of safety equipment and what to do during an H₂S emergency. The well will be monitored with seven H₂S continuous monitoring-type detectors.

2.0 DRILLING CONDITIONS

Drilling will be performed under three possible operating conditions:

2.1 Condition I: Possible Hazardous Conditions (H₂S Not Present)

- Warning Signs (for notification of general public): None
- Alarm (for notification of rig crew): None
- Characterized by: Drilling operations under control. Routine drilling operations in zones that may contain hydrogen sulfide. This condition will be in effect continuously from spud to total depth unless it is necessary to go to a Condition II Alert. This condition remains in effect until H₂S is detected.
- General Action:
 - Be alert for a condition change. There will be no smoking except in designated areas.
 - Check safety equipment for proper functioning. Keep it available. No welding or open fires without permission from the ARCO Drilling Representative.
 - Perform all drills for familiarization and proficiency.

2.2 Condition II - Potential Danger to Life (H₂S Present at 10 to 20 PPM)

- Warning Sign: MY-6 Flag System. "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of rig (yellow with black lettering to be illuminated at night).
- Alarm:
Working Area: Amber flashing light signal will continue as long as the H₂S concentration is present at 10 to 20 ppm or until deactivated by the Operator's Drilling Representative.
- Living Qtrs: 1 long - 1 short ring of general alarm followed by PA announcement.
- Characterized by: Drilling operations under control. Routine drilling operations in zones containing hydrogen sulfide. Poisonous gases present in concentrations at threshold levels and may or may not be detectable by odor.

This condition will be in effect continuously from the time H₂S is first detected at concentrations of 10 ppm to a total depth unless it is necessary to go to Condition III Alert. This condition remains in effect up to H₂S concentrations no greater than 20 ppm.

- General Action:
 - Be alert for a condition change. Observe wind direction regularly.
 - Check safety equipment for proper functioning; keep it available. "No Smoking" except in area designated by vessel's Barge Engineer. No welding or burning without permission from the onboard Drilling Superintendent.
 - Follow instructions of supervisors.
 - Perform all drills for familiarization and proficiency.

2.3 Condition III - Moderate to Extreme Danger to Life (H₂S Present At Or Greater Than 20 PPM)

- Warning Sign: MY-6 Flag System. A Flag System consisting of four (3' x 2') red flags will be placed at key locations. "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of vessel, etc.

- Alarm: Sirens and strobe lights will be activated at seven (7) rig locations. Global bell system sounded in rig quarters, followed by PA announcement when H₂S concentration reaches 20 ppm.
- Characterized by: Critical well operations, well control problems, and in the extreme, loss of well control. Poisonous gases may be present at or above threshold levels.
- General Actions:
 - Go to the Galley with breathing equipment if not specifically assigned to correct or control the situation.
 - Follow the instructions of the Global Superintendent/Toolpusher and the ARCO Drilling Representative.
 - The Global Superintendent/Toolpusher and the ARCO Drilling Representative shall initiate emergency action as provided in this plan.
 - All persons working in the hazard area will wear breathing air equipment. All personnel will restrict their movements as directed by the Global Superintendent/Toolpusher and the ARCO Drilling Representative.
 - All persons in the living quarters will pick up their self-contained breathing equipment and proceed to the Galley.
 - If the H₂ S gas is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide which is also poisonous. Therefore, DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES. FOLLOW THE INSTRUCTIONS OF SUPERVISORS.

2.4 Condition IV - Extreme Danger to Life - (H₂S Present At Greater Than 50 ppm)

- Warning Sign: MY-6 Flag System. Two 2' x 3' red flags at bow and stern. "DANGER - HYDROGEN SULFIDE - H₂S" signs on all sides of rig (yellow with black lettering to be illuminated at night).
- Alarm:
Working Area: Continuous sounding of the H₂S horn and H₂S siren and amber and red lights flashing. All alarm signals will continue as long as the H₂S concentration is present at greater than 50 ppm or until deactivated by the Safety Representative or ARCO Drilling Representative.
- Living Qtrs. 1 long - 2 short rings of general alarm bell followed by PA announcement.
- Characterized by: Loss of well control or the H₂S concentration is greater than 50 ppm.
- General Action:
 - All non-essential personnel, or all personnel if the situation warrants, shall be evacuated. Radio and other available communications shall be used to alert all known air and land craft in the immediate vicinity of the rig. The ARCO Drilling Representative will advise the Global Marine Drilling Superintendent of the plans to evacuate the rig. Notification of local civil authorities will be made by the ARCO Drilling Superintendent.
 - All people not specifically assigned to correct or control the situation shall, after being moved from the Galley, shall move to the appropriate debarkation point to await evacuation. A suggested list of essential personnel to be left aboard is on page 19 in Sub-tab Section I, herein. The number of essential personnel may be increased at the request of the ARCO Drilling Representative or on order of the Global Marine Superintendent/Toolpusher.
 - If the alarm sounds and it has not been preceded by Conditions II and III, the actions of Condition IV shall be taken. Circulation will be stopped, breathing air equipment shall be donned by all working personnel. Drilling Contractor Safety Representative shall check all personnel by roster. The Rig and Shore dispatcher will also be notified of the condition and will continually monitor the radio.

- The Global Marine Superintendent/Toolpusher and the ARCO Drilling Representative shall jointly determine if ignition is necessary as outlined under "IGNITING THE WELL". Section X herein, and will conduct any necessary operations with an absolute minimum of personnel. Final decision to ignite the well shall rest with the ARCO Drilling Representative.
- If the well is ignited, the burning hydrogen sulfide will be converted to sulfur dioxide which is also poisonous. DO NOT ASSUME THAT THE AREA IS SAFE AFTER THE GAS IS IGNITED. CONTINUE TO OBSERVE EMERGENCY PROCEDURES. FOLLOW THE INSTRUCTIONS OF SUPERVISORS.

3.0 EMERGENCY ACTIONS AND GENERAL INFORMATION

During an emergency, persons will utilize the "Buddy System", preventing anyone from entering a gas area alone - whether he is using breathing equipment or not.

If you are wearing breathing air equipment, do not remove it until you are absolutely certain the air is safe to breathe. If a sudden gas release occurs without warning, you should:

- Hold your breath and rapidly evacuate the area containing the H₂S. Move upwind, if possible.
- Put on breathing air equipment.
- Help anyone who may be affected by gas. NOTE: Put on your breathing air equipment before helping anyone overcome by H₂S. Then get him to a safe briefing area and administer rescue breathing or oxygen as needed.
- Evacuate quickly to the Galley to receive instructions from the Global Marine Superintendent/Toolpusher or the ARCO Drilling Representative.
- DO NOT PANIC.

ARCO tries to keep all formations overbalanced with mud weight so that no influx of gas will occur. However, these plans have been provided so that such an influx may be handled with a minimum of trouble. If you are on the rig during any operating condition, it is essential that you follow the instructions of the ARCO Drilling Representative and the Global Marine Superintendent/Toolpusher.

Five (5) copies of the "H₂S CONTINGENCY PLAN" are available in the ARCO Drilling Representative's office. This Plan sets out precautionary measures, safety equipment, emergency procedures, responsibilities, and duties pertaining to the drilling of a sour gas well. All personnel should become familiar with the contents of the Plan and afterward

should sign the log in the control room indicating that they have received, read and understand this "CONSIDERATIONS DURING THE DRILLING OF A SOUR GAS WELL."

The table following lists various poisonous gases and the concentrations at which they become dangerous.

<u>Common Name</u>	<u>Chemical Formula</u>	<u>Gravity Air = 1</u>	<u>Threshold Limit</u>	<u>Hazardous Limit</u>	<u>Lethal Concentration</u>
Hydrogen Sulfide	H ₂ S	1.19	10 ppm	250 ppm/hr	600 ppm
Sulfur Dioxide	SO ₂	2.21	5 ppm	--	1000 ppm
Carbon Monoxide	CO	0.97	50 ppm	400 ppm/hr	1000 ppm
Carbon Dioxide	CO ₂	1.52	5000 ppm	5%	10%
Methane	CH ₄	0.55	90000 ppm (9%)	Combustible Above 5% in air	--

- Threshold - concentration at which it is believed that all workers may repeatedly be exposed, day after day, without adverse effect.
- Hazardous - concentration that may cause death.
- Lethal - concentration that will cause death with short-term exposure.

Properties of Gases

The produced gas will probably be a mixture of carbon dioxide, hydrogen sulfide and methane.

- Carbon Dioxide
Carbon Dioxide (CO₂) is usually considered inert and is commonly used to extinguish fires. It is heavier than air (1.52 times) and it will concentrate in low areas of still air. Humans cannot breathe air containing more than 10% CO₂ without losing consciousness. Air containing 5% CO₂ will cause disorientation in a few minutes. Continued exposure to CO₂ after being affected will cause convulsions, coma, and respiratory failure.
- The threshold limit of CO₂ is 5000 ppm. Short-term exposure to 50,000 ppm (5%) is reasonable. This gas is colorless and odorless and can be tolerated in relatively high concentrations.

- Hydrogen Sulfide
 - Hydrogen Sulfide (H₂S) itself is a colorless, transparent gas and is flammable. It is heavier than air and, hence, may accumulate in low places.
 - Although the slightest presence of H₂S in the air is normally detectable by its characteristics "rotten egg" odor, it is dangerous to rely on the odor as a means of detecting excessive concentrations because the sense of smell is rapidly lost, allowing lethal concentrations to accumulate without warning. The following table indicates the poisonous nature of hydrogen sulfide.

<u>CONCENTRATION</u>		<u>EFFECTS</u>
<u>% H₂S</u>	<u>PPM</u>	
0.000013	0.13	Minimal perceptible odor
0.00046	4.60	Easily detectable, moderate odor
0.001	10.0	Safe for 8 hours without respirator. Obvious and unpleasant odor. Beginning eye irritation
0.002	20.0	Safe for 4 hour exposure without respirator.
0.0027	27.0	Strong unpleasant odor, but not intolerable
0.01	100	Kills sense of smell in 2 to 5 minutes; will sting eyes and throat, cause coughing
0.02	200	Kills sense of smell quickly; stings eyes and throat. Respiratory tract irritation after 1 hour exposure
0.05	500	Dizziness; breathing stops in a few minutes; need prompt artificial respiration. Loss of consciousness and possible death in 30 minutes to 1 hour.
0.07	700	Unconscious quickly; death will result if not rescued promptly
0.1	1000	Unconscious at once; followed by death within minutes

- Sulfur Dioxide
 - Sulfur dioxide is a colorless, transparent gas and is non-flammable.
 - Sulfur dioxide (SO₂) is produced during the burning of H₂S. Although SO₂ is heavier than air, it will be picked up by a breeze and carried downwind at elevated temperatures. Since sulfur dioxide is extremely irritating to the eyes and mucous membranes of the upper respiratory tract, it has exceptionally good warning powers in this respect. The following table indicates the toxic nature of the gas.
 - Sulfur dioxide becomes a liquid at 0°C (32°F). Considering the ambient temperatures at the Warthog location, it is possible that if SO₂ is present, it will be in the form of a mist in the air.

<u>CONCENTRATIONS</u>		<u>EFFECTS</u>
<u>% SO₂</u>	<u>PPM</u>	
0.005	3 TO 5	Pungent odor - normally a person can detect SO ₂ in this range. Safe for 8 hours without a respirator.
0.0012	12	Throat irritation, coughing, constriction of the chest, tearing and smarting of the eyes.
0.15	150	So irritating it can only be endured a few minutes.
0.05	500	Causes sense of suffocation, even with first breath.

