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AUG 17 1981

CONSERVATION DIVISION
U.S. GEOLOGICAL SURVEY
ANCHORAGE, ALASKA

EXPLORATION PLAN
BEAUFORT SEA AREA
TERN PROSPECT
ALASKA

OCS-Y-0195, OCS-Y-0196, OCS-Y-0197

SHELL OIL COMPANY
OPERATOR FOR SHELL, ARCO & MURPHY

AUGUST 1981

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ACCOMPANYING MATERIAL

TERN PROSPECT
EXPLORATION PLAN
SHELL-ARCO AND MURPHY
OCS-Y-0195, OCS-Y-0196, OCS-Y-0197
LEASE TRACT NOS. BF-41, BF-42, AND BF-43
BEAUFORT SEA AREA
ALASKA

Introduction

Shell Oil Company, as operator of a proposed unit located in the Beaufort Sea, to be formed for the purpose of exploring for hydrocarbon accumulations (Enclosure 1), hereby submits for approval our Exploration Plan to 1) build a gravel island drillsite, Tern "A", on Lease OCS-Y-0196, and 2) drill up to five exploratory wells from the island to explore and delineate the prospect. The environmental report as required by 30 CFR 250.34-3 is submitted with this exploration plan.

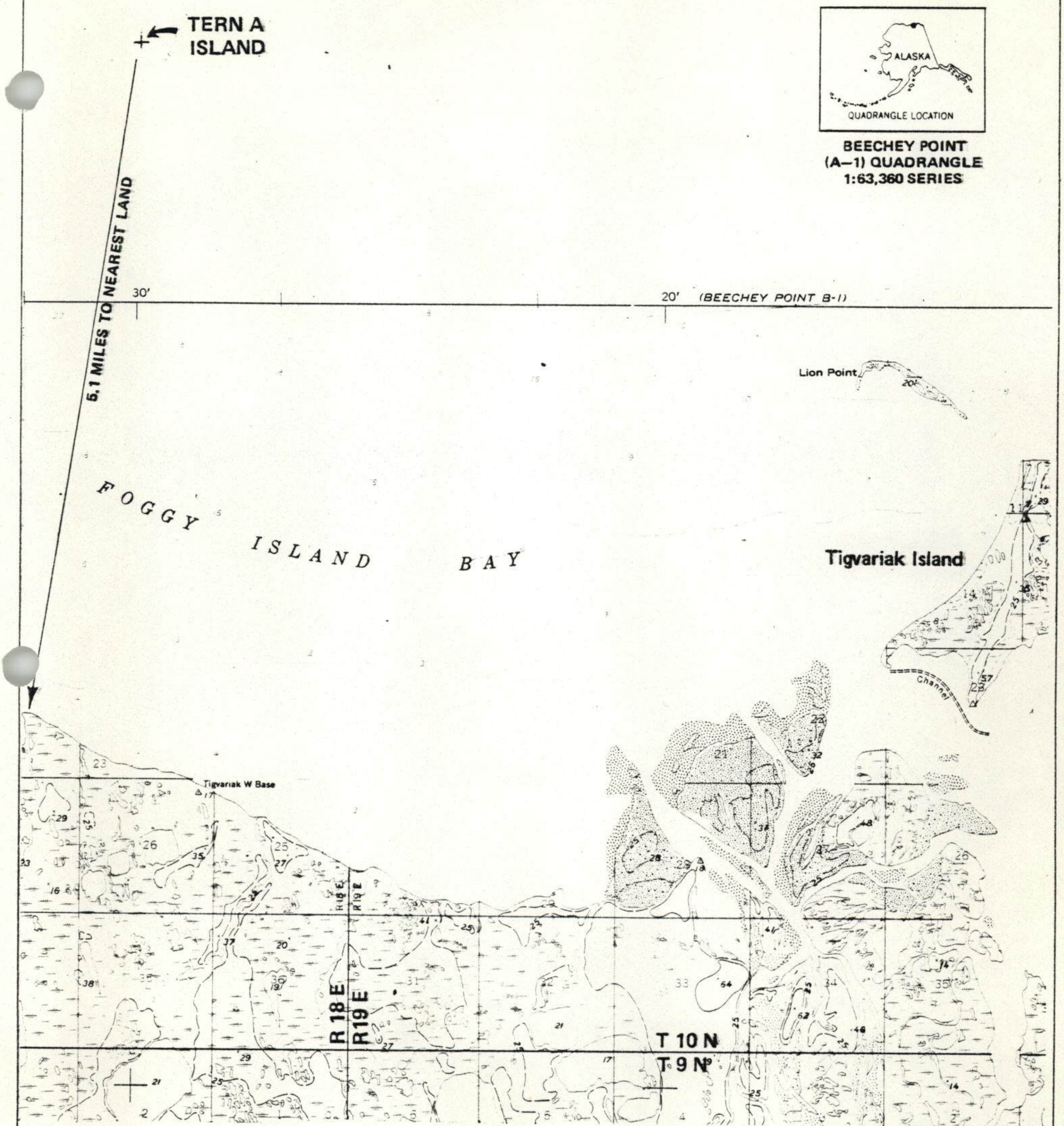
Gravel Island Location

1,800' FWL and 5,700' FSL of OSC-Y-0196 (Tract BF-42)

Alaska State Zone 3 Coordinates x = 315,209'.
y = 5,954,030'.
Lat = 70°16'45.9853"N.
Long = 147°29'42.8288"W.
UTM zone 6 coordinates x = 1,579,226'.
y = 25,580,453'.

Proprietary Data

Appendix 1, "Private and Confidential, Shell Oil Company, To Accompany Tern Exploration Plan Submitted To USGS For Their Exclusive Use" is enclosed as private and confidential data for use only by the USGS. Contents include a the proposed unit, (Enclosure 2) a structure map showing the prospect area, bathymetry, a cross section showing the initial well location and anticipated

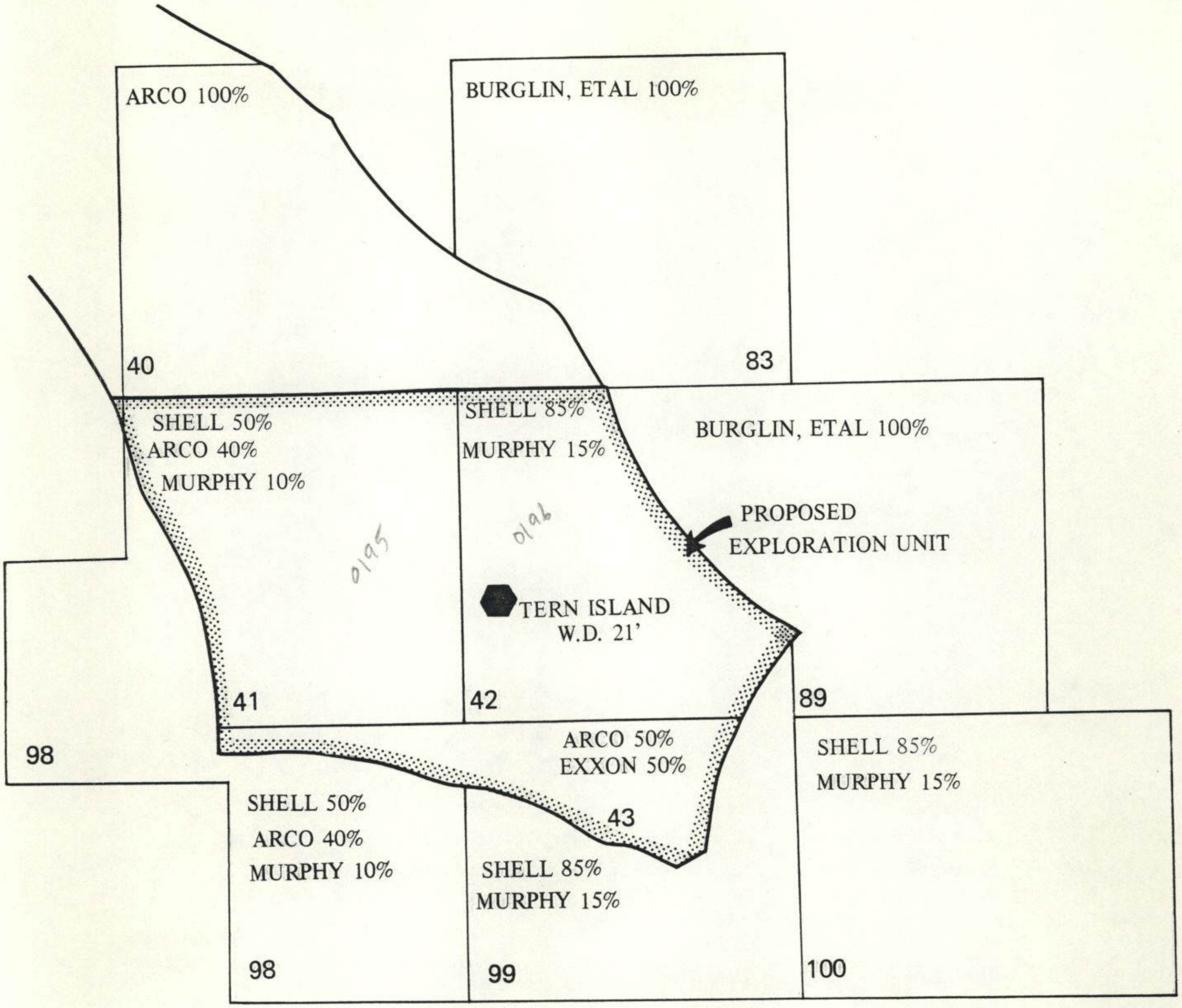


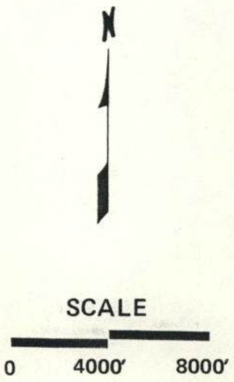
SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	PRODUCTION DEPARTMENT

LOCATION MAP
PROPOSED TERN EXPLORATION UNIT

Report: EXPLORATION PLAN
Province/Field: BEAUFORT SEA
State:
County:
Figure:
Author: C.F.M
Date:
File: 2Z01762–00

ENCLOSURE 1





SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	EXPLORATION DEPARTMENT

PROPOSED TERN EXPLORATION UNIT
BEAUFORT SEA OFFSHORE
NORTH ALASKA
PUBLIC INFORMATION

Report: EXPLORATION PLAN

Province/Field:
State: ALASKA

County:
Encl.: 2

Author: ROBERT SMITH
Date:
File: 1Z00334

stratigraphy and an interpreted seismic section. A copy of our complete tentative graphic prognosis is also included in this assemblage of proprietary data. This information is for the sole use of the USGS but portions of it will be required on a P&C basis by the Oil and Gas Conservation Commission for consistency certification.

Appendix 2 entitled "Private and Confidential, Shell Oil Company, Tern Island Design Documentation and Verification Plan, Submitted To USGS For Their Exclusive Use" is also Shell's proprietary information. This appendix includes material required by OCS Order No. 8. The design documentation includes design drawings, material specifications and other required data.

The design verification process for Tern "A" has been initiated with appointment of Woodward-Clyde Consultants (WCC) to serve as the Certified Verification Agent. Copies of the design documentation were transmitted to WCC on June 8, 1981, and they have begun their review of this information. To contact WCC during the verification process, please do so as follows:

Woodward-Clyde Consultants
ATTN: Mr. U. Luscher
Vice President
Three Embarcadero Center, Suite 700
San Francisco, CA 94111
Phone: 415-956-7070

Prior to the initiation of the verification, Shell and WCC agreed in principle to the fundamental elements of the verification which can be generally stated as 1) to review site investigation data as it is relevant to the stability of the island, 2) to review fundamental assumptions made in connection with environmental force parameters and material properties selection, 3) to review methodology as it is applied in developing environmental forces or computing island stability, and 4) to make spot checks of computations where necessary or appropriate. Meetings between Shell and WCC engineers will be held as necessary to discuss relevant point of the design.

With regard to timing, it is our intention to complete the design verification by early-August 1981 at which time WCC should be able to provide the necessary statements of certification to the U.S. Geological Survey.

OCS Order #8 also requires verification of the fabrication and installation of offshore structures and calls for a plan in each case. For gravel island construction using proved techniques, fabrication and installation comprise one activity and the fabrication and installation plan will be submitted after completion of the design verification.