Treatment Procedures for Hydrogen Sulfide Poisoning

- Remove the victim to fresh air.
- If breathing has ceased or is labored, begin resuscitation immediately. NOTE: This is the quickest and preferred method of clearing the victim's lungs of contaminated air. However, under disaster conditions, it may not be practical to move the victim to fresh air. In such instances, where those rendering first aid must continue to wear masks, a resuscitator should be used.
- Apply resuscitator to help purge H₂S from the blood stream.
- Keep victim at rest and prevent chilling.
- Get victim under physician's care as soon as possible.

**ARCO ALASKA, INC.
ARCO WARTHOG NO. 1
EXPLORATION WELL
BEAUFORT SEA**

Date _____

I, _____, an employee of _____,
(Please Print)

(Signature)

NOTE: This signed form will be kept on file on the Drilling Rig.

APPENDIX II
to the
EXPLORATION PLAN

ARCO ALASKA, INC.
ANCHORAGE, ALASKA

ENVIRONMENTAL REPORT
for
ARCO WARTHOG NO. 1
EXPLORATION WELL

OCS Lease Block Y-1663
Beaufort Sea Planning Area
Oil and Gas Lease Sale 144

Prepared by
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April 1997

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1.0 WARTHOG NO. 1 ENVIRONMENTAL REPORT

The purpose of the Environmental Report is to provide the Minerals Management Service (MMS), Alaska Outer Continental Shelf (OCS) Region, and other appropriate federal and state agencies with sufficient information for evaluation of the ARCO Alaska, Inc. (ARCO) Warthog No. 1 exploration well project and its compliance with the National Environmental Policy Act (NEPA) and its implementing regulations. Detailed information about the project is included in other sections of the Exploration Plan prepared for this project (see Fairweather E&P Services, Inc. [Fairweather E&P] 1997a).

Significant scientific data are available to describe the existing environment and to assess any potential impacts resulting from exploration activities at the Warthog Prospect. This prospect is located within Beaufort Sea Planning Area for Oil and Gas Lease 144 (held in September 1996). As required by NEPA regulations, the MMS has, in cooperation with the U.S. Environmental Protection Agency (USEPA) prepared a Final Environmental Impact Statement (EIS) for the Alaska OCS Beaufort Sea Planning Area Oil and Gas Lease Sale 144.

In addition, as regulated under applicable Sections of the Clean Water Act and the U. S. Coast Guard regulations (33 CFR Part 151), the EPA has issued a Final National Pollutant Discharge and Elimination System (NPDES) General Permit for Offshore Oil and Gas Operations on the OCS and State Waters of Alaska: (Arctic NPDES General Permit No. AKG284200). This Environmental Report is prepared to supplement the extensive review already completed during the EIS and the NPDES processes. The Final EIS for the Alaska OCS Beaufort Sea Planning Area Oil and Gas Lease Sale 144; the Final NPDES General Permit for Offshore Oil and Gas Operations on the OCS and State Waters of Alaska; and documents prepared by EPA in support of the Arctic NPDES General Permit (USEPA 1995a, 1995b) are hereby incorporated by reference.

In addition, previous studies have addressed the environmental impacts associated with exploration activity in the nearshore Beaufort Sea. The ARCO Warthog No. 1 exploration well, located approximately 3.5 miles offshore, would not be expected to result in new or different impacts to the surrounding environment. Site-specific environmental information prepared by ARCO and Fairweather E&P is hereby incorporated by reference. Finally, an EIS was prepared for the Endicott Development Project and several monitoring reports describe results of a number of studies in and near the project area. These documents, included in the References section of this report, are hereby incorporated by reference.

The Warthog Prospect activities are detailed in the ARCO Warthog No. 1 exploration well Exploration Plan (Fairweather E&P 1997a). The Exploration Plan and its stand-alone exhibits (Fairweather E&P 1997b, 1997c, 1997d, 1997e) include details of the proposed action as specified under 30 CFR 250.34-3 and are hereby incorporated by reference.

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1. Winter 1997-1998 Activities

The Warthog Prospect Exploration Program consists of drilling one or more exploratory wells during a winter exploration drilling program to evaluate the oil and gas potential of ARCO-operated leases in Camden Bay, eastern Beaufort Sea, Alaska. ARCO will be the permittee of record. At present, a single exploration well location has been identified in the area. This initial well, hereinafter referred to as "ARCO Warthog No. 1" is planned to be a directionally drilled hole from a surface location in OCS Lease Block Y-1663 to a bottomhole location in State of Alaska Lease Block No. 371014. Figure 2-1 shows the proposed surface and bottomhole locations within the area of interest.

The Warthog No. 1 well will be drilled during the 1997-1998 winter drilling season. The Global Marine Drilling Company "GLOMAR Beaufort Sea I" Concrete Island Drilling System (CIDS) will be used to drill the well. The CIDS is a mobile offshore drilling unit designed specifically for year-round exploratory drilling in harsh offshore arctic environments in water depths ranging from 35 to 55 feet. This drilling unit is described in detail in the project's Exploration Plan (Fairweather E&P 1997a).

Drilling activity is anticipated to start approximately November 1, 1997, depending on the development of ice cover in Camden Bay. No drilling activities will be conducted during the fall Bowhead whale migration, or prior to the development of ice cover in Camden Bay. The CIDS rig will be situated on the Warthog drilling location and held in a warm shutdown condition during those periods.

Any additional exploration/delineation drilling in the prospect area is dependent on the outcome of the Warthog No. 1 well, and further review of geologic and geophysical data. The Warthog No. 1 well will be expendable and plugged/abandoned regardless of any commerciality demonstrated during testing and evaluation. If the initial well shows potential for hydrocarbon development, the original hole may be plugged back and sidetracked to a different bottomhole location in order to provide a "second look" within the 1997-1998 drilling season.

2.2. Summer 1997 Activities

As part of the Warthog Prospect Exploration Program, a limited summer site survey is proposed. Site-specific bathymetric, side scan sonar, and shallow hazards data (as required by the MMS) would be collected in July 1997 prior to movement of the CIDS on-site. The Crowley Marine Service *MV Kavik River* would be the vessel employed for the high resolution seismic survey. The *MV Sea Ducer* is planned for the side scan, subbottom profile, and bathymetry surveys.

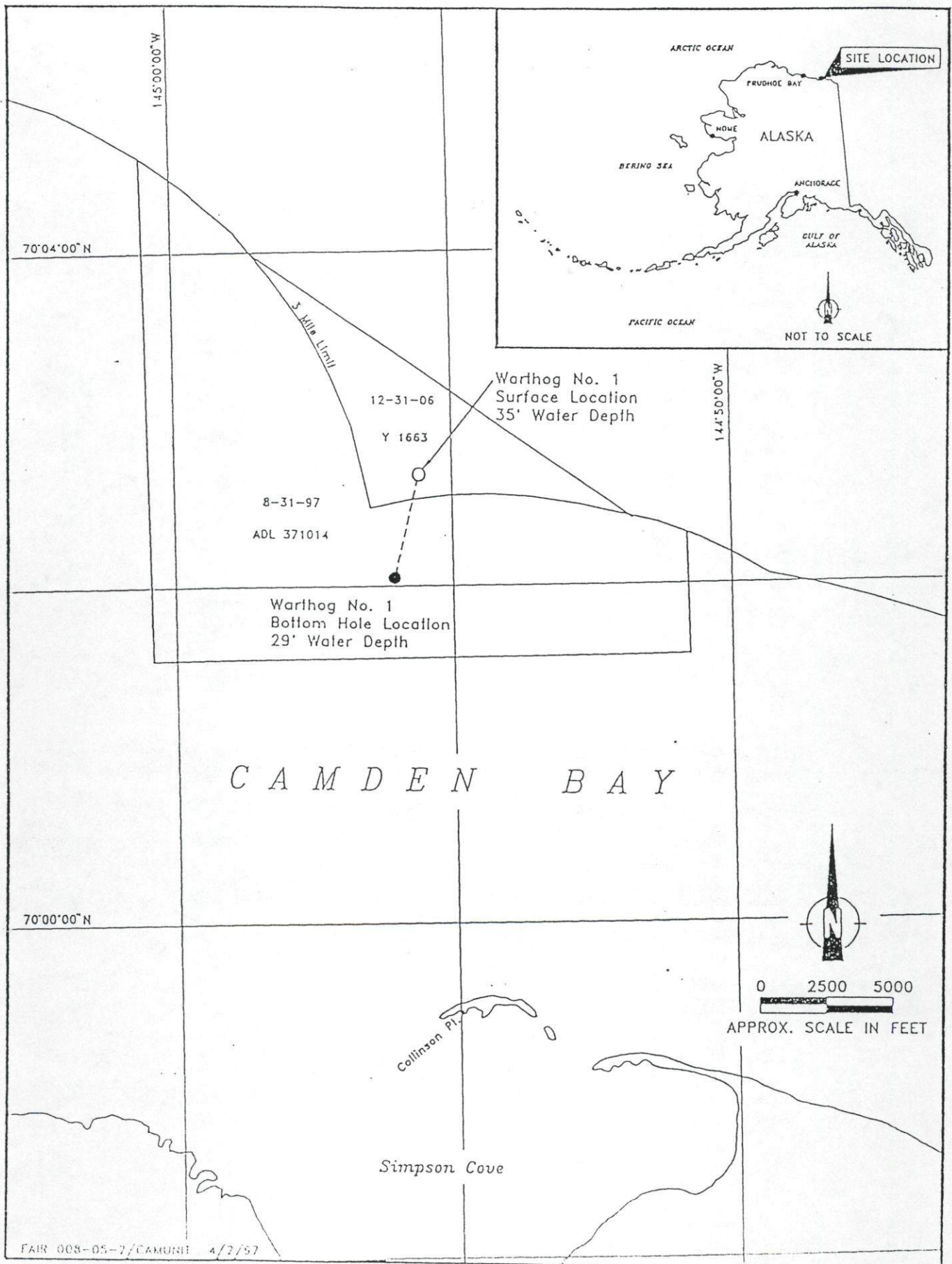


Figure 2-1 ARCO Alaska, Inc., Warthog No. 1 Project Location

The surveys will utilize a subbottom Geopulse profiling system (500 Hz to 12 kHz) that is expected to penetrate down to a subsurface depth of approximately 100 m. In the event that the system is unable to acquire sufficient data, a Bubble Pulser Subbottom Profiling System using a lower frequency system (300 Hz) will be employed. Additionally, a 100-kHz and 500-kHz fish will be used for the side scan sonar survey to provide surficial characteristics of the seafloor under and on either side of the survey vessel out to a range of approximately 100 m.

For rig mobilization, crews will first board the CIDS in June 1997 to ready it for transport. The rig will be moved to Camden Bay prior to September 1, 1997, so as to minimize any conflicts with the annual Bowhead whale migration. The rig would be moved onto the drilling location under light ship condition as a result of the water depths along the approach route and at the drilling location.

A complete project schedule for the exploratory program is contained in Figure 2-2. It is anticipated that the CIDS will be moved on-site in August 1997. Actual drilling activities would not begin until on or about November 1, 1997 after freezeup. The CIDS would be demobilized and returned to Prudhoe Bay in August 1998.

In addition, Figure 2-3 shows the specific activities and duration of work days planned for the site surveys in July 1997 (see Figure 2-2). Twelve days of open water site survey work are planned as soon as sufficient open water conditions exist. All summer site survey activities are anticipated to be completed by August 1, 1997.

Task	Days											
	1	2	3	4	5	6	7	8	9	10	11	12
Mobilize Side Scan, Subbottom, and Bathymetry Program	█	█										
Run Side Scan, Subbottom, and Bathymetry Survey			█	█	█	█						
Demob Side Scan, Subbottom, and Bathymetry							█					
Mob High Resolution Seismic Program							█					
Shoot High Resolution Seismic Program								█	█	█	█	
Demob High Resolution Seismic Program												█

Note: Project field activities are proposed to commence July 20, 1997, but the schedule may be delayed if sea ice conditions are unabated in the work area.

Figure 2-3. Warthog No. 1 Shallow Hazard Survey Proposed Field Schedule.

3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

3.1. Geology

The ARCO Warthog No. 1 drilling location lies approximately 6 miles northeast of Konganevik Point on the Eastern Alaska Beaufort Sea shelf in Camden Bay and approximately 35 miles west of Barter Island. Shallow water depths at the bottomhole location (approximately 29 feet MLLW) require that the well be drilled from a surface location with sufficient water depth to accommodate the towing draft of the CIDS drilling vessel. Refer to the Exploration Plan (Fairweather E&P 1997a) for a detailed description of the CIDS.

Near the drilling location, a series of transitory, low-lying sand/gravel deposits also known as the Barrier Islands occur immediately south of the Warthog No. 1 Exploratory Well location. Site investigations conducted for ARCO in the project area (see Fairweather E&P 1997b and 1997c) included: 1) geotechnical borings with geochemical analysis and a lead-line bathymetric program in April 1995 (Fairweather E&P 1995); and 2) a two-phase bathymetry survey with a limited geotechnical site investigation involving drilling and surficial sampling in April 1996 (EBA Engineering, Inc. 1996).

The Eastern Beaufort Sea Shelf is characterized by up to 600 feet of Quaternary sediments (Gubik Formation) overlying the Tertiary rocks and sediments of the Sagavanirktok Formation. The quaternary sediments are divided into Pleistocene soils, deposited prior to the end of the last glaciation, and recent Holocene deposits. The Warthog Prospect is located within an area known as the Camden Bay uplift, which is an east-northeast trending zone some 20 miles wide by 35 miles long that is thought to have been upthrust (Grantz et al. 1982). This site is relatively removed from major sediment sources such as river deltas, and present-day deposition is thought to be light. The major processes active at the seabed are likely to be littoral deposition of marine sediments and Holocene reworking of older materials by currents and ice scour activity.

Geotechnical borings and surficial sediment surveys in the vicinity of the Warthog Prospect indicated a layer of Holocene sediments, consisting of fine sand and soft silt and clay, with no cobble or boulder habitat (i.e., Boulder Patch) present (USGS 1981; Fairweather E&P 1997b, 1997c). Near-surface geology at the proposed well site consisted of an 8- to 10-foot thick fine sand layer above a thicker sequence of fine sandy silt or sand. A clayey material was encountered at depth beneath the silt. One soil boring at the location indicated frozen soil conditions in a zone beginning approximately 55 feet below mudline and continued to boring termination.

This site geology is consistent with Beaufort Sea barrier island formations. The uppermost fine sand is considered a continuation of the nearby barrier island formation. The soil is loose to medium dense and normally consolidated.

No near-surface faults, slumps, or unstable bottom sediments have been found in the project area by BLM/NOAA OCSEAP surveys (USGS 1981) or by ARCO-funded surveys. The Beaufort Sea Barrier Islands are located in an earthquake Zone 1; earthquake possibility is highly unlikely for this region.

The nature and extent of known mineral deposits in the Warthog Prospect is confidential and proprietary. This information is contained in a stand-alone exhibit to the project's Exploration Plan (see Fairweather E&P 1997b).

Onshore aquifer potentials are not applicable to this project.

3.2. Meteorology

The ARCO Warthog No. 1 Exploratory Well is located in the Arctic climate zone, characterized by cold temperatures, nearly constant wind, and low precipitation with conditions represented by Barter Island meteorological data (Table 3-1). Mean temperatures are approximately 10°F. The maximum recorded temperature in the region is 80°F and the minimum is -68°F. Freezing temperatures are reached for an average of 313 days per year. Mean sky cover varies from 0 to 9.2 tenths; Barter Island reports 0 to 8.6 tenths (WCC 1981). Fog is common from May through September and cloudy weather is common from February through October. Barter Island reports 50 days/year as clear, 68 days/year partly cloudy, and 192 days/year cloudy. Annual precipitation averages less than 10 inches, and winter snowfall is generally less than 3.5 feet.

Winds consistently average 16 km/hour (12.9 mph) along the Beaufort Sea coast with the prevailing wind direction being easterly (ENE to NE). From January to April, the prevailing wind direction is westerly (WCC 1981). Gale force winds blow frequently along the coast, and hurricane velocities have been recorded for this region.

Latitude: 70° 07' N
 Longitude: 143° 40' W
 Elevation: 40 feet

Temperature (Degrees F)													Precipitation (Inches)																	
Means			Extremes				Mean Days						Heat Degree Days			Mean Precip					Days Exceeded					Snow				
Mth	Max	Min	Mth	Rec Hi	Yr	Rec Lo	Yr	Max			Min			Mth Mean	Mean Mth Tot	Max Day	Yr	Mean Precip	.25	.5	1.0	Mean Mth Tot	Max Dpth	Yr	Mean Days 1.0					
								70+	32-	32-	0-	32-	0.1													0.5	1.0	3.0	4.0	5.0
Jan	-7.8	-20.5	-14.2	39.0	62	-54.0	75	0.0	30.8	28.6	31.0	2465.0	0.48	2.25	62	0.1	0.5	1.0	5.0	5.0	43.0	50	31.0							
Feb	-13.9	-26.4	-20.1	37.0	82	-59.0	50	0.0	28.1	27.1	28.3	2407.1	0.23	1.22	55	0.0	0.0	0.6	2.7	2.7	43.0	50	28.2							
Mar	-8.5	-22.4	-15.5	36.0	67	-51.0	73	0.0	31.0	30.0	31.0	2495.8	0.22	0.54	67	0.0	0.0	0.7	2.6	2.6	47.0	55	31.0							
Apr	6.8	-9.5	-1.3	43.0	58	-44.0	87	0.0	29.3	23.6	30.0	1992.6	0.19	0.44	63	0.0	0.0	0.3	2.4	2.4	47.0	55	30.0							
May	26.2	15.4	20.8	52.0	64	-16.0	64	0.0	24.3	3.0	30.9	1359.0	0.30	0.73	54	0.1	0.0	0.8	3.0	3.0	40.0	50	28.4							
Jun	38.3	30.2	34.3	68.0	76	13.0	74	0.0	3.0	0.0	22.8	912.5	0.52	1.20	52	0.1	0.0	1.5	1.6	1.6	35.0	55	5.8							
Jul	45.3	34.7	40.0	78.0	74	24.0	67	0.2	0.0	0.0	9.0	765.5	1.00	1.64	71	0.3	0.7	3.3	0.5	0.5	2.0	54	0.1							
Aug	43.9	34.4	39.2	72.0	57	20.0	86	0.1	0.9	0.0	10.8	794.8	1.08	0.90	48	0.3	0.7	3.4	1.3	1.3	3.0	69	1.0							
Sep	35.4	27.9	31.6	66.0	86	4.0	70	0.0	10.2	0.0	24.7	993.1	0.68	0.91	57	0.1	0.3	2.2	5.0	5.0	20.0	54	6.0							
Oct	20.5	10.3	15.4	46.0	69	-26.0	83	0.0	29.1	6.7	31.0	1539.0	0.77	1.98	54	0.1	0.7	1.7	9.0	9.0	24.0	54	25.7							
Nov	5.6	-6.2	-0.2	37.0	50	-51.0	48	0.0	29.8	20.0	30.0	1962.3	0.41	0.43	54	0.0	0.3	1.0	4.9	4.9	24.0	50	30.0							
Dec	-6.0	-18.5	-12.1	37.0	73	-51.0	61	0.0	30.9	28.1	31.0	2389.9	0.26	0.52	49	0.0	0.7	0.7	3.3	3.3	26.0	49	31.0							
Year	Avg 15.5	Avg 4.1	Avg 9.8	Rec 78.0	Rec -59.0	Tot 0.2	Tot 247.3	Tot 167.0	Tot 310.4	Tot 20076.7	Tot 6.12	Tot 2.25	Tot 1.2	Tot 3.8	Tot 17.0	Tot 41.2	Tot 47.0	Tot 248.2												

Table 3-1. Climatic Summary for Barter Island from 1947 to 1987 (Leslie 1989).

The sun remains below the horizon in the project area from November 24 to January 17. Daylight hours representative of the area (70°N) are presented below:

January	0.0
February	4.9
March	9.5
April	14.0
May	18.9
June	24.0
July	24.0
August	21.2
September	15.5
October	11.2
November	6.1
December	0.0

3.3. Air Quality

The existing onshore air quality for most areas adjacent to the Beaufort Sea Planning Area Lease 144 is considered to be relatively pristine, with concentrations of regulated air pollutants that are far less than the maxima allowed by the National Ambient Air Quality Standards and State air quality statutes and regulations. Over most of this onshore area, there are only a few small, scattered emissions from widely scattered sources (primarily diesel-electric generators in small villages). In addition, during the winter and spring, pollutants known as arctic haze are transported to arctic Alaska from Europe and Asia. However, despite this seasonal, long-distance transport of pollutants into the area, regional air quality is still far better than specified by standards (USDOI/MMS 1996).

Existing and anticipated offshore air quality conditions at the Warthog Prospect have been evaluated as part of the project's permitting effort. A description of the existing and anticipated air quality at the project site during the proposed exploration operations is contained in the project's Exploration Plan (Fairweather E&P 1997a).

3.4. Physical Oceanography

3.4.1. Summer Conditions

Tides in the Beaufort Sea are generally small and are characterized by a mixed semi-diurnal signal with mean ranges from 10 to 30 cm (4 to 12 inches). The tide appears to approach from the north with little phase change from Barrow to Demarcation Point (USDOI/MMS 1990). Storm surges significantly increase or decrease sea level from this mean level; in the Beaufort

Sea, storm surges are the most important factor in sea level variation. The storm surges are a result of meteorological conditions (wind, pressure gradients, temperature) interacting with the physical elements of the water surface (open water, fetch, density gradients, bathymetry, shoreline topography) creating wave, current, and water mass accumulations that can change sea level conditions by up to 3 m (9.8 feet). Storm surges most frequently occur in September and October when eastward moving storms cross the face of the Beaufort Sea coast and long stretches of open water are present. A vertical rise in water surface will occur on those beach fronts impinged by the wave train, and a negative vertical change in the water surface may help drive upwelling of warm saline water onto the shelf (Aagaard 1988). Much of the water flowing northward from the Chukchi Sea is carried by this current and results in a great expanse of warm water extending eastward across the Beaufort Sea during the summer and fall (Aagaard 1984).