Description & Schedule of Proposed Activity

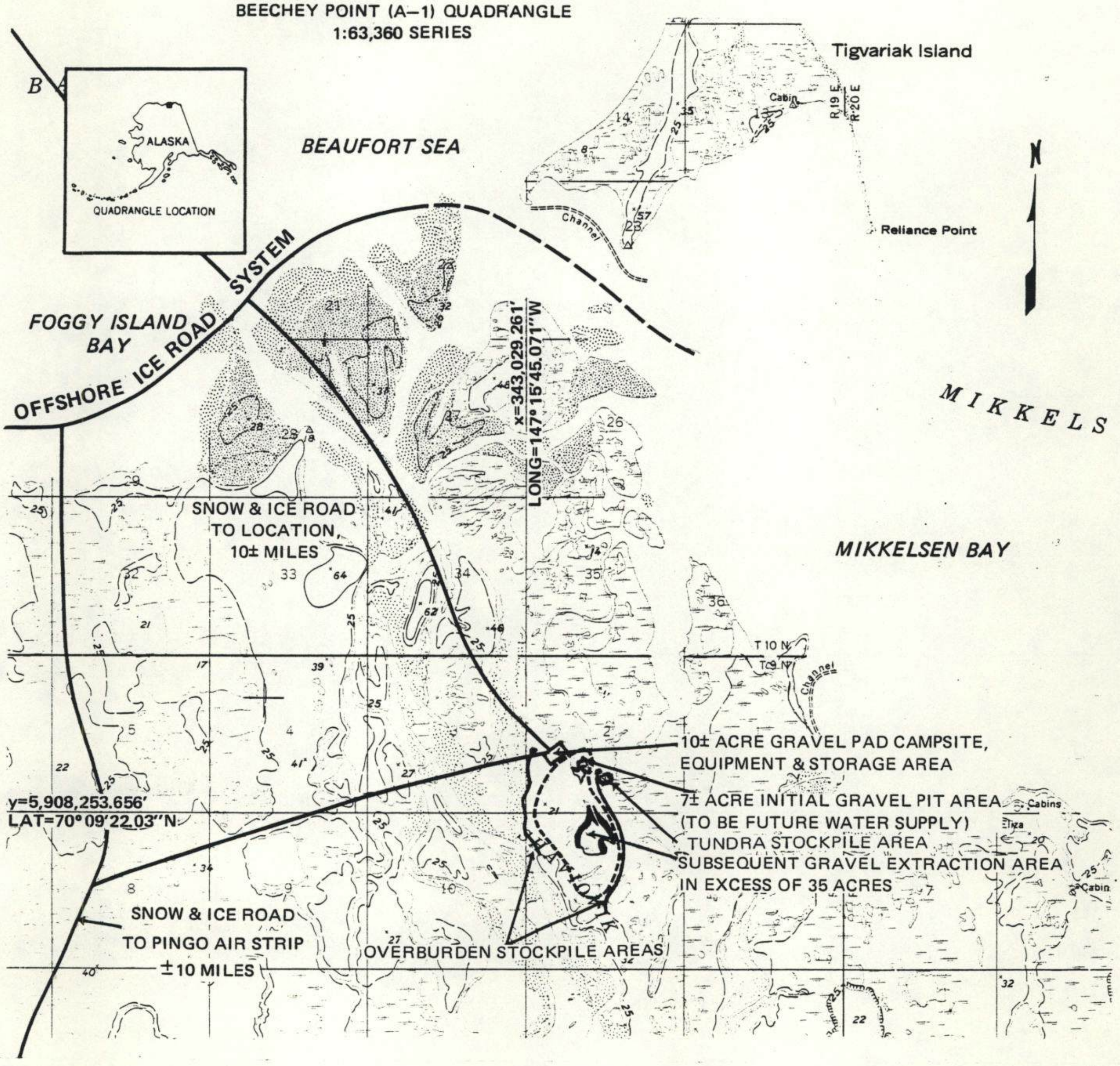
We propose to build a gravel island with a surface working diameter of approximately 400 feet, in about 6.5 meters (21.5 feet) water depth. It is our plan to obtain gravel at a proposed gravel site onshore for which an application has been made. Upon approval of our application to build a gravel island and to open an onshore gravel pit, which is anticipated by fall, 1981, we plan to build an onshore ice road to a suitable shore site and then on the ice to the proposed island site. Gravel will be transported to the island site during the 1981-82 ice season, (Enclosure 3). Upon completion of the island, the Brinkerhoff Drilling Company, Inc., Rig 84 will be transported to the island and rigged up with drilling operations to commence during February or March 1982, if possible. Lease Stipulation No. 8 requires cessation of downhole activities on March 31 and this stipulation will expire August 1, 1982, two years after lease issuance. When the stipulation expires, if proper permits are obtained, we plan to complete drilling and evaluation of the initial test, estimated to require a total of 100 days. Drilling of subsequent tests would be contingent upon the results and information obtained in the initial test. We expect to drill and test, subject to obtaining permits, on a year-round basis after Lease Stipulation No. 8 expires on August 1, 1982, until the proposed project has been completed or information has been obtained that warrants discontinuing the program.

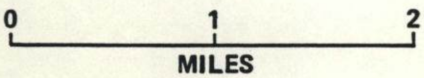
Exploration Depth

Estimated maximum total depth is 13,000 feet subsea for the first test and we request approval of that depth for all wells in our Exploration Plan. Unless deeper hydrocarbon accumulations are encountered in the first one or two tests, we anticipate subsequent tests will be drilled to a subsea depth of approximately 11,500 feet.

Island Description

As indicated, we contemplate construction of a gravel island using proved





SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	PRODUCTION DEPARTMENT

TENTATIVE ROAD SYSTEM
PROPOSED TERN EXPLORATION UNIT

Report: EXPLORATION PLAN
Province/Field: BEAUFORT SEA
State: ALASKA
County:
Figure:
Author: C.F.M
Date:
File: 2Z01729–00

ENCLOSURE

techniques in water depth of 6.5 meters (21.5 feet) with a surface diameter of approximately 122 meters (400 feet), (Enclosure 4). Planned freeboard is 4.6 meters (15 feet), (Enclosure 5). In addition, a 2.1 meter (7 feet) sandbag berm will be placed on the island perimeter and sandbags will be continued down the 1:3 island slope to the ocean bottom for protection of the island. Filter fabric will be placed between the gravel and the sandbags to afford additional protection of the structure. The island diameter at sea level will be about 149.4. meters (490 feet). The island base on the sea floor will be about 188.7 meters (619 feet) in diameter. We estimate construction of the gravel island structure will require about 267,600 m3 (350,000 yds3) of gravel. A typical rig layout on the gravel island is included (Enclosure 6).

Storm & Tide Surge

Our data indicates that a total storm and tide surge of about 1.0 meter (3.4 feet) can reasonably be expected with a return frequency of about 10 years. A conservative estimate of the 100 year storm and tide surge is 3 meters (9.8 feet). This is well below our planned island freeboard of 4.6 meters (15 feet). The planned protection of the outer perimeter of the island by armoring with sandbags will be adequate to withstand these forces.

Transportation

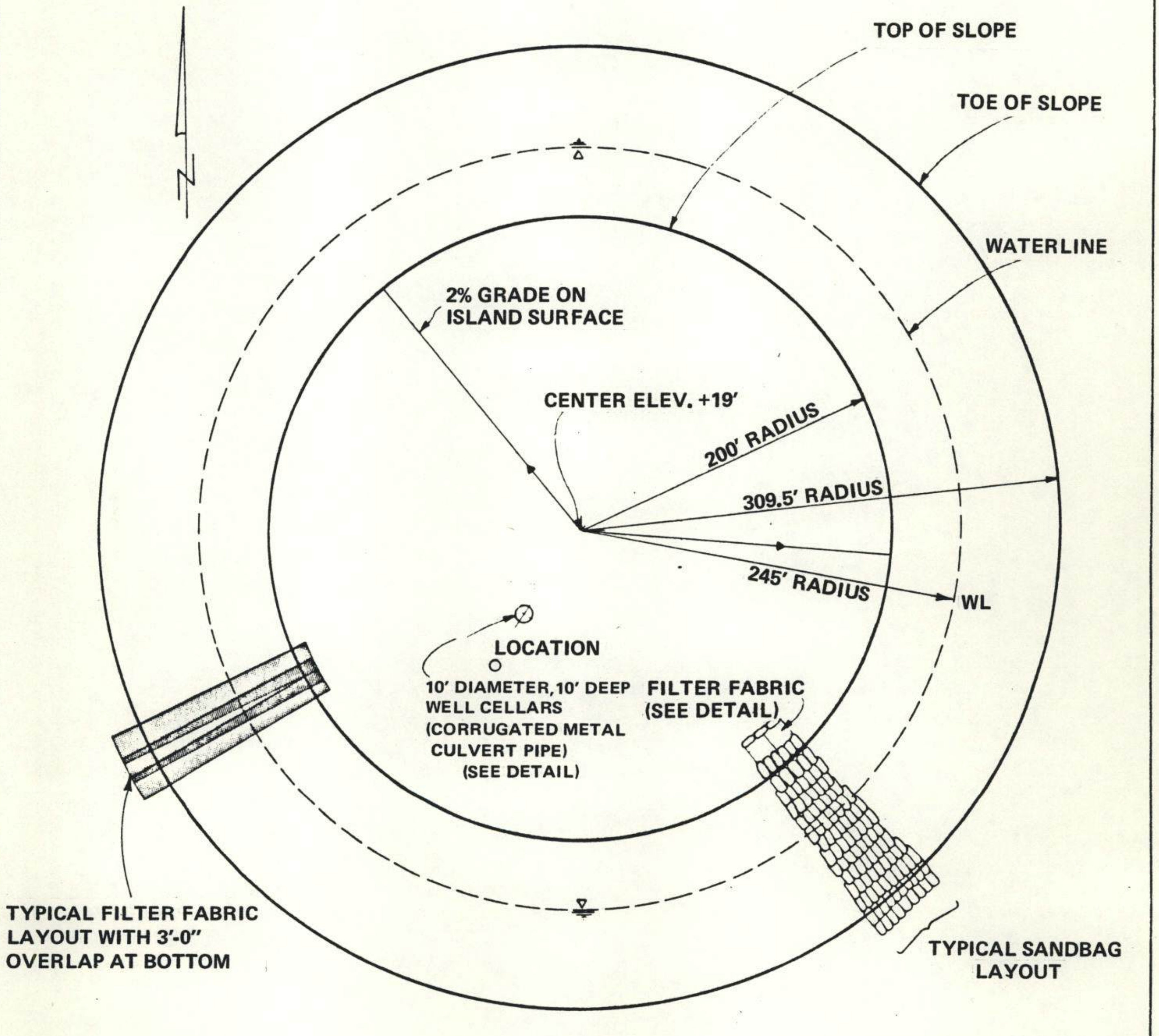
Access to the drillsite will be from facilities at Deadhorse and Prudhoe Bay to the gravel island by helicopter and/or hovercraft year-round, by ice roads during the winter and by water during the open-water season.

Supplies

We expect to supply equipment and materials for the proposed drilling operations from the existing dock and supply areas at Deadhorse and Prudhoe Bay.

Personnel

Staff and rig employees are expected to work 7- or 14-day shifts with some 20 drilling contractor employees including supervisory personnel on location at any given time. We expect to have two or three Shell supervisory personnel on location at all times. The number of service company and other contract person-



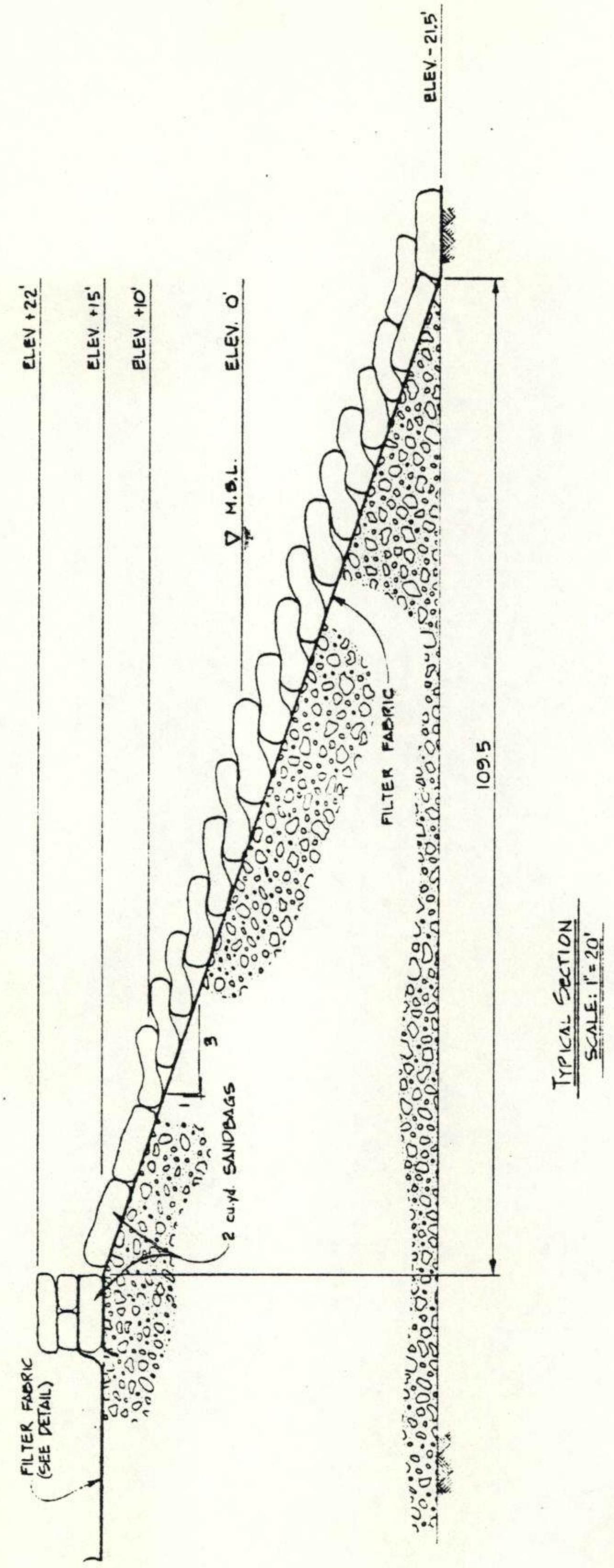
PLAN
SCALE: 1″ = 100′

SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	PRODUCTION DEPARTMENT

TYPICAL ISLAND PLAN
PROPOSED TERN
EXPLORATION UNIT

Report: EXPLORATION PLAN
Province/Field: BEAUFORT SEA — State: ALASKA
County: — Figure:
Author: JRR — Date: — File: 2Z01769–00

ENCLOSURE 4



TYPICAL SECTION
SCALE: 1" = 20'