The inner shelf region of the Beaufort Sea is characterized by mean westward water and ice motion primarily driven by the prevailing winds, which are from the east. Strong winds periodically develop from the west causing major flow reversals in the surface current; the response time is rapid, usually a matter of hours. Bottom currents also tend to travel from east to west. Nearshore currents are modified by bottom topography, the presence of ice, river discharge, and the location of offshore barrier islands and shoals (USDOI/MMS 1987; 1990).

Seaward of the 40 m (131 feet) isobath, and north of the project site, the circulation is dominated by the Beaufort Gyre that controls surface ice movement and by the Beaufort Undercurrent that generally runs counter to the predominantly westward ice drift (Aagaard 1984). The long-term mean speeds of this current are normally in the 5 to 10 cm/sec (0.09 to 0.2 knots) range, although maximum speeds near 75 cm/sec (1.5 knots) have been recorded (Aagaard 1988). Frequent current reversals have been observed and appear to be due to the long-shore wind component; they will occur on the lee side of large embayments and extended promontories.

Previous surveys in the region noted water temperatures for coastal areas on the Inner Shelf (i.e., less than 40 m water depths) generally ranged from 0°C to 9°C; salinity in true marine waters is greater than 25 ppt while more inshore areas range from 15 ppt to 25 ppt. During the early to mid-summer, temperature and salinity are stratified with depth because open-water areas adjacent to river deltas are dominated largely by river water and offshore by ice-melt water that forms a 3- to 4-m-thick surface layer. The colder, high salinity marine water lies below this surface layer. Due to the large density difference between the layers and the retreating ice cover, mixing of the fresh- and marine-water layers by winds is negligible in the early summer. Later in the summer, open water areas become large enough for winds and storms to affect mixing and circulation; strong easterly or westerly winds especially have sufficient force to bring about mixing. As a result, late summer storms can cause water temperatures along the coast to decrease from 8 to 12°C to 3 to 5°C and salinity to increase 10 or more ppt within 24 hours.

Due to little or no industrial activity, offshore water quality at the Warthog Prospect in the Beaufort Sea Planning Area Lease 144 is good with most contaminants occurring at low levels (USDOI/MMS 1996). However, turbidity, trace metals, and hydrocarbons are introduced into the marine environment through river runoff, coastal erosion, atmospheric deposition, and natural seeps.

3.4.2. Winter Conditions

During winter exploration operations at the Warthog No. 1 Exploratory Well, the region will be covered by ice. Ice cover exists from approximately late October or early November until late June. Winter sea ice on the Beaufort Sea shelf consists of landfast ice (fast ice), drifting pack ice (seasonal pack ice), and a region of pronounced ice ridging and shear line formation (Stamukhi or shear zone), which develops between the pack ice and landfast ice. At the project site, ice is generally within the floating-fast subzone of the landfast ice zone. This area is between the 2-m isobath (the bottomfast ice zone) and the 15-m isobath, the beginning of the grounded ice zone (WCC 1981). The ice sheet in the project area will grow to a thickness of approximately 2 m by April with breakup expected by June or July. Ice gouging of the seabed can be expected in the project area, and large multi-year floes will typically ground in water depths of 45 to 60 feet.

Negative tide surges (i.e., levels falling below mean sea level) occur primarily during December and January and are up to -1.6 m (-5.2 feet) (Norton and Sackinger 1981). Extensive fracturing of shorefast ice is possible during such surge events.

Previous surveys in the general area noted under-ice water temperatures of -1.7°C in February, -2.2°C in March, and -2.4°C in April. Average salinity was 33 ppt, ranging from a minimum of 28 ppt to a maximum of 33.7 ppt. Temperature and salinity were uniform with depth. Currents under ice were tidally driven and of very low magnitude (WCC 1981).

In winter, nearshore ocean currents are generally westerly and less than 5 cm/sec (0.09 knots) and may not exceed 10 cm/sec (0.2 knots). In fact, less than 5 percent of the registered under-ice current speeds exceeded 5.0 cm/sec (0.16 ft/sec) (WCC 1981; USDOI/MMS 1987, 1990).

3.5. Other Uses of Area

3.5.1. Commercial Fishing

No commercial fishing exists or is anticipated in the immediate project area. The one commercial fishery present along the Alaskan Beaufort Sea coastline, the Helmerick's

operation on the Colville River delta, occurs more than 100 miles to the west of the Warthog Prospect (USDOI/MMS 1996).

The USDOI/MMS (1996) notes that this commercial fishing operation began more than 25 years ago and occurs during the summer and fall months. Arctic cisco, least cisco, and, to a lesser extent, broad whitefish are the primary species harvested. They are sold for human consumption and for dog food in Fairbanks and Barrow. Alaska Department of Fish and Game catch statistics for 1964 through 1995 are presented in Table 3-2.

3.5.2. Shipping

The only commercial offshore activity in the project area, other than oil and gas exploration, is occasional open water barge traffic between Prudhoe Bay and the Mackenzie River in Canada. Barge travel is limited to regions north of the Barrier Islands and does not occur during winter months.

3.5.3. Military Use

No regular military use of the area exists or is known to be planned.

3.5.4. Recreation/Sport Fishing/Boating

No sport fishing occurs in the immediate project area. Local boating occurs in the area as part of normal subsistence fishing and whaling activities for the villages of Kaktovik and Nuiqsut. See Section 3.7 for a discussion of subsistence activities in the project area.

3.5.5. Kelp Harvesting or Mariculture

No kelp harvesting or mariculture exists or is anticipated in the project area.

3.5.6. Known Cultural Resources

Although a significant number of archaeological and cultural/historical sites have been identified in the general North Slope area, there are no cultural/historic sites located near the Warthog No. 1 Exploratory Well (Lobdell 1996). The closest archaeological site is the

Table 3-1. Colville River Commercial Whitefish Catches, 1964-1995, (ADF&G 1997)

<u>Year</u>	<u>Broad Whitefish</u>	<u>Humpback Whitefish</u>	<u>Arctic Cisco ("kaktok")</u>	<u>Least Cisco ("herring")</u>
1964	2,951 b		15,000	9,000
1965	3,000 b		50,000	
1966	2,500 b		40,000	
1967 g				
1968	3,130		42,055	18,180
1969 g				
1970	2,080 b		19,602	25,930
1971	3,815	132	38,016	22,713
1972	3,850	1,497	37,333	13,283
1973	2,161		71,569	25,188
1974	3,117	2,316	35,601	13,813
1975	2,201	1,946	28,291	20,778
1976	2,172	1,815	31,659	34,620
1977	443	1,431	31,796	14,961
1978 e	20 d	1,102	17,292	21,589
1979	d	1,831	8,684	24,984
1980	d	4,231	14,657	31,459
1981	1,035	469	38,206	16,584
1982	1,662	201	15,067 c	25,746 c
1983	d	408 d	18,162	35,322
1984	789	179	27,686	13,076
1985	401	191	23,679	17,595
1986 f	0	18	29,895	9,444
1987 f	5	1,989	24,769	10,922
1988	429	6,733	10,287	23,910
1989	71	6,575	17,877	23,303
1990	0	5,694	19,374	21,003
1991	0	1,240	13,805	5,697
1992	126	5,209	20,939	6,962
1993	20	5,339	31,310	6,037
1994	0	6,056	8,958	10,176
1995	0	5,973 h	13,236 i	0

a Numbers reflect fish harvested with the intent of commercial sale.

b Includes small numbers of humpback whitefish.

c Also reported taken were 1 chinook, 2 sockeye, 9 chum, and 118 pink salmon

d No fishing effort during June or July.

e No fishing effort during November or December.

f No fishing effort during July or December.

g No data available.

Average weights: Broad whitefish 5.1 lbs.
Least cisco 0.9 lbs.
Arctic cisco 1.0 lbs.

h Humpback and broad whitefish recorded only as whitefish on fish tickets.

i Includes undetermined numbers of lease cisco.

Kadleroshilik Mound, a large pingo located near the Kadleroshilik River, 3 miles from the coast of Foggy Island Bay. The 3-mile-square site is one of the largest in the Arctic Coastal Plain, and it has been recommended for designation as a Natural Landmark. This site was described by early explorers and geologists. The pingo is approximately 20 feet above the surface of the tundra with multiple crests that indicate advanced age and degradation of the ice core.

3.5.7. Refuges, Preserves, and Sanctuaries

The only refuge, preserve, or sanctuary in the immediate vicinity of the Warthog project is the Arctic National Wildlife Refuge (ANWR). The Warthog project is located approximately 3.5 miles offshore. The CIDS rig, all ancillary equipment and consumables will be mobilized to the drilling location from Prudhoe Bay/Deadhorse by marine transport during the open water season and will not physically contact ANWR. After winter freeze-up, the CIDS will essentially be self sufficient for drilling operations. Any access to the drilling location will be by helicopter or rolligon. All rolligon travel to the drilling location will avoid traveling onshore in ANWR. Despite allegations to the contrary, there will be no pipeline facilities associated with the Warthog project placed on ANWR.

The CIDS rig will have all onshore support staged from Prudhoe Bay/Deadhorse.

3.5.8. Existing Pipelines/Cables

There are no existing pipelines or cables in the area.

3.5.9. Other Mineral Uses

There are no other existing or anticipated mineral uses in the project area.

3.5.10. Ocean Dumping Activities

Not applicable.

3.6. Flora and Fauna

3.6.1. Pelagic Environment

Plankton: Phytoplankton species are abundant in the region, but are unlikely to occur during winter months between September and April when decreased daylight hours and frozen ice conditions exist. Ice algae are likely to be present, but are not expected to be abundant in the project area (WCC 1981). The MMS/DOI (1996) notes that the contribution of ice algae to annual productivity in the Beaufort Sea is probably relatively small (e.g., one-twentieth of the annual total primary production of nearshore Beaufort). Zooplankton (e.g., copepods) are not

likely to be abundant between September and May when frozen ice conditions exist and food sources are minimal.

Marine Fisheries: The MMS/DOE (1996) notes that 43 marine species have been identified in the Alaskan Beaufort Sea, with the most widespread and abundant species being the Arctic cod (*Boreogadus saida*). Other prevalent species include the saffron cod (*Eleginus gracilis*), fourhorn sculpin (*Myoxocephalus quadricornis*), twohorn sculpin (*Icelus bicornis*), Canadian eelpout (*Lycodes* sp.), capelin (*Mallotus villosus*), and the Arctic flounder (*Liopsetta glacialis*) (Craig 1984 as cited in USDOI/MMS 1996).

Arctic cod is a key species in the ecosystem of the Arctic Ocean due to its widespread distribution, abundance, and importance in the diets of other fishes, marine mammals, and birds (Andriashev 1984; Quast 1974; Bain and Sekerak 1978; Craig et al. 1982; Sekerak 1982; Craig 1984a). It has been calculated to be the most important consumer of secondary production in the Alaskan Beaufort Sea (Frost and Lowry 1983) and may influence the distribution and movements of marine mammals and seabirds (Craig 1984a citing Klumov 1937; Bradstreet 1980; Davis et al. 1980; and Finley and Gibb 1982).

With the exception of capelin, which spawn in August, most marine species spawn primarily during the winter. Craig and Haldorson (1981) suggest that Arctic cod spawn under the ice between November and February in shallow coastal areas, as well as in offshore waters (USDOI/MMS 1990).