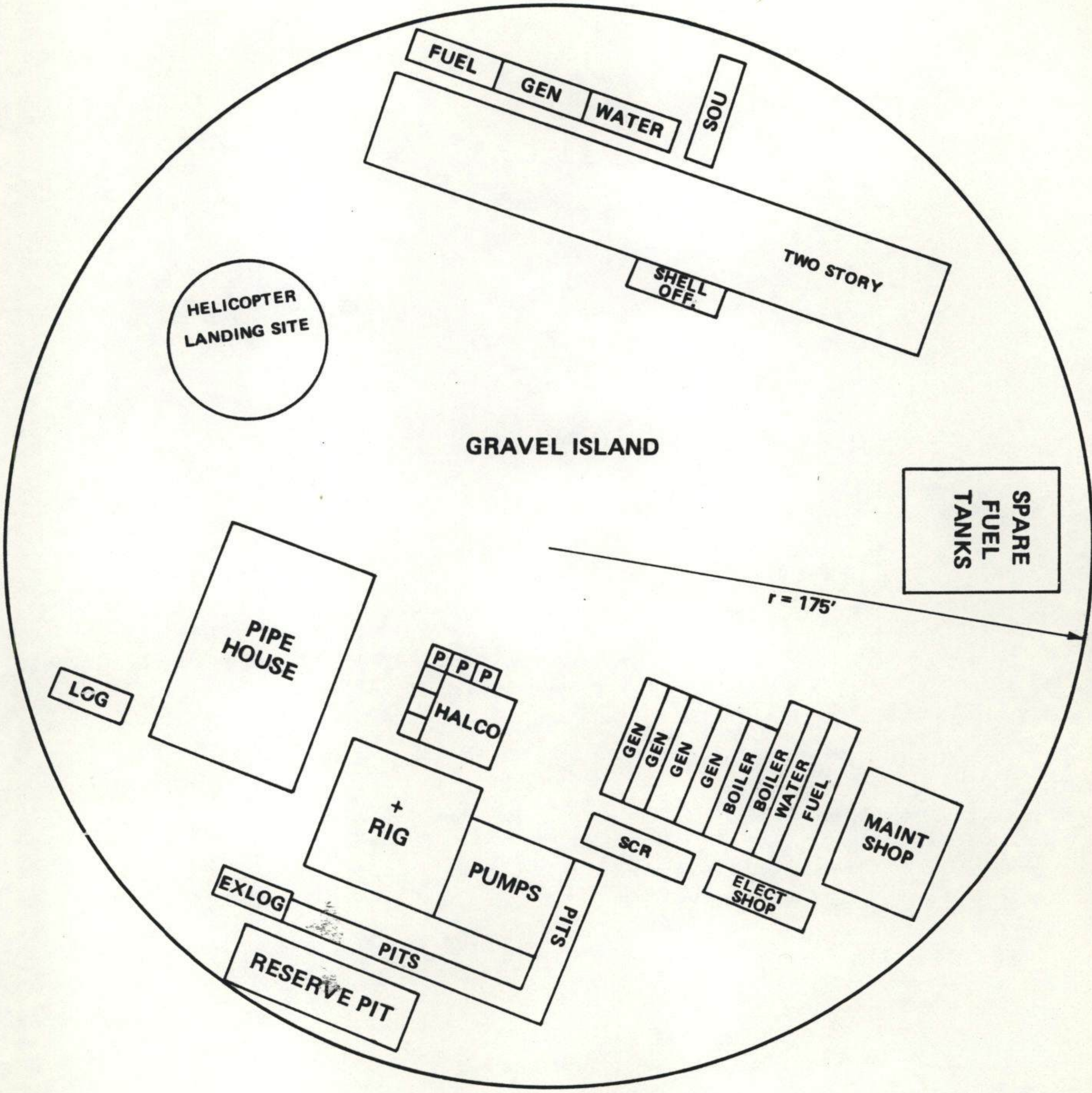
SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	PRODUCTION DEPARTMENT

TYPICAL ISLAND SECTION

PROPOSED TERN EXPLORATION UNIT

Report: EXPLORATION PLAN			
Province/Field: BEAUFORT SEA		State: ALASKA	
County:		Figure:	
Author: JRR	Date:	File: 2Z01761—00	

ENCLOSURE 5



SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	PRODUCTION DEPARTMENT

TYPICAL RIG LAYOUT
PROPOSED TERN EXPLORATION UNIT

1" = 50'

Report: EXPLORATION PLAN

Province/Field: BEAUFORT SEA

State: ALASKA

County:

Figure:

Author: KWB

Date:

File: 2Z01760–00

ENCLOSURE 6

nel on the island will vary depending upon activity and is expected to range from 5 to 30 persons. Living quarters will be a portable camp located on the gravel island.

Rig Description, Critical Operations Curtailment Plan & Drilling Prognosis

We plan to utilize Brinkerhoff Drilling Company's Rig 84 which has been active on the North Slope. The rig was used to drill the Shell-Texaco-Murphy-West Mikkelsen Unit No. 3 on the North Slope. Thus it has been operational under the adverse winter conditions encountered in the area. A rig description is included herewith in Appendix 3. This appendix also includes our Critical Operations Curtailment Plan and a public information copy of our drilling prognosis.

Development/Production Discussion

We estimate that, as a maximum, a successful exploration program could result in a development/production program requiring two production islands with up to 90 wells and a production peak on the order of 30,000 barrels of oil per day. While the foregoing represents the maximum case anticipated, a discovery of this magnitude is statistically improbable.

Oil Spill and Hydrogen Sulfide Contengency Plan

Our Oil Spill Contingency Plan, as required in OCS Order No. 7, is attached as Appendix 4. As indicated, we provide our own facilities for containment and cleanup of smaller spills. However, Shell Oil Company is a member of the Alaska Beaufort Sea Oilspill Response Body (ABSORB) with full access, as warranted, to ABSORB facilities and management personnel. By reference the ABSORB Oilspill Contingency Plan is made a part of our contingency plan. Further, for identification of protection and clean up priorities of the coastal area, the Alaskan Beaufort Sea Coastal Sensitivity Analysis, to be finalized before the end of 1981 is also made by reference a part of our plan. In addition and if warranted, other operators in the area would make facilities available for our use in emergency situations. Our Hydrogen Sulfide Contingency Plan is also attached as part of Appendix 4. Continuous monitoring equipment capable of detecting concentrations of five parts per million will be utilized. If concentrations exceed 10 ppm, protection and/or corrective measures will be undertaken.

Hazardous Materials

All hazardous material spills will be reported and cleaned up.

TABLE A

ESTIMATED QUANTITIES OF WASTE MATERIALS PER WELL FOR TERN AREA EXPLORATION

WASTE	QUANTITIES		
	Per Day	Per Well	Disposal
Drilling Mud	15 Bbl. (1)	2500 Bbl. (2)(3)	Discharge into Beaufort Sea in accord with NPDES Permit to be obtained. If oil contaminated inject into subsurface disposal zone or transport to approved onshore disposal site.
Cuttings	25 Bbl. (1)	2500 Bbl. (3)	Discharge into Beaufort Sea in accord with NPDES Permit to be obtained. Remove any oil contamination prior to discharge or transport to an approved onshore disposal site.
Sewage and Gray water -	4,000 Ga. (4)	400,000 Gal.(1)	Use in drilling mud and for rig wash down. Discharge excess into Beaufort Sea in accord with NPDES Permit to be obtained.
Trash - Combustible materials - wood boxes, paper, kitchen wastes, etc.	1,000 lb.(5)	100,000 lb.(1)	Incinerate at site.
Junk - Noncombustible items, such as oil drums, junk, tires, batteries, etc.	500-1,000lb.	50,000-100,000(1)	Transport to an approved onshore disposal site.

(1) Based on 100 day drilling operation.

(2) Includes approximately 1000 Bbl. of mud to be discharged or injected if oil contaminated upon completion of the last of up to 5 exploratory wells projected from Tern "A" Island.

(3) Estimated maximum well depth 13000 feet subsea.

(4) Approximately 30 gal/day sewage and 30 gal/day gray water for average 60-70 persons.

(5) AP-42-Solid Waste Disposal-10 lb/trash/day/person plus drilling rig operation wastes.

Disposal of Waste and Test Oil and Natural Gas

Waste and test oil will be disposed of in an approved manner--by burning through a burner or incinerator, containerized and transported to an onshore site or pumped down the 13 3/8 to 9 5/8-inch casing annulus or other method as specified. Any gas produced during testing will be burned by means of a flare.

Solid and Liquid Waste Disposal

Drill cuttings, drilling muds and wastewater will be discharged as approved in the required NPDES permit. Lease Stipulation No. 6, 2. provides that the discharge of mud and cuttings into marine waters is prohibited except that the Supervisor may approve discharge (b) in tracts of less than 10 meters of water on a case-by-case basis if effluents are shown to be nontoxic and can be adequately dispersed. Permission is also requested for permission to pump oil contaminated mud and waste water, lube oil and other liquids down the 13 3/8-9 5/8-inch casing annulus and/or down the last casing string below the 13 3/8-inch casing as warranted. Table A lists our estimate of the quantities and planned disposition of the waste materials resulting from the proposed exploration. All putrescible wastes and sewage sludge will be incinerated in an approved unit. Wood, paper, and cardboard will be open-burned in a manner that will not emit black smoke. Tin cans will be incinerated before disposal and incinerator residue backhauled to an approved site. Nonburnable items (steel drums, rubber, metals, batteries, etc.) will also be backhauled to an approved site.

Air Emissions

Our estimates of air emissions from the island drilling operations, onshore support and transportation equipment are detailed on Table B in accordance with the requirements of 30 CFR part 250.57-1(a). As prescribed in Paragraph (d) we have calculated the exemption levels "E" for each air pollutant based on a distance of 5.1 statute miles to the nearest onshore area. Based on these formulas, the exemption level "E" for CO is 10,074 TPY, while the exemption levels for TSP, SO_X, NO_X, and VOC are 170 TPY. From Table B, it can be calculated that total emissions of the pollutants CO, SO_X, NO_X, TSP & VOC would be 40.9, 36.9, 107.3, 23.4 and 7.3 tons per year and the facility is exempt from further air quality review.

TABLE B
PROJECTED AIR EMISSION
TERN PROSPECT - ALSKA

SOURCE	SOX		TSP		NOX		VOC		CO	
	lb/D	T/W	lb/D	T/W	lb/D	T/W	lb/D	T/W	lb/D	T/W
1. Camp at Location Power Generation 1 Model 3408 Cat Eng. 400 Continuous HP 550 gpd	19.7(2)	1.0(2)	21.2(2)	1.1(2)	99.5(1)	5.0(1)	5.3(1)	0.3 (1)	31.7(1)	1.6(1)
2. Drilling Rig Power Generation 3 Model 398 Cat Eng. 600 Continuous HP ea. 2250 gpd	88.7(2)	4.4(2)	95.2(2)	4.8(2)	381.0(1)	19.0(1)	23.8(1)	1.2(1)	142.9(1)	7.1(1)
Steam Boilers (3) 2-150 hp McWilliams Davis 2000 gpd	56.8	2.8	4.0	0.2	44.0	2.2	2.0	0.1	10.0	0.5
Hot Air Heaters (3) 2-Tioga Heaters 4.2 MMBTU-1000gpd	28.4	1.4	2.0	0.1	22.0	1.1	1.0	0.1	5.0	0.2
Incinerators (3) 1-8'X 15' 1 SDU Type Neptune Micro Floc PC Chemical Waste Plt 200 gpd	5.7	0.3	0.4	0.02	4.4	0.2	0.2	0.01	0.5	0.02
1. Model 966 Cat Loader (2) 1 400 amp Welder)	2.0	0.1	2.2	0.1	31.2	1.5	2.5	0.1	6.8	0.3
2 4X4 Crew Cab Truck) (4)	0.1	0.1	0.2	0.1	5.7	0.3	4.4	0.2	27.0	1.4
TOTAL	201.4	10.1	125.2	6.4	587.8	29.3	39.2	2.0	223.9	11.2

06/29/81
(Continued)
TABLE B

(1) Based on emission factors provided by Caterpillar Engine Company for these particular diesel engines.

(2) Based on emission factors from EPA AP-42 Table 3.3 3.1 Diesel Powered Industrial Engines.

(3) Based on emission factors from EPA AP-42 Table 1.3-1 Industrial & Commercial Boilers (0.2% S by wt)

(4) Based on emission factors from EPA AP-42 Table 3.1 1-1 Average Emission Factors for Highway Vehicles corrected.

Consistency Certification

The activities proposed in this Exploration Plan are consistent with Alaska's Coastal Management Program and will be conducted in a manner consistent with the Program. Consistency will again be certified in our application for a Corps of Engineers permit and in our application for an NPDES Permit.

Drilling Mud Components

As required by OCS Order No. 7 for a drilling permit, Table C is a list of the common names of the drilling mud components that we plan to use and also includes results of toxicity testing on similar types of muds. Specifically we plan to utilize a dispersed/fresh water, chrome-free lignosulfonate mud using bentonite for gel and barium sulfate as weighting material. References for Table C are contained in Appendix 5. Given current velocities of two to five cm/sec together with experience elsewhere which indicates dispersion to background values at about 200 meters from discharge, background values should be attained in about 1.1 to 2.8 hours. During times of ice cover with low phytoplankton production, the impacts of this mud discharge are expected to be negligible. Because Beaufort Sea currents are essentially wind-driven during open-water season, dispersion should occur during a shorter time span again resulting in a negligible adverse impact on the environment.

Water Supply

Potable water will be obtained from approved land sources in Deadhorse, deep fresh water lakes in the area or possible desalinization (which will require an NPDES Permit for discharged salt water) and/or snow melters and treated to meet Alaska Drinking Water Standards.

Mud Logging Unit

A mud logging unit will be used on all exploratory wells drilled in the proposed exploration plan. In addition to monitoring the drilling mud, drilling parameters and drill cuttings, the unit incorporates hydrocarbon and H_2S detection equipment and alarm systems for which the sensitivity can be preselected in addition to the regular monitoring system. A description of the mud logging unit is included as Appendix 6.

TABLE C
BEAUFORT SEA AREA, ALASKA
DRILLING MUD COMPONENTS
TERN EXPLORATION (5 WELLS)

MATERIAL

Bentonite (Gel)

Barite (Barium sulfate)

Chrome free lignosulfonate

Lignite

Caustic Soda

Sodium Bicarbonate

Drispac-Polanionic Cellulose Polymer

Lime

Lubrikleen-organic detergent, lubricant, with amines

Water

(Continued)

SUMMARY OF LABORATORY STUDIES ON BIOLOGICAL EFFECTS OF DRILLING FLUIDS ON MARINE ORGANISMS

This table summarizes the results of bioassays reported in the literature that are most relevant to assessment of drilling fluid impacts in north temperate and sub-Arctic regions. Results of acute tests (Table C-1) are generally grouped by study in approximate decreasing order of relevance.

The bioassays reported in the literature were performed with five different fractions of used drilling fluid (or some component of drilling fluid) and seawater mixtures. These are designated in the table as:

Layered Solid Phase (LSP). A known volume of drilling fluid is layered over the bottom or added to seawater. Although little or no mixing of the slurry is done, the water column contains very fine particulate fractions which do not settle out of solution.

Suspended Solids Phase (SSP). Known volumes of drilling fluids are added to seawater, and the mixture is kept in suspension by aeration or other mechanical means.

Suspended Particulate Phase (SSP). One part by volume of drilling fluid is added to nine parts artificial seawater. The drilling fluid-seawater slurry is well mixed, and the suspension is allowed to settle for 4 hr before the supernatant (100 percent SPP) is siphoned off for immediate use in bioassays.

Mud Aqueuous Fraction (MAF). One part by volume of drilling fluid is added to nine parts seawater. The mixture is stirred thoroughly and then allowed to settle for 20 hr. The resulting supernatant (100 percent MAF) is siphoned and is used immediately in the bioassays. The MAF is similar to the SPP except that longer settling times of MAF allow for a lower concentration of particulates.

Filtered Mud Aqueous Fraction (FMAF). The mud aqueous fraction (MAF) or whole drilling fluid is centrifuged and/or passed through a 0.45-u filter eliminating all particulates greater than this size.

SW is used in these tables as an abbreviation for seawater, and chrome lignosulfonate is abbreviated CLS.

TA C

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used Cook Inlet lignosulfonate drilling fluid	Stage I larvae of: *Paralithodes camtschatica*, (king crab) *Cancer magister* (Dungeness crab) *Chionoecetes bairdi* (tanner crab)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF(a)	(144 hr) 0.20-0.94% LSP (144 hr EC50)(c) 0.28% LSP (king crab larvae only) (144 hr) LC50=1.41-3.34% FMAF (144 hr) EC50=0.56-2.58% FMAF	Carls and Rice 1981
Used Cook Inlet lignosulfonate drilling fluid	Stage I larvae of: *Eualus suckleyi* (kelp shrimp) *Pandalus hypsinotus* (coonstripe shrimp) *Pandalus danae* (dock shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) 0.05-0.44% LSP (144 hr EC50) 0.05-<0.50% LSP (144 hr) 0.30-0.90% FMAF (144 hr) 0.32-0.56% FMAF	Carls and Rice 1981
Used Prudhoe Bay lignosulfonate drilling fluid	Stage I larvae of: *Pandalus hypsinotus* (coonstripe shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) 15.31% FMAF (144 hr) 9.07% FMAF	Carls and Rice 1981
New Prudhoe Bay drilling fluid without lignosulfonate	Stage I larvae of: *Paralithodes camtschatica* (king crab) *Pandalus hypsinotus* (coonstripe shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) 2.33-3.23% FMAF (144 hr EC50) 2.42% FMAF (*Pandalus* only) (144 hr EC50) <1% LSP	Carls and Rice 1981
Used Homer spud mud	Stage I larvae of: *Paralithodes camtschatica* (king crab)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) 9.45% FMAF (144 hr EC50) 6.60% FMAF	Carls and Rice 1981
New Homer drilling fluid	Stage I larvae of: *Paralithodes camtschatica* (king crab) *Pandalus hypsinotus* (coonstripe shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) <5 to 7.17% FMAF (144 hr EC50) <5 to 6.18% FMAF (144 hr EC50) <1% LSP (king crab)	Carls and Rice 1981
Used Homer driling fluid	Stage I larvae of: *Paralithodes camtschatica* (king crab) *Pandalus hypsinotus* (coonstripe shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF	(144 hr) 30.08-37.62% FMAF (144 hr EC50) 18.05-26.79% FMAF (144 hr EC50) 1.53-2.98% LSP	Carls and Rice 1981

(a) FMAF used by Carls and Rice began with 50 percent whole mud in seawater rather than 10 percent used by most other authors.

(b) 96-hr LC_{50} given unless otherwise stated.

(c) EC_{50}--concentration at which 50% of organisms ceased swimming.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})[b]	Reference
Used Cook Inlet lignosulfonate drilling fluid	Stage I larvae of: *Paralithodes camtschatica* (king crab) *Pandalus hypsinotus* (coonstripe shrimp)	SW, 28.4-30.9 ppt, 4.5-7.5°C Static LSP, FMAF[a] Test for toxicity of aged drilling fluid	(144 hr) 1.47-3.91% FMAF at 7 days (144 hr EC50)[c] 0.92-2.41% FMAF at 7 days (144 hr) 4.08-6.03% FMAF at 14 days (144 hr EC50) 2.49-3.63% FMAF at 14 days (144 hr) 5.63-5.83% FMAF at 21 days (144 hr EC50) 2.87% FMAF at 21 days (144 hr) 4.19% FMAF at 28 days (144 hr EC50) 3.82% FMAF at 28 days	Carls and Rice 1981
Used high density lignosulfonate drilling fluid	*Pandalus hypsinotus* (coonstripe shrimp)	SW, 29 ppt, 12°C Static LSP	3.2% to >15.0% (5 experiments)	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Pandalus hypsinotus* (coonstripe shrimp)	SW, 27 ppt, 13°C Static SSP	4.4% 5.0% <48 hr LC50 <10.0%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Oncorhynchus gorbuscha* (pink salmon fry)	SW, 29 ppt, 13.5°C Static LSP	2.9%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Oncorhynchus gorbuscha* (pink salmon fry)	SW, 29 ppt, 12°C Static SSP	0.3-1.9% (2 experiments)	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Eogammarus confervicolous* (amphipods)	SW, 29 ppt, 11.4°C Static LSP	>20% 1% <48 hr LC50 <5%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Eogammarus confervicolous* (amphipods)	SW, 29 ppt, 10°C Static SSP	>7%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Neomysis integer* (mysids)	SW, 26 ppt, 13°C Static LSP	(48 hr LC50) 7.4% 10% <48hr LC50 <15% 10% <96 hr LC50 <12.5%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Neomysis integer* (mysids)	SW, 26 ppt, 13°C Static SSP	1% <96 hr LC50 < 5%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Neomysis integer* (mysids)	SW, 26 ppt, 13°C Static SSP	48 hr LC50 > 10%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Gnorimosphaeroma oregonensis* (isopods)	SW, 29 ppt, 10°C Static SSP	>7%	Houghton et al. 1980b

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(a) FMAF used by Carls and Rice began with 50 percent whole mud in seawater rather than 10 percent used by most other authors.
(b) 96-hr LC_{50} given unless otherwise stated.
(c) EC_{50}--concentration at which 50% of organisms ceased swimming.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})$^{(b)}$	Reference
Used high density lignosulfonate drilling fluid	*Leptocottus armatus* (staghorn sculpin juveniles)	SW, 12.4°C Static SSP	10% <48 hr LC50 <20%	Houghton et al. 1980b
Used high density lignosulfonate drilling fluid	*Modiolus modiolus* (mussels)	SW, Static LSP	(13.6 day LC50) >3%	Houghton et al. 1980b
Used CMC/Resinex/Tannathin/Gel drilling fluid	*Melaenis loveni* (polychaetes) *Matica clausa* *Neptunea* sp. *Buccineum* sp. (snails)	SW, ~20 ppt, ~0°C Static, LSP	>60%	Tornberg et al. 1980 Tornberg et al. 1980
Used CMC/Resinex/Tannathin/Gel drilling fluid	*Saduria entomon* (isopods)	SW, ~25 ppt, ~3°C Static, LSP	~53% to >60% (2 experiments)	Tornberg et al. 1980
Used CMC/Resinex/Tannathin drilling fluid	*Melaenis loveni* (polychaetes) *Matica clausa* *Neptunea* sp. *Buccineum* sp. (snails)	SW, ~22 ppt, ~1.2°C Static, LSP	>70%	Tornberg et al. 1980
Used CMC/Gel/Resinex drilling fluid	*Mysis* sp. (mysids)	SW, 3.3 ppt, 11.8°C Static LSP	<6% to 7.3% (2 experiments)	Tornberg et al. 1980
Used CMC/Gel/Resinex drilling fluid	*Myoxocephalus quadricornis* (fourhorn sculpin juveniles)	SW, 5 ppt, 10°C Static LSP	5% to 7% (2 experiments)	Tornberg et al. 1980
Used CMC/Gel drilling fluid	*Mysis* sp. (mysids)	SW, 11 ppt, 7.8°C Static LSP	21.5%	
Used CMC/Gel drilling fluid	*Myoxocephalus quadricornis* (fourhorn sculpin juveniles)	SW, 11 ppt, 7.7°C Static LSP	12%	Tornberg et al. 1980
Used CMC/Gel drilling fluid	*Eliginus navaga* (saffron cod)	SW, 15 ppt, 7.8°C Static LSP	17% to 30%	Tornberg et al. 1980
Used CMC/Gel drilling fluid	*Coregonus nasus* (broad whitefish juveniles)	SW, 9.8 ppt, 10.3°C Static LSP	>20%	Tornberg et al. 1980

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used XC-polymer/ Unical drilling fluid	Saduria entomon	SW, 20 ppt, 0°C Static LSP	31.4% <96 hr LC50 <50%	Tornberg et al. 1980
Used XC-polymer/ Unical drilling fluid	Onisimus sp. Boeckosimus sp. (amphipods)	SW, 22 ppt, 1°C Static LSP	22.1% to 38.1% (6 experiments	Tornberg et al. 1980
Used XC-polymer drilling fluid	Mysis sp. (mysides)	SW, 15 ppt, 10°C Static LSP	5% <96 hr LC50 <17% (3 experiments)	Tornberg et al. 1980
Used XC-polymer drilling fluid	Myoxocephalus quadricornis (fourhorn sculpin juveniles)	SW, 16 ppt, 10°C Static LSP	5% to 21.5% (5 experiments)	Tornberg et al. 1980
Used XC-polymer drilling fluid	Myoxocephalus quadricornis (fourhorn sculpin juveniles)	SW, 6.5 ppt, 11°C Static SPP. Maximum test concentration 25% drilling fluid to seawater (V/V)	25%	Tornberg et al. 1980
Used XC-polymer drilling fluid	Coregonus nasus (broad whitefish juveniles)	SW, 10 ppt, 7.5°C Static LSP.	6.4% to 37% (4 experiments)	Tornberg et al. 1980
Used XC-polymer drilling fluid	Coregonus nasus (broad whitefish juveniles)	SW, 8 ppt, 9°C Statis SPP Maximum test concentration 25% drilling fluid to seawater (V/V)	10% <96 hr LC50 <17%	Tornberg et al. 1980
Used XC-polymer drilling fluid	Boreogadus saida	SW, 17 ppt, 10.8°C Statis LSP	25%	Tornberg et al. 1980
Used lignosulfonate drilling fluid	Myoxocephalus quadricornis (fourhorn sculpins)	SW, 15 ppt, 9°C Static LSP.	35%	Tornberg et al. 1980
Used lignosulfonate drilling fluid	Coregonus nasus (broad whitefish)	SW, 20 ppt, 9.9°C Static LSP.	<10%	Tornberg et al. 1980
Used lignosulfonate drilling fluid	Boreogadus saida (Arctic cod)	SW, 18 ppt, 7.6°C Static LSP.	20% <96 hr LC50 <25%	Tornberg et al. 1980
Used lignosulfonate drilling fluid	Coregonus autumnalis (Arctic cisco)	SW, 20.8 ppt, 7.1°C Static LSP.	40%	Tornberg et al. 1980