Freshwater Fishes: Freshwater fish, which occur in coastal waters of the Alaskan Beaufort Sea, are found almost exclusively in association with fresh waters off of major river deltas. Their presence in the marine environment is generally sporadic and brief, with peaks during and immediately following breakup. Freshwater species, which have been observed in these areas, include Arctic grayling (*Thymallus arcticus*), round whitefish (*Prosopium cylindraceum*), and burbot (*Lota lota*) (USDOI/MMS 1987).

Migratory Fishes: Fish species that move between marine waters and fresh waters as part of their life history (e.g., to spawn) or on a seasonal basis in response to food resources tend to concentrate in the nearshore waters of the Beaufort Sea. Species most commonly found in the region include Arctic char (*Salvelinus alpinus*), Arctic cisco (*Coregonus autumnalis*), least cisco (*Coregonus sardinella*), Bering cisco (*Coregonus laurettae*), rainbow (boreal) smelt (*Osmerus mordax*), and whitefish (*Coregonus nasus* and *C. clupeaformis*). These fish generally spawn in fall, with the exception of boreal smelt, which spawn in spring or early summer. Spawning occurs in river deltas, as well as further upstream in the Sagavanirktok, Canning, Hulahula, Aichilik, Kongakut, and Colville Rivers (USDOI/MMS 1984). The Colville River delta west of the prospect area supports spawning populations of Arctic char, ciscoes, whitefish, and smelt plus small runs of salmon, and is an overwintering area for ciscoes, smelt, and other species (ACS 1983).

In early June, adult and juvenile migratory fish move into and disperse in coastal waters. During the 3 to 4 month open water season, migratory fish use the nearshore environment as a feeding area. Food is abundant in this area, the source being mainly epibenthic invertebrates (mysids and amphipods). Temperature and/or salinity parameters, rather than food, appear to be the limiting factors in migratory fish distributions in the warm nearshore brackish water (Craig and Haldorson 1981; Moulton et al. 1985). Although most migratory fish feed in nearshore waters during the summer, both Arctic and least cisco may continue to feed throughout the winter in Colville River delta habitats (USDOI/MMS 1990).

Within in the nearshore brackish waters, fish tend to concentrate along the mainland shoreline and the edges and lee sides of the Barrier Islands, rather than offshore or in lagoon centers as exemplified in the general coastal distributions of four major Beaufort Sea migratory species illustrated in Figure 3-1. Arctic cisco, which apparently originate from the Canadian Mackenzie River, can range as far west as Point Barrow, Alaska, whereas Arctic char are found east of the Colville River and spawn and overwinter in mountain streams. Migratory least cisco occur from the Colville River west to Wainwright and in rivers on the northern coast of the Yukon and Northwest Territories, but are absent from the central Beaufort Sea (between the Colville River and the Babbage River in Canada). In the Alaskan Beaufort Sea, broad whitefish occur in association with the freshwater discharges of larger rivers from Point Barrow east to the Sagavanirktok River Delta and also have been reported from the Canning River (USDOI/MMS 1990). A more detailed description of Alaskan Beaufort Sea migratory fish can be found in the Sale FEIS (USDOI/MMS 1984, 1990, 1996; Morrow 1980; Craig 1984a; and Moulton et al. 1985).

In summary, during winter months, the offshore marine environment in the project area includes marine species with no current commercial or subsistence value. Arctic cod are the dominant pelagic fish in the region, but earlier surveys show that significant numbers are not present in the project area during the ice-covered months (WCC 1981) as these fish most likely move farther offshore. Marine species that have been associated with the region's benthic environment are unlikely to be present at the well site due to the absence of boulders and cobbles. Fourhorn sculpin are abundant in the area during open water, but move offshore during winter.

Freshwater and migratory fish (e.g., Arctic cisco, broad whitefish, and least cisco) are present in summer, but overwinter in the Colville and Sagavanirktok Rivers and in the Mackenzie River system, and therefore are not likely to be present during winter exploration activities. As with marine species, few of these fish will likely be encountered during the project due to the absence of boulders and cobbles or similar hard-bottom habitats in the project area.

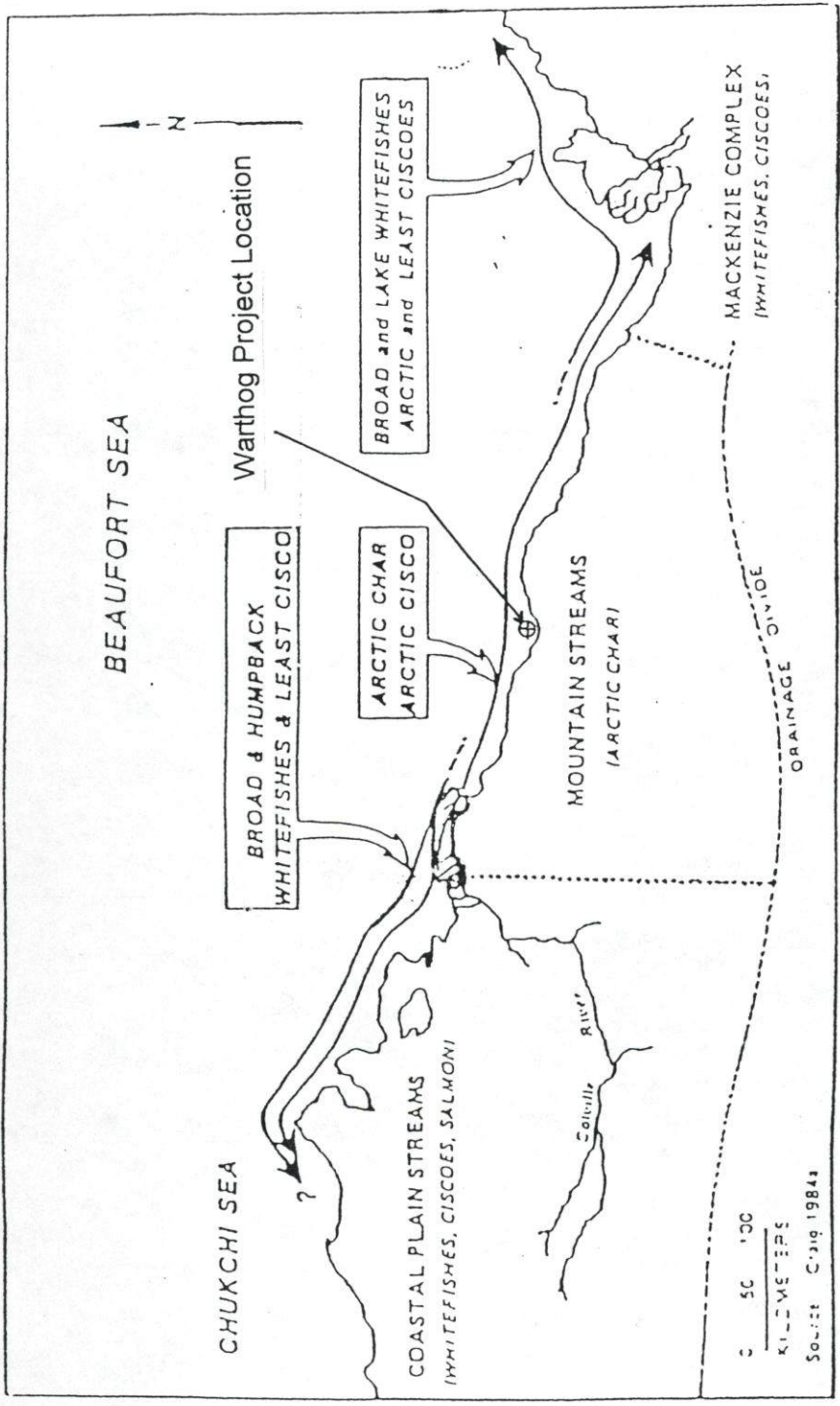


Figure 3-1. Freshwater Sources and Coastal Dispersal Patterns of the Principal Migratory Fishes Occurring along the Beaufort Sea Coastline.

3.6.2. Benthic Environment

Benthic organisms in the project area include sessile species living within the substrate (bivalves, polychaetes) and mobile organisms living on or near the bottom surface sediments (amphipods, isopods, mysids, and some polychaetes). Benthic organisms are abundant during the summer, but can have decreased numbers and diversity in winter months between October and May when frozen ice conditions exist and grounding of ice occurs. Benthic species diversity increases with water depth until the shear zone is reached at about 15 to 25 m; biodiversity then declines due to ice gouging between the landfast ice and the moving polar pack ice (BPXA 1996).

3.6.3. Breeding Habitats and Migration Routes

The Warthog Prospect is located within the migratory path and range of a number of marine mammals, and a variety of marine and freshwater fish and invertebrates. Few of these species, however, are likely to be present during the majority of the exploration program (i.e., the winter exploration activities) and few are likely to be present during the brief summer site surveys. Critical life periods for North Slope mammals, fish, and birds are contained in USDO/I/MMS (1990, 1996) and in the Warthog No. 1 Exploration Well Oil Spill Contingency Plan (see Fairweather E&P 1997d).

Marine Mammals: Species in this group are the pinnipeds (ringed, bearded, and spotted seals and Pacific walrus), the polar bear, and the beluga, bowhead and gray whales. All marine mammals in U.S. waters are protected under the Marine Mammal Protection Act of 1972. Note that endangered bowhead whales are discussed in Section 3.6.5. Endangered and Threatened Species.

Pinnipeds: Ringed seals are the most abundant seal in the Beaufort Sea. Densities of ringed seals in the floating shorefast ice zone, which is just seaward of the prospect area, generally range from 1.5 to 2.4 seals per square nautical mile (Frost et al. 1988). Bearded seals are much more abundant in the Bering and Chukchi Seas than in the Beaufort. Densities of bearded seal are greatest during the summer and lowest in winter. Important winter and spring habitat is the Arctic ice zone, which is shoreward of the prospect area. The spotted seal is a seasonal visitor to the Beaufort Sea.

Most Pacific walrus are associated with the moving pack ice. During the summer, a few walrus migrate through the Beaufort Sea to Canadian waters. Year-round, there are no walrus concentration areas near the prospect area.

Polar Bears: Polar bears (*Ursus maritimus*) are found throughout the Arctic. The Beaufort Sea population (from Point Barrow to Tuktoyaktuk Peninsula) is estimated at 2,000 bears, while the Alaskan population is estimated at 3,000 to 5,000 (USDO/I/MMS 1990). Polar bear distribution exhibits substantial annual variation in the Beaufort Sea. Average density appears

to be about one bear to every 30 to 50 square miles. During the summer in the Alaskan Beaufort Sea area, very few polar bears are found on land; most are found along the edge of the permanent pack ice (Frame 1972; Moore and Quimby 1975; Eley and Lowry 1978). With the advance of the ice sheet in winter, most polar bears are found along the shear zone between the landfast ice and drifting pack ice (Lentfer 1971; Stirling 1974; Moore and Quimby 1975, Eley and Lowry 1978).

Polar bears are most abundant where seals are common in drifting pack ice or shorefast ice in winter, near the pack-ice edge in summer, and along new ice and leads in the fall. Polar bears can be expected to be occasional visitors around the project site during winter exploration activity. Note that Arctic foxes range over large areas in winter and are likely to be present in the project area during operations. If polar bears have recently taken seals in the region, sightings of foxes will likely increase as the foxes will follow bears to scavenge.

Polar bear den locations in the region have been mapped, historically, by the U. S. Fish and Wildlife Service and the National Biological Service and are scattered throughout the Lease 144 Sale Area (USDOI/MMS 1996).