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results $(LC_{50})^{(b)}$	Reference
Used KCl-polymer drilling fluid	Salmo gairdneri (saltwater acclimated juvenile rainbow trout)	SW, 26 ppt 12°C Static SSP	2.4%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Oncorhynchus kisutch (juvenile coho salmon)	SW, 26 ppt 12°C Static SSP	2.9%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Oncorhynchus keta (juvenile chum salmon)	SW, 26 ppt 12°C Static SSP	2.4%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Oncorhynchus gorbuscha (juvenile pink salmon	SW, 26 ppt 12°C Static SSP	4.1%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Nereis vexillosa (mussel worm)	SW, 26 ppt 12°C Static SSP	3.7%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Mya arenaria (soft-shelled clam)	SW, 26 ppt 12°C Static SSP	4.2%	Division of Applied Biology B.C. Research 1976
Used KCl-polymer drilling fluid	Hemigrapsus nudus (purple beach crab)	SW, 26 ppt 12°C Static SSP	5.3%	Division of Applied Biology B.C. Research 1976
Used SW/ polymer drilling fluid	Oncorhynchus kisutch (juvenile coho salmon)	SW, 26.5 ppt, 12°C Static SSP	13%	Division of Applied Biology B.C. Research 1976
Used SW/ polymer drilling fluid	Nereis vexillosa (mussel worm)	SW, 26.5 ppt, 12°C Static SSP	22.0%	Division of Applied Biology B.C. Research 1976
Used SW/ polymer drilling fluid	Mya arenaria (soft-shelled clam)	SW, 26.5 ppt, 12°C Static SSP	32.0%	Division of Applied Biology B.C. Research 1976
Used SW/ polymer drilling fluid	Hemigrapsus nudus (purple beach crab)	SW, 26.5 ppt, 12°C Static SSP	53.0%	Division of Applied Biology B.C. Research 1976
Used SW/ polymer drilling fluid	Orchestia traskiana (sand flea)	SW, 26.5 ppt, 12°C Static SSP	23.0%	Division of Applied Biology B.C. Research 1976

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used KCl-XC polymer drilling fluid	*Oncorhynchus kisutch* (juvenile coho salmon)	SW, 27 ppt, 12°C Static SSP	2.3%	Division of Applied Biology B.C. Research 1976
Used KCl-XC polymer drilling fluid	*Nereis vexillosa* (mussel worm)	SW, 27 ppt, 12°C Static SSP	4.1%	Division of Applied Biology B.C. Research 1976
Used KCl-XC polymer drilling fluid	*Mya arenaria* (soft-shelled clam)	SW, 27 ppt, 12°C Static SSP	5.6%	Division of Applied Biology B.C. Research 1976
Used KCl-XC polymer drilling fluid	*Hemigrapsus nudus* (purple beach crab)	SW, 27 ppt, 12°C Static SSP	7.8%	Division of Applied Biology B.C. Research 1976
Used KCl-XC polymer drilling fluid	*Orchestia traskiana* (sand flea)	SW, 27 ppt, 12°C Static SSP	1.4%	Division of Applied Biology B.C. Research 1976
Used weighted polymer drilling fluid	*Oncorhynchus kisutch* (juvenile coho salmon)	SW, 26.8 ppt, 12°C Static SSP	1.5%	Division of Applied Biology B.C. Research 1976
Used weighted polymer drilling fluid	*Nereis vesillosa* (mussel worm)	SW, 26.8 ppt, 12°C Static SSP	2.3%	Division of Applied Biology B.C. Research 1976
Used weighted polymer drilling fluid	*Mya arenaria* (soft-shelled clam)	SW, 26.8 ppt, 12°C Static SSP	1.0%	Division of Applied Biology B.C. Research 1976
Used weighted polymer drilling fluid	*Hemigrapsus nudus* (purple beach crab)	SW, 26.8 ppt, 12°C Static SSP	6.2%	Division of Applied Biology B.C. Research 1976
Used weighted polymer drilling fluid	*Orchestia traskiana* (sand flea)	SW, 26.8 ppt, 12°C Static SSP	3.4%	Division of Applied Biology B.C. Research 1976
Used weighted Gel/XC polymer drilling fluid	*Oncorhynchus kisutch* (juvenile coho salmon)	SW, 24.6 ppt, 12°C Static SSP	19.0%	Division of Applied Biology B.C. Research 1976
Used weighted Gel/XC polymer drilling fluid	*Nereis vexillosa* (mussel worm)	SW, 24.6 ppt, 12°C Static SSP	32.0%	Division of Applied Biology B.C. Research 1976

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})[(b)]	Reference
Used weighted Gel/XC polymer drilling fluid	*Mya arenaria* (soft-shelled clam) *Hemigrapsus nudus* (purple beach crab)	SW, 24.6 ppt, 12°C Static SSP	56.0%	Division of Applied Biology B.C. Research 1976
Used weighted Gel/XC polymer drilling fluid	*Orchestia traskiana* (sand flea)	SW, 24.6 ppt, 12°C Static SSP	42.0%	Division of Applied Biology B.C. Research 1976
Used Gel Chemical XC drilling fluid	*Oncorhynchus kisutch* (juvenile coho salmon)	SW, 28 ppt, 12°C Static SSP	3.9%	Division of Applied Biology B.C. Research 1976
Used Gel Chemical XC drilling fluid	*Nereis vexillosa* (mussel worm) *Mya arenaria* (soft-shelled clam) *Hemigrapsus nudus* (purple beach crab)	SW, 28 ppt, 12°C Static SSP	>56.0%	Division of Applied Biology B.C. Research 1976
Used Gel Chemical XC drilling fluid	*Orchestia traskiana* (sand flea)	SW, 28 ppt, 12°C Static SSP	8.0%	Division of Applied Biology B.C. Research 1976
Used Gel XC-polymer drilling fluid	*Oncorhynchus kisutch* (juvenile coho salmon)	SW, 28 ppt, 12°C Static SSP	3%	Division of Applied Biology B.C. Research 1976
Used Gel XC-polymer drilling fluid	*Nereis vexillosa* (mussel worm)	SW, 28 ppt, 12°C Static SSP	20%	Division of Applied Biology B.C. Research 1976
Used Gel XC-polymer drilling fluid	*Mya arenaria* (soft-shelled clam) *Hemigrapsus nudus* (purple beach crab) *Orchestia traskiana* (sand flea)	SW, 28 ppt, 12°C Static SSP	>56%	Division of Applied Biology B.C. Research 1976

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used drilling fluid containing fresh-water sodium montmorillinite, $BaSO_4$, NaOH, XC-polymer, potassium chrome alum, polyanionic cellulosic polymer, vinyl acetate-maleic acid copolymer; CLS may or may not be present	Onchorhynchus gorbuscha, (pink salmon fry, 48-mm T.L.)	SW, 12.5°C, static, media stirred once each hour to resuspend mixture, media was not changed after beginning of experiment, 96-hr exposure	Observed mortality less than 10% for concentrations of drilling fluid to SW of 1.0 to 10.0% (V/V) except at 5.6% concentration where 2 organisms died (17% mortality)	Johnson and LeGore 1976
Same drilling fluid as above plus paraformaldehyde at a concentration of 0.25 lb per barrel of mud	Onchorhynchus gorbuscha, (pink salmon fry, 48-mm T.L.)	SW, 12.5°C, static, media stirred once each hour to resuspend mixture, media was not changed after beginning of experiment, 96-hr exposure	Observed mortality less than 10% for all test concentrations (1.0 - 10.0% by volume)	Johnson and LeGore 1976
Drilling fluid as above with and without paraformaldehyde	Pandalus borealis (pink shrimp); P. danae (coonstripe shrimp) Spirontocaris sp.	SW, 12.5°C static, SPP media was not changd after beginning of experimnet, 96-hr exposure	3 mortalities in all test concentrations including the control tank. No apparent toxic effect to 10% drilling fluid	Johnson and LeGore 1976
Drilling fluid as above without paraformaldehyde	Copepods and mysids	SW, 6.0-8.1°C static, SSP media was not changed after the beginning of experiment. 48-hr exposure, test concentrations 1.0-10.0% drilling fluid to seawater by volume	40-60% copepod mortality in test concentrations greater than 1.8%, control mortality of 30%. No significant mysid mortalities at concentrations less than 4.5%. Concentrations >5.6% had 40% mortality	Johnson and LeGore 1976
Drilling fluid as above without paraformaldehyde (1.0 lb/barrel)	Copepods and mysids	SW, 6.0-8.1°C static, SSP media was not changed after the beginning of experiment. 48-hr exposure, test concentrations 1.0-10.0% drilling fluid to seawater by volume	Mortality of 80-100% after 48-hr exposure of SSP media concentratoins of 1.0-10.0% for both copepods and mysids	Johnson and LeGore 1976
Drilling fluid as above with Lubrikleen (1.0 lb/barrel)	Mysids	SW, 10.8-12.0°C static, SPP media was not changed after the beginning of experiment, 48-hr exposure, 1.0-10.0% concentrations	No significant mortalities excluding an apparent experimental artifact at 1.0% concentration (80% mortality)	Johnson and LeGore 1976
Drilling fluid as above with paraformaldehyde (0.25 lb/barrel) plus Lubrikleen (1.0 lb/barrel)	Mysids	SW, 10.8-12.0°C static, SPP media was not changed after the beginning of experiment, 48-hr exposure, 1.0-10.0% concentrations	No significant mortalities	Johnson and LeGore 1976

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Mate	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used SW CLS drilling fluid composed primarily of SW, bentonite, CLS, lignite, caustic soda, lime, and barite	*Clibanarius vittatus* adults	Static MAF changed daily	28.7% MAF	Neff et al. 1980
	Penaeus aztecus juveniles	Static MAF changed daily	41.5% MAF	Neff et al. 1980
	Penaeus duorarum postlarvae	SW, 28 ppt, 22°C, Static MAF	86% MAF	Neff et al. 1981
	Palaemonetes pugio	SW, 16 ppt, 22°C,		
	1st Zoeae	Static MAF changed daily	27.5% MAF	Neff et al. 1980
	4-day Zoeae	Static MAF	34% MAF	Neff et al. 1981
	postlarvae	Static MAF	67% MAF	Neff et al. 1981
	adults	Static MAF	90% MAF	Neff et al. 1981
	adults	Static MAF changed daily	92.4% MAF	Neff et al. 1980
	Donax variabilis	SW, 35 ppt, 22°C, n=20-25		
	(coquina clam) adults	Static SPP changed daily	(72 hr) 92.4% SPP	Neff et al. 1980
	adults	Static SPP changed daily	53.7% SPP	Neff et al. 1980
	juveniles	Static MAF	>100% MAF	Neff et al. 1981
	adults	Static MAF	86% MAF	Neff et al. 1981
	Neanthes arenaceodentata (marine annelid worm)	SW, 32 pt, 25°C		Neff et al. 1981
	Juveniles	Static MAF	96% MAF	
		Static FMAF	>100% F,AF	
	Adults	Static MAF	51% MAF	
		Static MAF changed daily	10% MAF	
	Ophryotrocha labronica (marine annelid worm) adults	SW, 34 ppt, 25°C		
		Static MAF	>100% MAF	Neff et al. 1981
		Static FMAF	>100% MAF	
	Dinophilus sp. (marine annelid worm) adults	SW, 33 ppt, 25°C Static MAF	76% MAF	Neff et al. 1981
	Ctenodrilus serintus (marine annelid worm)	SW, 35 ppt, 25°C, n=40		Neff et al. 1981
		Static MAF	32% MAF	
		Static FMAF	45% FMAF	
		Static MAF	(480 hr) 13% MAF	
		Static FMAF	(480 hr) 15% FMAF	

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Same CLS mud as above	Mysidopsis almyra	SW, 20 ppt, 25°C		
	1-day old postlarvae of (opposum shrimp)	Static MAF changed daily	(48 hr) 32.0% MAF	Neff et al. 1980
		Static MAF changed daily	(72 hr) 29.0% MAF	Neff et al. 1980
		Static MAF changed daily	27% MAF	Neff et al. 1981
		Static MAF	40% MAF	Neff et al. 1981
	3-day old	Static MAF	79% MAF	Neff et al. 1981
	7-day old	Static MAF	73% MAF	Neff et al. 1981
		Static MAF, changed daily	81% MAF	Neff et at. 1980
	14-day old	Static MAF	96% MAF	Neff et al. 1981
	Mercenaria compechiensis adult (hard shell clam)	SW, 20 ppt, 22°C, Static MAF	>100% MAF	Neff et al. 1981
	Rangia cuneata, adults (marsh clam)	SW, 20 ppt, 22°C, Static MAF	>100% MAF	Neff et al. 1981
	Penaeus duorarum postlarvae (pink shrimp)	SW, 28 ppt, static SPP changed daily 168-hr exposure to 10 ml drilling fluid/l SW (10,000 ppm or 1.0% by volume)	71% survival	Neff et al. 1981
	Penaeus aztecus juveniles (brown shrimp)	SW, 28 ppt, static SPP changed daily 168-hr exposure to 10 ml drilling fluid/l SW (10,000 ppm or 1.0% by volume)	40% survival	Neff et al. 1981
	Portunus spinicarpus adult (crab)	SW, 35 ppt, static SSP changed daily, 168-hr exposure to 20 ml drilling fluid/l SW (20,000 ppm or 2.0% by volume)	100% survival	Neff et al. 1981
	Mercenaria compechiensis adult (hard shell clam)	SW, 20 ppt, static SSP changed daily, 168-hr exposure to 20 ml drilling fluid/l SW (20,000 ppm or 2.0% by volume)	100% survival	Neff et al. 1981
	Rangia cuneata adult (mollusc)	SW, 20 ppt, static SSP changed daily, 168-hr exposure to 20 ml drilling fluid/l SW (20,000 ppm or 2.0% by volume)	100% survival	Neff et al. 1981
	Donax variabilis texasiana juvenile and adult (coquina clam)	SW, 35 ppt, 22°C, static LSP changed daily, 96-hr exposure to 100 ml drilling fluid/SW (100,000 ppm or 10% by volume)	32% survival of juveniles (<1 cm) and 0% survival of adults	Neff et al. 1981

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})[b]	Reference
Same CLS as above	*Aequipecten amplicostatus* adult (estuarine scallop)	SW, 20 ppt, 22°C, Static LSP changed daily, 96-hr exposure to 20 ml drilling fluid/ 1 SW (20,000 ppm or 2% by volume)	40% survival	Neff et al. 1981
	Neanthes arenaceodentata juvenile and adult (marine worm)	SW, 32 ppt, 22°C, Static LSP changed daily, 96-hr exposure to 40 ml drilling fluid/ 1 SW (40,000 ppm or 4% by volume)	77.5% survival of juveniles and 25% survival of adults	Neff et al. 1981
	Ophryotrocha labronica adult (marine worm)	SW, 34 ppt, 22°C, Static LSP changed daily, 96-h4 exposure to 50 ml drilling fluid/ . 1 SW (50,000 ppm or 5% by volume)	95% survival	Neff et al. 1981
	Mysidopsis almyra 1-day old (opposum shrimp)	SW, 20 ppt, 22°C, Static LSP changed daily, 168-hr exposure to 25 ml drilling fluid/ 1 SW (25,000 ppm or 2.5% by volume)	55% survival	Neff et al. 1981
	Crangon septemspinosa (sand shrimp)	SW, 31-33 ppt, 7-12°C, static MAF	>100% MAF	Gerber et al. 1980
	Mytilus edulis (blue mussel)			
	Nereis virens (sand worm)			
	Fundulus heteroclitus (killifish)			
Used low density lignosulfonate drilling fluid	*Crangon septemspinosa* (sand shrimp)	SW, 31-33 ppt, 8-22°C Static MAF, SSP; flow-through LSP	>100% MAF at 8°C 98% MAF at 18°C 71% LSP at 18°C >15,000 ppm SSP at 18°C	Gerber et al. 1980
	Carcinus maenas (green crab)	SW, 31-33 ppt, 8-22°C Static MAF, SSP flow through LSP	>100% MAF at 8°C 89% LSP at 8°C >15,000 ppm SSP at 8°C	Gerber et al. 1980
	Homarus americanus (American lobster)	SW, 31-33 ppt, 8-22°C Static MAF, SSP flow through LSP		
	Stage V larvae		5% MAF at 18°C	
	adults		19-25% MAF	

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})[b]	Reference
Used low density lignosulfonate drilling fluid	*Macoma balthica* (clam) *Placopecten magellanicus* (ocean scallop) *Littorina littorea* (periwinkle) *Thais lapillis* (dog whelk) *Nereis virens* (sand worm) *Strongylocentrotus droehbachiensis* (green sea urchin)	SW, 31-33 ppt, 8-22°C Static MAF, SSP flow through LSP	>100% MAF at 8°C 49% to 100% LSP >15,000 ppm SSP for *Macoma* and *Thais*	Gerber et al. 1980
Used medium density lignosulfonate mud composed primarily of SW, bentonite, clay, CLS, lignite, NaOH, barite,	*Mysidopsis alymara* (opposum shrimp)	SW, 20 ppt, 25°C Static exposure		Carr et al. 1980
		1st day juveniles, LSP	100% mortality in 2 days of 25,000 ppm drilling fluid 96% mortality in 4 days of 50% SSP 12% mortality in 7 days of 50% FMAF	
		1st day juveniles, static SPP	32% SPP	
		1-14 day old, static MAF	41-112.8% MAF	
		1st day juveniles, MAF changed daily	26.8% MAF	
Note: Drilling mud exposure reduced biomass production and net growth efficiency of mysids at sublethal concentrations in the range of 15 to 30% MAF.				
	Clibanarius vittatus adults	SW Static MAF with daily replacement	34.5% MAF	
	Penaeus aztecus juveniles	SW Static MAF with daily replacement	16% MAF	Neff et al. 1980
	Palaemonetes pugio (grass shrimp)			Neff et al. 1980
	1st Zoeae	Static MAF changed daily	35.0% MAF	
	adults	Static MAF changed daily	91.0% MAF	
	Ophryotrocha labronica adult (marine worm)	Static MAF changed daily	60.0% MAF	Neff et al. 1980
	Mysidopsis almyra			Neff et al. 1980
	1-day old, postlarvae (opposum shrimp)	Static MAF changed daily	(24-hr LC50) 47.9% MAF (48-hr LC50) 28.5% MAF (72-hr LC50) 14.5% MAF (96-hr LC50) 12.8% MAF	Neff et al. 1980
	7-day old postlarvae	Static MAF changed daily	(24-hr LC50) 22.0% MAF (48-hr LC50) 18.0% MAF (72-hr LC50) 14.5% MAF (96-hr LC50) 13.0% MAF	Neff et al. 1980

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results $(LC_{50})^{(b)}$	Reference
Used medium density lignosulfonate mud composed primarily of freshwater, bentonite, CLS, lignite, NaOH, lime and barite	Donax variabilis adult (coquina clam)	Static SPP changed daily	(48-hr LC50) 49% SPP (72-hr LC50) 38% SPP (96-hr LC50) 29% SPP (192-hr LC50) 20% SPP	Neff et al. 1980
	Crassostrea gigas (oyster spat) 3-10 mm 10-25 mm	Static SPP	(48-hr LC50) 83% SPP (72-hr LC50) 65% SPP (96-hr LC50) 53% SPP (72-hr LC50) 72% SPP (96-hr LC50) 50% SPP	Neff et al. 1980
	Crangon septemspinosa (sand shrimp) Gammarus locusta (amphipod Carcinus maenas (green crab) Homarus americanus (American lobster)	SW, 31-33 ppt, 6-12°C Static MAF, SSP Flow through, LSP	>100% MAF >15,000 ppm SSP (Crangon and Carcinus only) 96-hr LC50 = 29-90% LSP	Gerber et al. 1980
	Mytilus edulis (blue mussel) Littorina littorea (periwinkle) Nereis virens (sand worm)	SW, 31-33 ppt, 10-12°C Static MAF, SSP Flow through LSP	>100% MAF >15,000 ppm SSP (Mytilus only) >100% LSP	Gerber et al. 1980
	Pandalus borealis Stage I (northern shrimp larvae)	SW, 31-33 ppt, 5°C Static MAF, FMAF	17% MAF 19% FMAF	Gerber et al. 1980
	Placopecten magellanicus (ocean scallop)	SW, 31-33%, 13°C Flow through LSP	3,200 ppm (0.32%) LSP	Gerber et al. 1980
	Fundulus heteroclitus (killifish)	SW, 31-33%, 14°C Static MAF, SSP	>100% MAF >15,000 ppm SSP	Gerber et al. 1980

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)
SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})[b]	Reference
Used high-weight lignosulfonate drilling fluid. Composed primarily of fresh water, bentonite, CLS, lignite, NaOH, soda ash, $NaHCO_3$, polyanionic cellulose derivative, barite	*Clibanarius vittatus* adults	Static MAF changed daily	65.6% MAF	Neff et al. 1980
	Palaemonetes pugio 1st zoeae grass shrimp adult grass shrimp	Static MAF changed daily	<18.0% MAF 93.3% survival in 96 hr	Neff et al. 1980
	Ophroyotrocha labronica adult marine worm	Static MAF changed daily	87.5% survival in 96 hr	Neff et al. 1980
	Mysidopsis almyra (opossum shrimp) 1-day old postlarvae	Static MAF changed daily	(24-hr LC50) 93.0% MAF (48-hr LC50) 20.0% MAF (72-hr LC50) 16.0% MAF (96-hr LC50) 16% MAF	Neff et al. 1980
	7-day old postlarvae		(48-hr LC50) 90.0% MAF (72-hr LC50) 38.0% MAF (96-hr LC50) 32.5% MAF	Neff et al. 1980
	Donax variabilis (coquina clam)	Static SPP changed daily	(48-hr LC50) 95% SPP (72-hr LC50) 77% SPP (96-hr LC50) 56% SPP (192-hr LC50) 41% SPP	Neff et al. 1980
	Crassostrea gigas oyster spat 3-10 mm	Static, SPP changed daily	(48-hr LC50) 97% SPP (72-hr LC50) 84% SPP (96-hr LC50) 74% SPP	Neff et al. 1980
	oyster spat 10-25 mm	Static, SPP changed daily	(72-hr LC50) 84% SPP (96-hr LC50) 73% SPP	Neff et al. 1980
	Palaemonetes pugio (grass shrimp) 1-day (Z1)	Static, SPP changed daily	(48-hr LC50) 18.0% SPP (72-hr LC50) 13.2% SPP (96-hr LC50) 11.8% SPP	Neff et al. 1980
	5-day (Z3)	Static, SPP changed daily	(24-hr LC50) 23.2% SPP (48-hr LC50) 20.6% SPP (72-hr LC50) 15.8% SPP (96-hr LC50) 13.2% SPP	Neff et al. 1980
	10-day (Z4-Z5)	Static, SPP changed daily	(24-hr LC50) 60.0% SPP (48-hr LC50) 17.6% SPP (72-hr LC50) 15.5% SPP (96-hr LC50) 11.7% SPP	Neff et al. 1980

(b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results $(LC_{50})^{(b)}$	Reference
Used high density lignosulfonate drilling fluid	*Crangon septemspinosa* (sand shrimp) *Gammarus locusta* (amphipod) *Carcinus maenas* (green crab)	SW, 31-33 ppt, 6-14°C Static MAF, SSP Flow through LSP	>100% MAF >15,000 ppm SSP 28 to >100% LSP	Gerber et al. 1980
	Mytilus edulis (blue mussel) *Macoma balthica* (clam) *Littorina littorea* (periwinkle) *Nereis virens* (sand worm)	SW, 31-33 ppt, 7-12°C Static MAF, SSP Flow through LSP	>100% MAF >15,000 ppm SSP for (*Mytilus* only) >100% LSP	Gerber et al. 1980
	Pandalus borealis Stage I (northern shrimp larvae)	SW, 31-33 ppt, 2°C Static MAF, FMAF	96-hr LC50 = 65% MAF 96-hr LC50 = 55% FMAF	Gerber et al. 1980
	Fundulus heteroclitus (killifish)	SW, 31-33 ppt, 14°C Static MAF, SSP	96-hr LC50 >100% MAF 96-hr LC50 >15,000 ppm SSP	Gerber et al.
Used spud mud	*Palaemonetes pugio* 1st zoeae and adults *Ophryotrocha labronica* adults *Mysidopsis alyura* 1- and 7-day old postlarvae *Donax variabilis* adults *Crassostrea gigas* spat	Static, MAF or SPP changed daily	LC50 for all bioassays >100% MAF or SPP	Neff et al.1980
Used spud mud	*Mysidopsis almyra* 1- and 7-day old postlarvae (opossum shrimp)	Static, MAF changed daily	100% survival after 96-hr exposure	Neff et al. 1980
Used spud mud	*Donax variabilis texasiana* adult (coquina clam)	Static SPP changed daily	100% survival after 192-hr exposure	Neff et al. 1980
Used spud mud	*Crassostrea gigas* spat (Pacific oyster)	Static SPP changed daily	100% survival of oyster spat after 96-hr exposure	Neff et al. 1980

---

b) 96-hr LC_{50} given unless otherwise stated.

TABLE C-1 (Continued)

SUMMARY OF RESULTS OF ACUTE DRILLING FLUID BIOASSAYS ON MARINE ORGANISMS

Test Material	Test Organism	Test Conditions	Results (LC_{50})(b)	Reference
Used spud mud	*Crangon septemspinosa* (sand shrimp) *Gammarus locusta* (amphipod) *Mytilus edulis* (blue mussel) *Nereis virens* (sand worm) *Fundulus heteroclitus* (killifish)	SW, 31-33 ppt, 7-12°C Static MAF Flow through LSP	>100% MAF >100% LSP (*Gammarus* only)	Gerber et al. 1980
18 used drilling fluids from an exploratory platform in Mobile Bay. Note: this was an experimental drilling fluid not intended for ocean disposal	*Palaemonetes pugio* intermolt (Stage C) (grass shrimp)	SW, 10 ppt, 20°C Static with daily replacement of media, LSP	30% mortality or greater in 96-hr exposure at 1,000 ppm for 7 of 18 drilling fluids assayed. Mortality was 100% in 96 hr for drilling fluid XVIII	Conklin et al. 1980
5 used drilling fluids (most toxic in initial collection of 18 samples	*Palaemontes pugio*	SW, 10 ppt, 20°C Static with daily replacement of media LSP	363 to 739 ppm	Conklin et al. 1980
Most toxic drilling fluid sample (XVIII) from collection above	*Mysidopsis bahia* 1 day through 42 day old (entire life cycle) (mysid or opossum shrimp)	SW, 10 ppt, 20°C continuous flow	4-day LC50 = 161 ppm 7-day LC50 = 116 ppm 14-day LC50 = 85 ppm 21-day LC50 = 77 ppm 28-day LC50 = 59 ppm 35-day LC50 = 57 ppm 42-day LC50 = 50 ppm	Conklin et al.
Diesel-based drilling fluid plus cuttings. Components by percent weight: barite (6.5%) bentonite (22.0%) diesel (64.7%)	*Crassostrea virginica* (oysters) 70-120 mm	SW, 4.4-16.5%, 27-29°C Solutions changed 3 times per day 1,000-2,000 ppm 200-500 ppm 80-120 ppm	50% mortality after 6 days exposure 50% mortality after 7 days exposure 50% mortality in both controls and treatment organisms after 14 days exposure	Cabrera 1968

(b) 96-hr LC_{50} given unless otherwise stated.

Geophysical Hazards

In non-confidential copies of our Exploration Plan Appendix 7 (part 4 of 4 of Appendix 2 in confidential copies) is a copy of the Harding-Lawson Associates Marine Geophysical Survey, Tract 42, Beaufort Sea, Alaska. In general, the findings indicate an exceedingly flat seabed at the proposed island site with no evidences of ice gouging or strudel scour. No evidence of archaeological remains was observed. The area is blanketed by up to nine feet of soft Holocene marine deposits. These deposits overlie stiff and partially ice-bonded Pleistocene marine deposits which overlie Pleistocene alluvium. No significant acoustic anomalies were observed on the seismic records. Shallow soil borings confirm the findings of the hazard surveys. Seismic activity in the area is very low.