Whales: Three species of whales are seasonal visitors in the Beaufort Sea: the beluga, the bowhead, and the gray whale. Bowhead whales are on the endangered species list and are discussed in Section 3.6.5. Endangered and Threatened Species; gray whales were recently delisted.

Although small numbers of beluga and bowhead whales have been observed migrating along the coast, most migration occurs further offshore (Figure 3-2). The Bering-Chukchi-Beaufort Sea beluga whale population may exceed 25,000 animals. An estimated 11,500 beluga migrate from the Bering Sea to the eastern Beaufort Sea during April and May (BPXA 1996).

Gray whales are uncommon or rare in the Beaufort Sea. They occur more frequently in the Chukchi Sea which compromises part of the feeding area for the species. Gray whales may be present from June through September and into October before migrating south (USDOI/MMS 1996).

Neither beluga, bowhead, or gray whales would typically occur in the area during winter exploration activity. See further discussion of bowhead whales in Section 3.6.5, Endangered and Threatened Species.

Avian Species: Several million birds of approximately 150 species containing seabirds, waterfowl, shorebirds, passerines, and raptors (including the recently delisted Arctic peregrine falcon and the proposed threatened Steller's eider) occur on the North Slope. Nearly all of these species are found in the Arctic seasonally from May through September. Approximately 75 regularly occurring species would be expected to occur in the general project area.

In the Beaufort Sea, concentrations of birds occur nearshore (in waters less than 20 m) and in coastal areas, such as at coastal lagoons and river deltas (Figures 3-3 and 3-4). Except for a seabird colony at Konganevik Point immediately southwest of the Warthog No. 1 site, seabird colonies and waterfowl concentrations have not been reported for the general area (USFWS 1975).

Although an estimated 10 million birds use the Beaufort Sea area for spring migration/pre-nesting, nesting, molting and brood-rearing, and fall staging/migration (Johnson and Herter 1989), few birds are expected to be present during winter exploration activities. Most of the 75 regularly occurring aquatic and terrestrial species are migratory, arriving in late May or early June to breed and departing by Late September. Some oldsquaw and eiders may be present in the project area during freeze-up in late October and November (Johnson and Herter 1989). These migration stragglers occupy open leads during freeze-up and eventually leave the area when full ice coverage occurs. Few birds (e.g., gyrfalcon, snowy owl, and common raven) overwinter in the project area. Of these, only ravens are expected to occur at the exploration site during drilling operations.

The population of Arctic peregrine falcons in Alaska appears to be increasing and has resulted in the falcon being delisted as threatened or endangered. They are present in Alaska from about mid-April to mid-September. Egg laying on the North Slope begins in the middle of May, and the young fledge from about the end of July to mid-August. There are no known active site nests on the Barrier Islands or along the coast. Nest sites closest to the coast occur about 25 miles inland.

3.6.4. Presence of Sensitive Underwater Features

The Boulder Patch is an area in Stefansson Sound with patches of scattered rocks on the sea bottom ranging in size from pebbles to boulders. These cobbles and boulders, discovered in the early 1970s by the U.S. Geological Survey, provide the substrate that supports a highly diverse and productive biota, including Arctic kelp and sessile invertebrates (Reimnitz and Ross 1979). Because of its rarity in a region known for soft sediments, the Boulder Patch was intensively studied as part of the National Oceanic and Atmospheric Administration/Outer Continental Shelf Environmental Assessment Program (NOAA/OCSEAP) in the late 1970s and early 1980s. This significant and unique biological community is located approximately 100 miles west of the proposed site near the Sagavanirktok River Delta (BPXA 1996). Significant

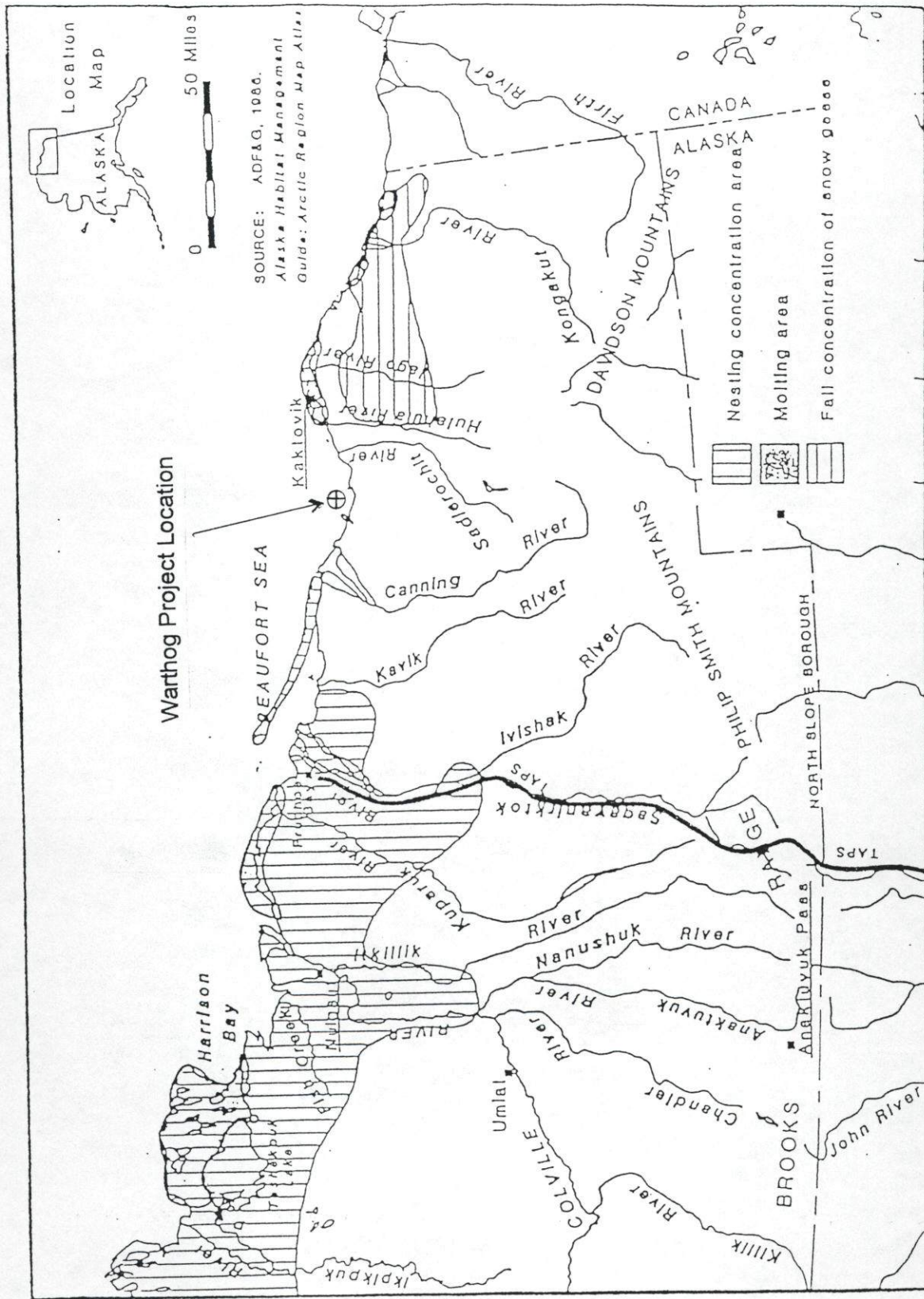


Figure 3-3. Waterfowl Concentration Areas on the North Slope.

environmental information has been collected on the location and distribution of this colony (LGL 1992). Based upon the best available data, no confirmed Boulder Patch type of habitat has been identified at the Warthog drilling location (Reimnitz and Ross 1979).

3.6.5. Endangered or Threatened Species.

The only endangered or threatened species listed for the Beaufort Sea area are the endangered bowhead whale, the threatened spectacled eider, and the proposed threatened Steller's eider. The Arctic peregrine falcon and gray whale were recently delisted. These endangered and threatened species will not be encountered near the project area during the winter exploration activity and are very unlikely to be present in the area during the brief summer site surveys although they do occur year-round or seasonally in the Beaufort Sea Lease Sale 144 area (USDOI/MMS 1996). The Environmental Information Section of the State of Alaska Regional Oil and Hazardous Substance Spill Contingency Plan for the North Slope Region identifies when these species are present in the Beaufort Sea area.

Bowhead Whales: The bowhead whales northward spring migration appears to be timed with ice breakup, usually beginning in April. After passing Barrow from April through mid-June, they move through or near offshore leads in an easterly direction. The USDOI/MMI (1996) notes that east of Point Barrow, the lead systems divide into numerous branches varying in their location and extent from year to year. Bowheads arrive on their summer-feeding grounds in the Canadian Beaufort Sea and Amundsen Gulf and remain there until late August or early September (Moore and Reeves as cited in USDOI/MMS 1996).

In late August, bowheads begin migrating westward from summer feeding grounds located in the Canadian Beaufort Sea to wintering areas in the Bering Sea. Generally, few bowheads are seen in Alaskan waters until the major portion of the fall migration occurs, typically between mid-September and mid-October. The migration route and extent of ice cover may influence the timing or duration of the fall migration. However, based on aerial surveys from 1982 through 1993, the typical water depth over which the greatest number of whales appear to migrate is from 66 to 165 feet (USDOI/MMS 1996). Therefore, during rig mobilization in the latter half of August, bowhead whales would typically be distributed to the east and well offshore of the project site which occurs at approximately 35-foot water depths in Camden Bay.

Spectacled and Steller's Eiders: Both species of eiders may occur in the immediate project area, but are unlikely. Spectacled eiders are present on the arctic slope from May to September; it is estimated a few thousand pairs nest on the Alaskan arctic slope. Nest success for spectacled eiders has been relatively high in the Prudhoe Bay area (e.g., 40 percent), suggesting that the recently observed declines in their numbers is caused by factors operating outside the nesting period. Brood-rearing occurs in tundra-pond habitat. The