Environmental Training Program

Lease Stipulation No. 2 requires that any exploration plan shall include a proposed environmental training program for all personnel involved in exploration activities (including personnel of the lessees' contractors and subcontractors) for review and approval by the Supervisor. Shell Oil Company has participated in the cost of the videotape presentation prepared by Mobil, Sohio, and Exxon which has been reviewed and found satisfactory by the Joint Federal/State Biological Task Force. The program will be given to all personnel involved in the exploration activities. These tapes have been edited for industry wide application under guidance from the Alaska Oil and Gas Association. The tapes are narrated by qualified instructors to insure that personnel understand and use techniques necessary to preserve archaeological, geological and biological resources. The program is designed to increase the sensitivity and understanding of personnel to community values, customs and lifestyles in areas in which such personnel will be operating. The required continuing technical environmental briefing program for supervisory and managerial personnel involved including those of Shell, its agents, contractors and subcontractors has also been videotaped for industry-wide use.

Island Disposition

Based on present knowledge we have located the Tern "A" gravel island at a position that will permit utilization of the exploratory drilling island in a development/production plan. If the planned exploration effort fails to establish the presence of commercial hydrocarbons we believe that the retention of the island will be environmentally desirable to provide predator-free resting and nesting sites for birds as well as a favorable marine habitat. We see no adverse environmental impacts as a result of leaving the island in place. However if required, the island can be eliminated by distribution of the gravel over the sea bottom area.

Special Restriction

Except for the northwest corner of the lease, all of OCS-Y-0196, the island site, is located in an area on which the North Slope Borough or other agency imposes no special restriction.

Relief Well Discussion

Arctic OCS Orders require provisions to deal with an emergency situation involving a means of drilling a relief well should a blowout occur. We consider this to be an extremely remote possiblity because of extensive precautions taken to prevent such an occurence. Fundamental is the training of all personnel involved in the exploratory operations and the rig safety equipment. All crew and supervisory personnel will be trained in accordance with OCS Order No. 2 (GSS-OCS-T1). A list of personnel and training will be available on the rig on request.

In the unlikely event of a blowout, the equipment for building a relief well drilling island will be mobilized from Deadhorse and Prudhoe to the location. Contractors are listed in the ABSORB manual. The equipment to be used and method of transport will depend upon the time of year and weather conditions. For such an emergency it is customary for all operators in the area to cooperate in making a suitable drilling rig immediately available. For documentation evidencing a commitment for a drill rig to drill a relief well we attach a copy of our mutual assistance agreement with Arco. If required, a rig adapted to transport by a Hercules (C-130) cargo carrier could be used. Depending upon the time of year, the rig could be transported by helicopter or an air-cushioned vehicle.

Immediately, supplies such as tubulars and wellhead equipment would be stockpiled at Deadhorse for use at the relief well. Normal supplies such as mud, cement, bits, fuel and other items utilized in drilling the relief well and for killing the uncontrolled well are available at Deadhorse and would be transported to the relief wellsite when the site is completed or near completion. Gravel for the relief well drilling pad will be available at the gravel site for the Tern "A" island or from supplies at Prudhoe, depending upon the season.

Transportation during the ice season would be over ice roads already built and by boat and/or barge during the open-water season. During freeze up and breakup, transportation will be by helicopter or possibly by an air-cushioned vehicle.

During the ice season, a gravel island of design similar to that proposed herein would be constructed using proven techniques. Because of the temporary nature of the relief well drilling, an island somewhat smaller than the presently proposed island would be constructed. The drilling rig would be moved onto the site at the earliest time considered safe. Island construction could proceed until the island size was adequate for the relief well drilling and supply storage. During the open-water season, island construction would be by barge and tugs. Relief well island construction will not be attempted during freeze up and breakup until conditions are deemed safe for personnel and equipment. During any such delays, all possible preparations will be done for transporting and stockpiling materials and equipment to expedite construction and drilling of a relief well.

The relief well drillsite will be determined by consideration of forecasts of meteorological data, directional survey data from the blowout well and the indicated required depth of intersection of the relief wellbore with the blowout wellbore. Water depth would be similar to that at the blowout well site. The relief well would always be located away from the blowout at a distance adequate for the protection of personnel and equipment.

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EXPLORATION PLAN
TERN PROSPECT

BEAUFORT SEA, ALASKA

APPENDIX I
PROPRIETARY DATA

Released to public file
Name: Date: NOV 1 2018

SHELL OIL COMPANY
PACIFIC DIVISION
MAY 1981

DISCUSSION:

Our principal objective is a Flaxman Sand stratigraphic trap. The prospect is a gently dipping, lenticular sandstone body comprising turbidites deposited on Late Cretaceous submarine fans (Enclosure 1). These fans are encased in shales deposited in slope and basin floor environments of a rapidly prograding shelf-slope system. Facies-controlled porosity pinchouts provide a lateral seal (Enclosure 2).

Possible secondary objectives include a thin transgressive shoreline sandstone lying on the Early Cretaceous unconformity (Put River Ss.), as well as Mississippian deltaic sandstones (Kekiktuk Fm.). The stratigraphic relationship of these units is shown on Enclosure 3.

Released to public file
Name: Date: NOV 1 2018

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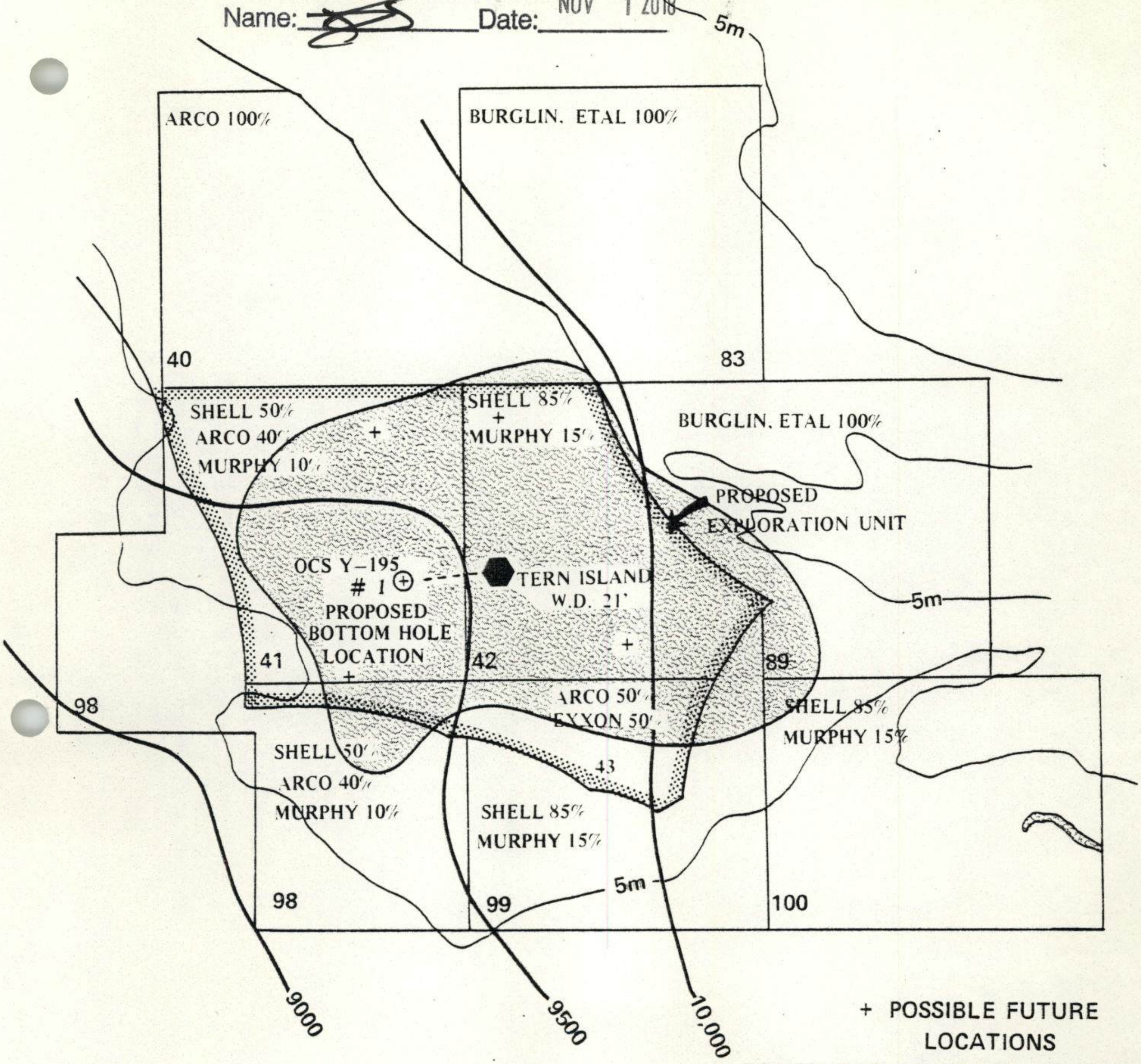
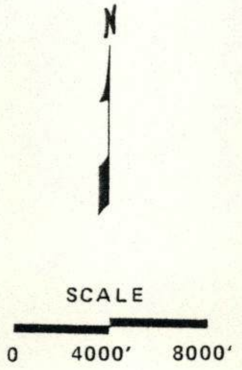


+ POSSIBLE FUTURE LOCATIONS

CONTOURED ON TOP OF FLAXMAN SAND

C.I. = 500'



SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	EXPLORATION DEPARTMENT

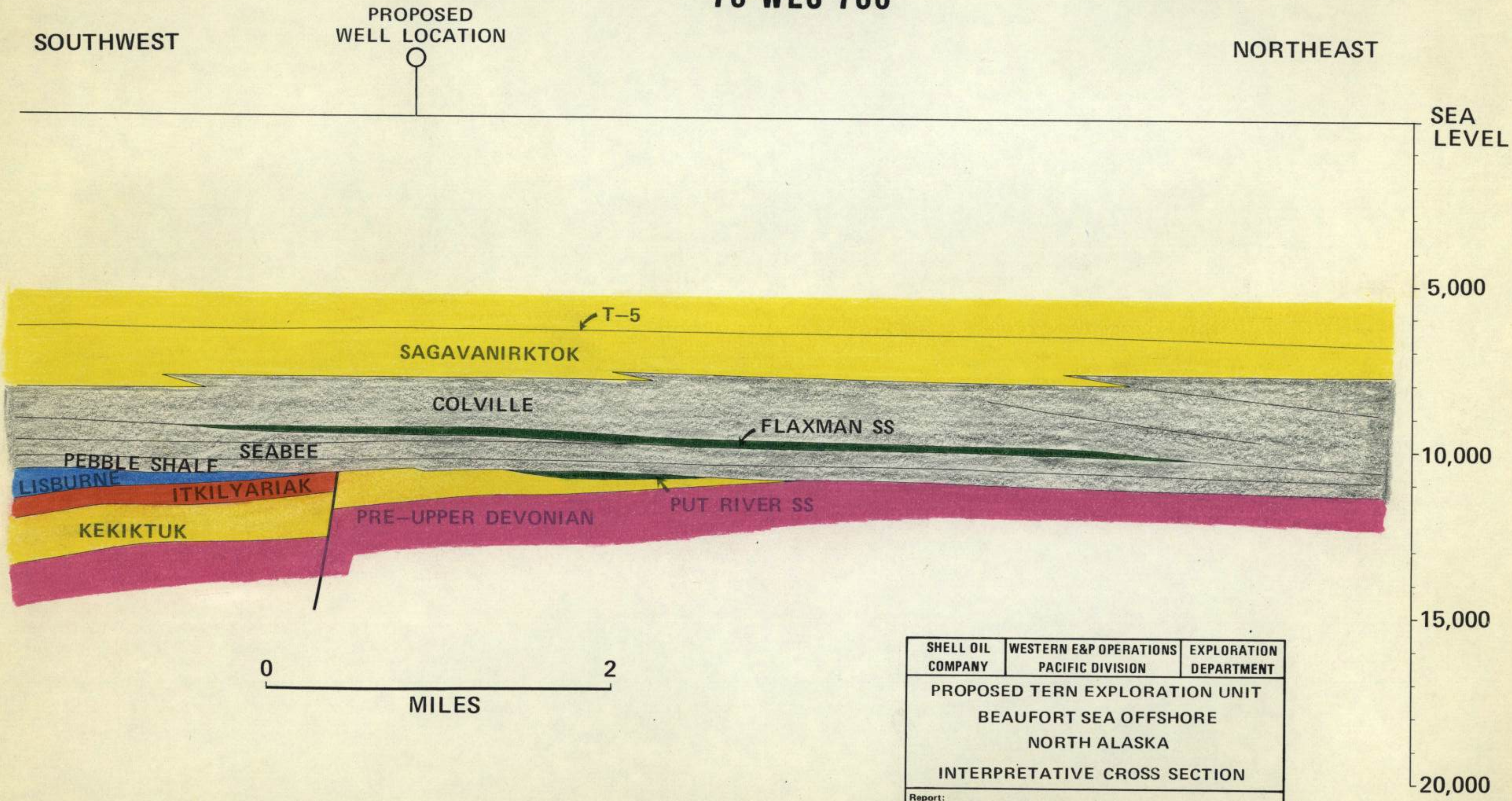
PROPOSED TERN EXPLORATION UNIT
BEAUFORT SEA OFFSHORE
NORTH ALASKA

Report: EXPLORATION PLAN
Province/Field: State: ALASKA
County: Encl.: 1
Author: ROBERT SMITH Date: File: 1Z00334