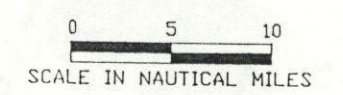
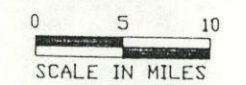
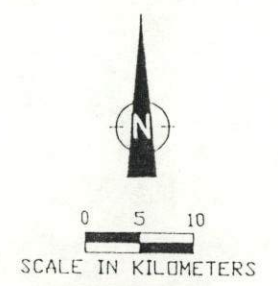
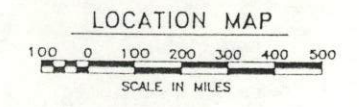
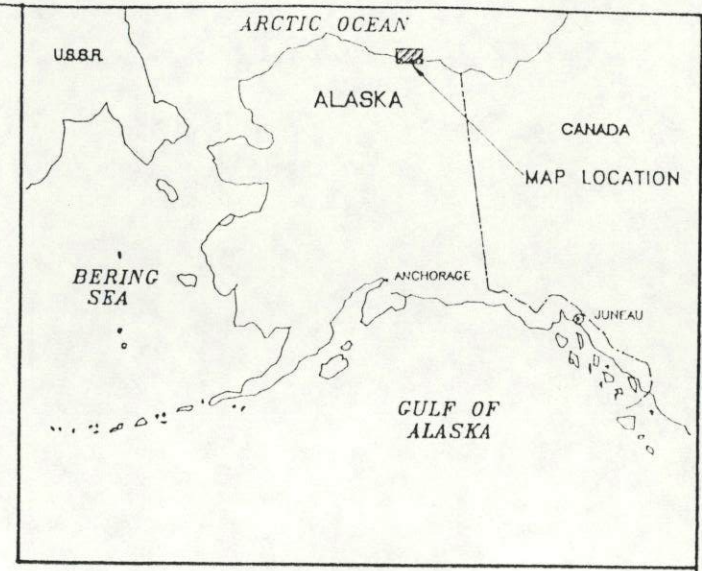
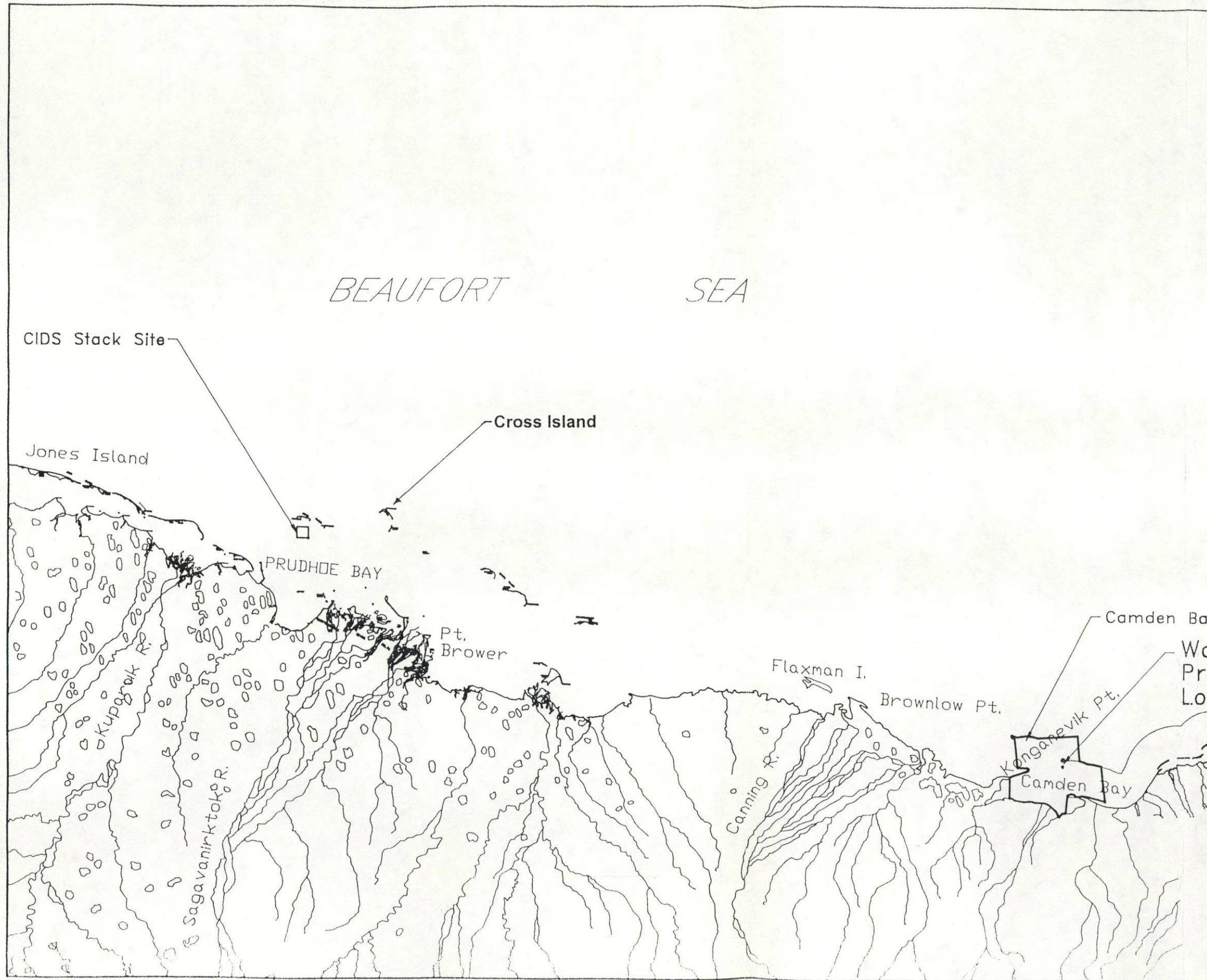
Steller's eiders are coastal migrants along the western Beaufort Sea and the only confirmed nesting area is currently in the vicinity of Barrow (USDOI/MMS 1996). As noted above in Section 3.6.3, some eiders may be present in the project area in late October or November prior to commencement of drilling operations, however, these late migrating birds will be in migration to avoid complete freeze-up.

3.7. Socioeconomics

Land use in the region has traditionally revolved around subsistence resources. Residents of the villages of Nuiqsut and Kaktovik are the primary subsistence users in the project area. The village of Nuiqsut (population 350) is located on the Colville River, more than 100 miles to the west of the Warthog No. 1 Exploratory Well. Kaktovik (population 250) is located 35 miles to the east on Barter Island. Most of the marine subsistence harvest areas for these two villages lie within the Lease Sale 144 area and both villages access the general Warthog project area for this purpose

As noted in USDOI/MMS (1996), in both the villages of Nuiqsut and Kaktovik, bowhead whaling is the most valued activity in the subsistence economy of these communities today. In these villages, bowhead whaling occurs only during the fall season between late August and early October. The exact timing depends on the ice and weather conditions which can cause the season to last longer than 2 months or contract to less than 2 weeks. The Nuiqsut and Kaktovik whalers use aluminum skiffs with outboard motors to hunt bowheads in open water. Generally, they whale within 10 miles of shore, but at times they may travel 20 miles or more offshore. Bowhead whales are commonly harvested off of Cross Island with whalers staging from the island, but the entire coastal area from Nuiqsut east to Flaxman Island and the Canning River Delta may also be used. Any potential interactions with whaling activities on Cross Island are expected to be mitigated by ARCO's plan to have the CIDS rig moved and set down at the Warthog surface location in Camden Bay by the end of August. In the event that weather and ice conditions delay the siting of the CIDS until after September 1, 1997, ARCO will coordinate all vessel movements with subsistence whalers in order to avoid interactions with whaling activities. Although the CIDS rig will be towed past Cross Island en route to Camden Bay, the rig will not be in close proximity to Cross Island and no interference with any staging on Cross Island for whaling activities is anticipated. Figure 3-5 identifies the location of Cross Island to the current stacked rig location and the Warthog surface location in Camden Bay.

General harvest use patterns and subsistence seasonal cycles for the Nuiqsut and Kaktovik communities are described for bowhead whales and other species in USDOI/MMS (1996).



FAIRWEATHER E&P SERVICES, INC. 715 "L" ST., No. 4, Anchorage Ak. 99501 907-258-3446 Fax: 907-258-5557			
ARCO Alaska, Inc.			
FIGURE 3-5 Map of Cross Island in Relation to the CIDS Stack Site and Camden Bay			
DATE: 7/2/97	DRAWN BY: SR	SCALE: AS SHOWN	DRAWING: CAMBAY3
C/SC: 1:18000	PM: J. Mohrbacher	CHECKED: J. Mohrbacher	PROJECT: 008-05-211

As a result of the subsistence lifestyle that occurs in the villages of the nearshore Beaufort Sea, many marine resources besides bowhead whales are utilized by subsistence users. Other regional subsistence activities include fishing, waterfowl and sea duck harvests, and hunting for seals, polar bears, walrus, and beluga whales (the latter two very infrequently). Travel in the region is by small boat in the summer and snowmobile in winter. Residents of both villages have historically used coastal areas near the Barrier Islands for subsistence activity. Onshore subsistence activity has typically occurred near the mouths of river deltas. Hunting for ringed seals and polar bears are the activities most likely to occur near the project area.

The most important migratory fish caught for human subsistence use in nearshore Beaufort Sea waters are Arctic and least cisco and Arctic char. Catch statistics also indicate that broad whitefish are an important and preferred species in subsistence harvest (George and Nageak 1986; Moulton et al. 1986; Craig 1984a, 1984b). Migratory fishes, particularly ciscoes, whitefish, and char are the focal point of the subsistence fishery.

In summer and early fall, bird hunting for waterfowl and coastal birds often occurs as an adjunct to other subsistence activities, such as checking fishing nets.

With the exception of seal and polar bear hunting, subsistence activities by Nuiqsut and Kaktovik villages occur almost entirely during the spring and open water summer months; drilling of the Warthog well will be confined to the winter months after freeze-up. Only a brief summer site survey and movement of the CIDS vessel on-site will occur during open water conditions.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1. General

In general, direct and cumulative impacts on the offshore and onshore environments expected to occur from exploration activity at the Warthog Prospect will be limited. Some local disturbance of bottom sediments and a temporary increase in turbidity during breakup can be expected due to drilling cuttings disposal. In addition, there is an increased potential for certain wildlife encounters, but general effects to the marine and coastal environment are likely to be minimal (USDOI/MMS 1996).

4.2. Geologic Hazards

No H₂S was encountered in previous wells in the project area nor in the nearby Endicott field where the stratigraphy is similar to the prospect location. However, as a safety precaution, an H₂S Plan (Fairweather E&P 1997e) that includes H₂S monitors will be available on-site during drilling operations. All on-site personnel will receive safety training as described in the H₂S Plan.

4.3. Meteorology

4.3.1. Weather

There will be no impacts from the project on weather conditions.

4.3.2. Air Quality

Impact to onshore air quality from the temporary OCS exploratory drilling program at the Warthog Prospect is not expected to exceed the maximum allowable Prevention of Significant Deterioration (PSD) Class II increments. Additionally, criteria pollutant (oxides of nitrogen [No_x], carbon monoxide [CO], particulate matter [PM₁₀], and sulfur dioxide [SO₂], concentrations in the onshore air are not expected to cause an exceedance of the National or State of Alaska ambient air quality standards (AAQS). No significant primary adverse environmental effects should result from air emissions generated by the project. Secondary impacts on induced growth, transportation and construction, and subsistence living are believed to be insignificant, particularly due to the temporary nature of the project. Further discussion of air quality project impacts are contained in the project's Exploration Plan (Fairweather E&P 1997a).

4.4. Physical Oceanography

There will be no impacts from the project on the physical oceanography of the area.

4.5. Other Uses of the Area

4.5.1. Shipping

No impacts are expected since most project activities take place during the winter months when shipping does not occur.

4.5.2. Commercial and Sport Fishing

There will be no impacts from this project on these activities since commercial fishing and sport fishing do not occur in the immediate project area. See Section 4.5.6, Cultural Resources, for a discussion of potential impacts on fishing by subsistence users.

4.5.3. Military Use

There will be no impacts from this project since military use does not occur in the area.

4.5.4. Existing Pipelines and Cables

There will be no impacts from this project since existing pipelines and cables do not occur in the project area.

4.5.5. Mineral Resource Development Other than Oil and Gas

There will be no impacts from this project since other resource development activities do not occur in the project area.

4.5.6. Cultural Resources

During project mobilization (including movement of the CIDS on site) in August 1997 and demobilization activities in August 1998, noise-producing activities will include aircraft traffic, geophysical/seismic surveys (July 1997), and other vessel traffic. However, subsistence use of the Warthog Prospect area is likely to be very low given the distance/direction of the prospect from Nuiqsut and Kaktovik and the current subsistence use focus on Cross Island (BPXA 1996). Because of the August activities, some bowhead and beluga whales could be present farther offshore during August; however, in this area the majority of the fall bowhead whale migration typically occurs after September 1 and is unlikely to occur inside the Barrier

Islands (WCC 1981; BPXA 1996; USDOJ/MMS 1996). Whales will not be present during the winter months when exploration drilling activities will occur.

Other impacts to subsistence users or subsistence resources are likely to be negligible given the project location and time of season for the majority of project activities. Noise-producing activities (drilling, personnel changeouts, and periodic resupply) will occur during winter months. However, to the extent that any impacts to seals and polar bears occur, they are expected to be highly localized with no population-level impacts (USDOJ/MMS 1996).

4.5.7. Mariculture Activities

There will be no impacts from this project since mariculture activities do not occur in the area.

4.6. Flora and Fauna

Impacts to lower trophic-level organisms (phytoplankton, zooplankton, benthic, and epontic communities) and fishes are expected to be negligible to none due to their limited presence during winter months and the brief duration of the summer site surveys. Few fish will likely be encountered in the project area due to the absence of boulders and cobbles or similar hard-bottom habitats and the presence of ice during the majority of planned activities and operations. However, any fish present in the project area may experience temporary, non-lethal effects (i.e., displaced location) as a result of the planned exploration activities (USDOJ/MMS 1996).

Polar bear denning sites have previously been reported in the general area. Prior to initiating any site work at the well location, the surrounding areas will be investigated for signs of polar bear denning or other bear activity. Polar bears are likely to be present during winter operations, but ARCO will have a Polar Bear Interaction Plan and safety training program in place prior to operations to minimize and, in many cases, avoid interaction between bears and humans. Any polar bear encounter will be avoided if at all possible. While field operations are underway, a polar bear monitor person will be on-site and will be responsible for implementation of a Polar Bear Interaction Plan. Any interaction between a polar bear and personnel will be promptly reported to both the Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service.

Arctic foxes are common inhabitants of the project area. Arctic foxes are one of the primary vectors of rabies in northern Alaska. If a person is bitten by a fox, efforts will be made to trap the animal for observation and rabies testing. Encounters with Arctic foxes will, therefore, be avoided if at all possible. A safety training program will also be in place to educate on-site personnel about Arctic foxes and to minimize and avoid interaction between foxes and humans.

4.7. Onshore Impacts

4.7.1. Socioeconomics

The Warthog surface location is located approximately 3.5 miles offshore. The CIDS rig will have all project activities staged from existing infrastructure located in Deadhorse/Prudhoe Bay. Therefore, with the minor exception pertaining to subsistence described under Cultural Resources in Section 4.5.6, there will be no adverse socioeconomic impacts to nearby village communities or landfall areas.

4.7.2. Demand for Goods and Services

All project activities associated with ARCO Warthog No. 1 will be staged from existing infrastructure located in Deadhorse/Prudhoe Bay. Goods and services will be obtained from Deadhorse/Prudhoe Bay during the entire duration of the project. No goods or services are anticipated to be obtained from onshore village communities with the possible exception of local oil spill response teams located in Nuiqsut and Kaktovik.

4.7.3. Environmental Impacts

The Warthog project is located approximately 3.5 miles from the nearest landfall. Direct environmental impacts resulting from mobilization activities include short-term air emissions created by air and marine traffic transiting between Prudhoe Bay/Deadhorse and the project site, and noise related to the vessel traffic. This traffic may temporarily disturb (through displacement) local coastal birds. The limited quantities of short-term air emissions created by vessel traffic should be localized and adequately dispersed by local wind patterns. Therefore, no adverse impacts to marine and coastal areas are expected. Noises related to mobilization will be short-term and localized in nature.

More than 10 years of aerial survey data indicate that migrating bowheads would typically be located to the east and well offshore of the project site during the rig move in late August. Bowhead whales have been observed to react to very loud noises such as seismic noises. However, current research indicates bowheads do not appear to travel more than a few kilometers out of their original swimming direction and that the duration of these changes is temporary. Any noise disturbance that might occur will be brief in duration and limited in area to the immediate vicinity of the CIDS. Observations during both of ARCO's Stinson and Kuvlum projects demonstrated that Bowhead whales will closely approach drilling vessels in a warm stack (idle) condition. For this project, summer mobilization activities are anticipated to be completed by September 1 to mitigate potential impacts to migrating whales.

After mobilization of the CIDS to the Warthog No. 1 surface location, the CIDS will be placed in warm shutdown (idle status) until freeze-up on or about November 1. During this two month period, some low level noise will be generated by the CIDS. These low level noises were documented during similar idle operations in 1988. In summary, the results of this study (Measurements of underwater sounds from concrete island drilling structure located in the Alaskan sector of the Beaufort Sea, Journal of the Acoustical Society of America, 1991) and onsite observations indicate that the CIDS had negligible impacts to the environment and bowhead whale migration. Detailed information on the acoustic characteristics of the CIDS is available in ARCO's application for an Incidental Harassment Authorization (IHA) which has been filed with the National Marine Fisheries Service.

Direct environmental impacts resulting from exploration activity at the Warthog Prospect include short-term air emissions created by exploratory activity, drill cuttings discharges on the ice, and noise related to drilling and limited site survey activities. Short-term air emissions created by exploration drilling should be adequately dispersed by local wind patterns, thereby mitigating any adverse impacts (EPA 1996). Drilling-related noises will be present, but are unlikely to affect the few seals and polar bears that may be present in the project area (USDOI/MMS 1996). ARCO is applying for a Letter of Authorization (LOA) from the U. S. Fish & Wildlife Service (USFWS) for "taking" of polar bears incidental to project activities.

As described in Section 2.2, site-specific bathymetric, side scan sonar, and shallow hazards data would be collected in July 1997. These surveys would consist of 12 days of projected activity. Noise generated from this activity is expected to diminish to below ambient at distances of approximately 2 to 3 miles from the source, and noise will be present for approximately 60 minutes during any 12-hour period of operation. Based on guidance from NMFS, ARCO will meet with representatives from the villages of Kaktovik and Nuiqsut to discuss any potential concerns related to impacts from drilling noise.

Under the terms of the Final NPDES General Permit for Offshore Oil and Gas Operations on the OCS and State Waters of Alaska (Arctic NPDES General Permit No. AKG284200), drill cuttings and drilling fluids will be discharged to sea ice adjacent the CIDS. Material submitted in support of the Arctic NPDES General Permit, including the final Ocean Discharge Criteria Evaluation (ODCE) and the Final Biological Evaluation, are hereby incorporated by reference (EPA 1995a and 1995b).

Some short-term effects resulting from NPDES discharges include disturbance of bottom sediments, an increase in local turbidity, elevated concentrations of some mud constituents (i.e., barium) in the water. However, these effects would only be evident during breakup and would be limited to the initial discharge on the ice surface. The ice in the disposal area will melt in place, limiting deposition of muds and cuttings to a localized area, with only limited impacts to a wider area. Previous studies of the effects of NPDES discharges show no long-

term or significant impacts are expected due to the low toxicity of barium sulfate and no adverse effects on the composition of benthic macroinvertebrate communities (ENSR 1991). In general, projected discharges from all exploration activity in the Beaufort Sea Lease Sale 124 and 144 areas are small compared to the natural sediment load of the Beaufort Sea. EPA has stated that discharges authorized under this General Permit are not likely to adversely affect any endangered or threatened species nor adversely affect their critical habitat (USGS 1981). Under the terms of the General Permit, discharges will not occur "within 1,000 m of the Stefansson Sound Boulder Patch (near the mouth of the Sagavanirktok River) or between individual units of the Patch where the separation between units is greater than 2,000 m but less than 5,000 m." Under the terms of the General Permit, discharges during stable ice conditions "shall be to above-ice locations and shall avoid to the maximum extent possible areas of sea ice cracking or major stress fracturing." Environmental monitoring may be conducted to comply with the terms of the General Permit.

The CIDS rig will have materials and consumables required for both ARCO Warthog No. 1 well and a sidetrack well put aboard during the initial rig mobilization phase of the program. Unless well operations extend much longer than anticipated, fuel resupply should not be required. If specific items of large equipment have to be replaced, or specialized downhole tools which were not anticipated in the original well proposal are brought to the rig, or if fuel resupply becomes necessary, these items will be transported by rolligon on an as needed basis. Overland travel time from Deadhorse to the ARCO Warthog well site (no ice road) is expected to be approximately twelve (12) hours. Rolligons are currently based in Deadhorse, as are operators and support personnel. No additional personnel or facilities are required for the Warthog project, and no ice road connecting the Warthog location and Deadhorse will be constructed.

Aircraft travel will be controlled by FAA-approved flight paths. Aircraft will avoid Native land areas and will comply with flight restrictions imposed by the Beaufort Lease Sale 124 and 144 stipulations regarding sensitive biological areas (USDOI/MMS 1990, 1996).

In addition, specific lease stipulations addressing Protection of Biological Resources, an Orientation Program, Transportation of Hydrocarbons, Industry Site-Specific Bowhead Whale Monitoring program, and Subsistence Whaling and Other Subsistence Activities will be followed to prevent and mitigate environmental impacts (USDOI/MMS 1996).

No significant cumulative impacts are expected from exploration activity at the Warthog No. 1 exploratory well. Any cumulative impacts that could result from development of the Warthog Prospect will be addressed as part of the NEPA review for that project.

As indicated previously, monitoring will also be implemented to mitigate environmental impacts. Air monitoring and any required NPDES monitoring plans will be developed and submitted as

part of the notification process for these permits. A Polar Bear Interaction Plan that includes self monitoring will be submitted to the U.S. Fish and Wildlife Service.

As described in this section, onshore impacts to adjacent landfall areas such as the Arctic National Wildlife Refuge will be negligible from the ARCO Warthog No. 1 operations. The Warthog project is located approximately 3.5 miles offshore and will require no access or use of onshore areas. The CIDS rig, all ancillary equipment and consumables will be mobilized to the drilling location from Prudhoe Bay/Deadhorse by marine transport during the open water season and will not physically contact ANWR. The rig will then be placed in warm shutdown (idle) status to minimize project open water activities and await winter freeze-up. After winter freeze-up, the CIDS will be self sufficient for drilling operations. Any travel to the drilling location will be by helicopter or rolligon and all rolligon travel to the drilling location will avoid traveling onshore in ANWR. The numerous mitigation measures, described herein, imposed by regulatory agencies and/or proposed by ARCO are anticipated to minimize adverse socioeconomic and environmental impacts.

4.8. Accidents

Adverse environmental impacts that could occur as a result of exploration activity at this site include an oil spill. However, the probability of a spill from winter exploration activity is very low and advanced well control equipment and procedures will be used for the Warthog No. 1 well. An Oil Spill Contingency Plan (OSCP) has been prepared for this project and submitted as a stand-alone exhibit (Fairweather E&P 1997d) to the project's Exploration Plan (Fairweather E&P 1997a). Section 2.3 of the OSCP, Potential Discharges, contains a detailed analysis of the potential and probability of a major spill event. ARCO will also use best management practices to reduce potential impacts from all spills.

5.0 ALTERNATIVES TO THE PROPOSED ACTION

Per the MMS guidelines, discussion of alternatives is not required in Environmental Reports for plans of exploration.

6.0 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

No additional unavoidable adverse environmental effects have been identified beyond those described in Section 4.0 of this Environmental Report.

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