~~PRIVATE & CONFIDENTIAL~~

NORTH ALASKA
BEAUFORT SEA
TERN PROSPECT
78-WES-786

Released to public file
Name: Date: NOV 1 2018



SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	EXPLORATION DEPARTMENT

PROPOSED TERN EXPLORATION UNIT
BEAUFORT SEA OFFSHORE
NORTH ALASKA

INTERPRETATIVE CROSS SECTION

Report:
Province/Field: State:
County: Encl.: 2
Author: R. SMITH Date: 5/81 File: 1V01832

PRIVATE ~~& CONFIDENTIAL~~

BEAUFORT SEA

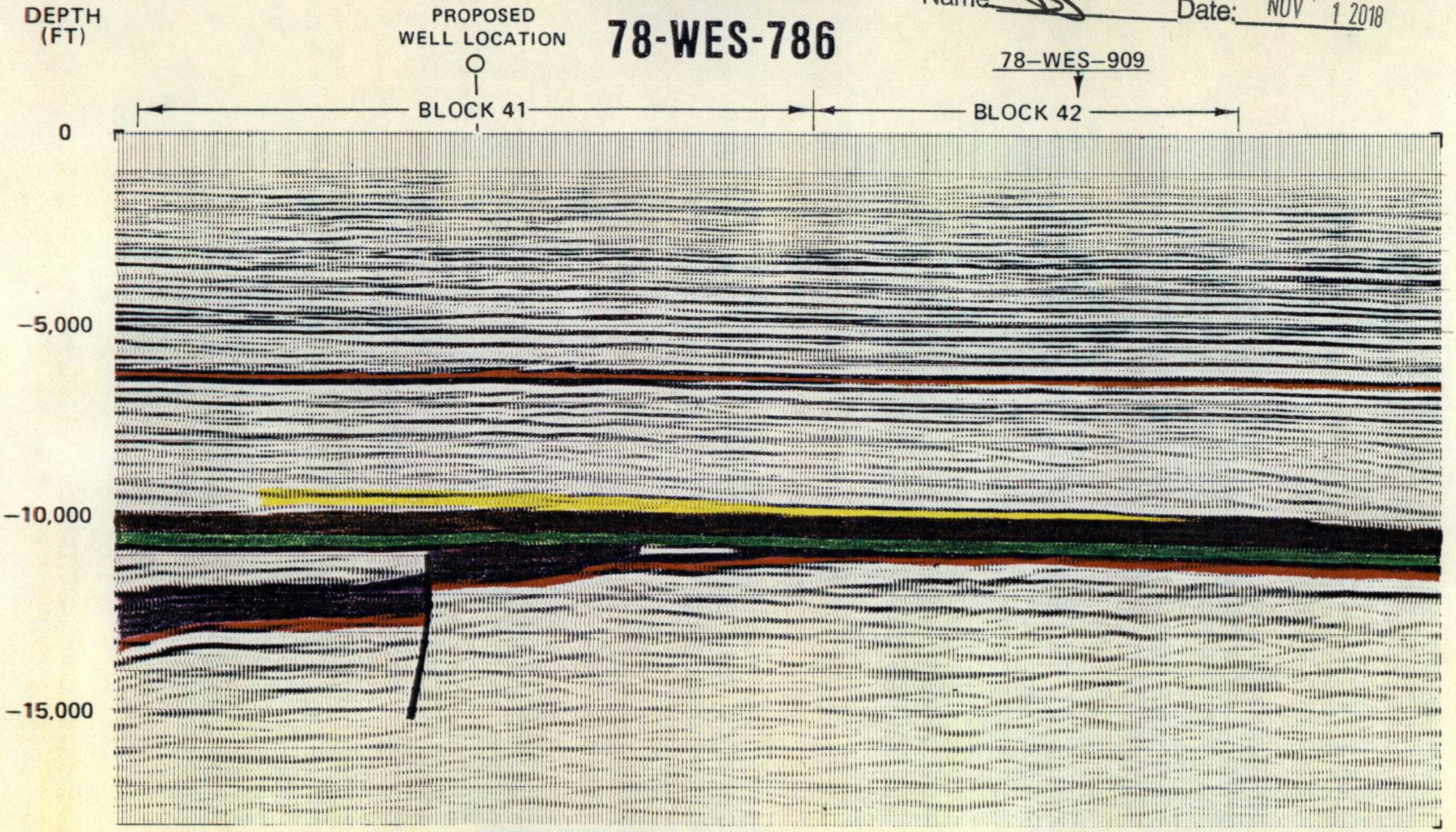
TERN PROSPECT

78-WES-786

Released to public file

Name: SD

Date: NOV 1 2018



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MILE

- 🟥 T_{T5}
- 🟨 FLAXMAN ISLAND
- ⬛ SEABEE SHALE
- 🟩 PEBBLE SHALE
- ⬛ KEKIKTUK
- 🟥 BASEMENT

SHELL OIL COMPANY	WESTERN E&P OPERATIONS PACIFIC DIVISION	EXPLORATION DEPARTMENT

PROPOSED TERN EXPLORATION UNIT

BEAUFORT SEA OFFSHORE

NORTH ALASKA

INTERPRETATIVE SEISMIC SECTION

Report:

Province/Field: State:

County: Encl.: 3

Author: R. SMITH Date: 5/81 File: 1V01810

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AFE ______

Released to public file
Name:
Date: NOV 1 2018

TENTATIVE
GRAPHICAL PROGNOSIS

FI D: TERN EXPLORATION AREA

WELL: SHELL OCS Y-195 #1

Alaska State Zone 3

LOCATION: X- 315,209 Lat = 70"16'45.9853"N
Y- 5,954,030 Long = 147°29'42.8288"W

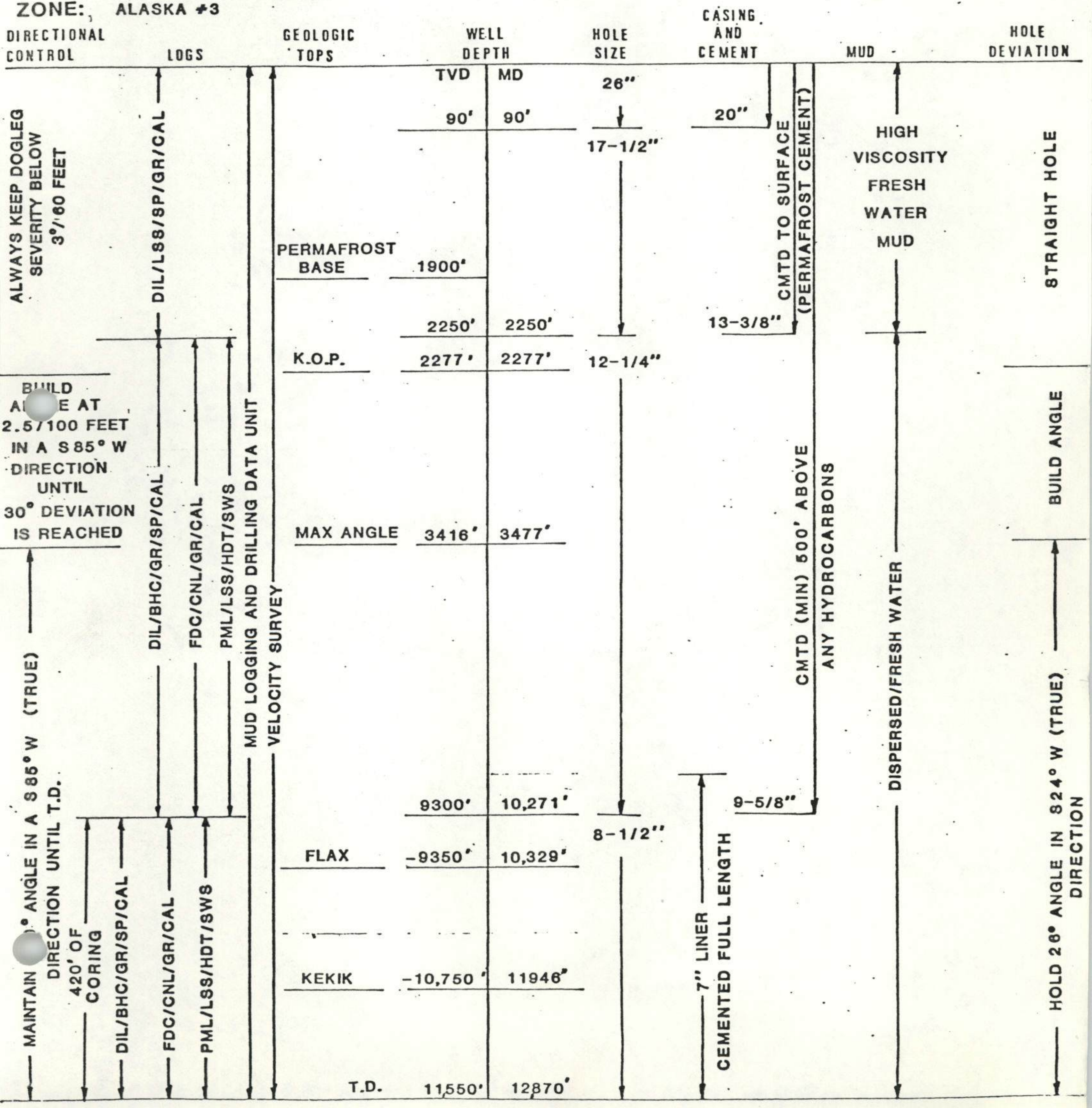
ELEVATION: 30'± G.L.
60'± K.B.

UTM Zone 6

OBJECTIVE: X- 310,198 X = 1,579,226'
Y- 5,953,614 y = 25,580,453'

NORTH SLOPE BOROUGH, ALASKA

ZONE: ALASKA #3



DIRECTIONAL CONTROL
- ALWAYS KEEP DOGLEG SEVERITY BELOW 3°/60 FEET
- BUILD A E AT 2.5/100 FEET IN A S 85° W DIRECTION UNTIL 30° DEVIATION IS REACHED
- MAINTAIN ° ANGLE IN A S 85° W (TRUE) DIRECTION UNTIL T.D.
- 420' OF CORING

LOGS
- DIL/LSS/SP/GR/CAL
- DIL/BHC/GR/SP/CAL
- FDC/CNL/GR/CAL
- PML/LSS/HDT/SWS
- MUD LOGGING AND DRILLING DATA UNIT
- VELOCITY SURVEY
- DIL/BHC/GR/SP/CAL
- FDC/CNL/GR/CAL
- PML/LSS/HDT/SWS

GEOLOGIC TOPS	WELL DEPTH TVD	WELL DEPTH MD
	90'	90'
PERMAFROST BASE	1900'	
	2250'	2250'
K.O.P.	2277'	2277'
MAX ANGLE	3416'	3477'
	9300'	10,271'
FLAX	-9350'	10,329'
KEKIK	-10,750'	11946'
T.D.	11,550'	12870'

HOLE SIZE
- 26"
- 17-1/2"
- 12-1/4"
- 8-1/2"

CASING AND CEMENT
- 20"
- 13-3/8" CMTD TO SURFACE (PERMAFROST CEMENT)
- 9-5/8" CMTD (MIN) 500' ABOVE ANY HYDROCARBONS
- 7" LINER CEMENTED FULL LENGTH

MUD
- HIGH VISCOSITY FRESH WATER MUD
- DISPERSED/FRESH WATER

HOLE DEVIATION
- STRAIGHT HOLE
- BUILD ANGLE
- HOLD 26° ANGLE IN S24° W (TRUE) DIRECTION

APPENDIX 2

~~PRIVATE & CONFIDENTIAL~~

4 PARTS

Released to public file
Name:____________ Date: NOV 1 2018

The drilling rig used for this proposed exploration operations will be BSI Rig 84 owned by Brinkerhoff Signal Incorporated or an equivalent. The following is a list and description of equipment for BSI Rig 84.

MAJOR DRILLING EQUIPMENT

Drawworks

1 - NATIONAL 110 UE drawworks, 1500 hp, double drum for 1-3/8" line, 5/8" sand line and TOTCO instrumentation console.

Brake

1 - PARMAC hydromatic brake.

Engines and Generators

3 - BEMAC III generators, 1000 KVA, each driven by a Caterpillar D-398, 912 hp diesel engine.

1 - ROSS HILL SCR power distribution system.

1 - BYRON JACKSON 3 1/2" X 130" elevator bails.

1 - BYRON JACKSON hook, 500 ton capacity.

1 - CONTINENTAL EMSCO MA 50-5 taveling blocks, 500 ton capacity.

Drill Pipe and Collars

11,000' - 5" 19.5# Grade E drill pipe.

4,000 - 5" 25.6# Grade E drill pipe.

12 - 8" X 2-13/16" drill collars.

18 - 6 1/4" X 2-13/16 drill collars.

1000 Barrel Mud System

1 - BRANDT dual shale shaker.

1 - DRILCO degasser.

1 - PICENCO 15 cone desilter with MISSION MAGNUM 5" X 6" pump driven by GENERAL ELECTRIC motor, 50 hp.

Mast

1 - IDECO full view 145' mast, 1,090,000# gross nominal capacity with 7 sheave crown block.

Substructure

1 - 29' H pin type substructure.

Pumps

2 - CONTINENTAL EMXCO F-1300 triplex mud pump, 7 1/4" X 12", 1300 hp. Each pump equipped with 2-752 CONTINENTAL EMSCO traction motors.

Rotary Table

1 - NATIONAL C-275 rotary table, 27 1/2" opening, independently driven.

Taveling Equipment

1 - GRAY Type B-44M Swivel, 500 ton capacity.

1 - PICENCO mud cleaner with MISSION MAGNUM 5" X 6" pump driven by GENERAL ELECTRIC motor, 50 hp.

5 - BRANDT mud mixers, 7 1/2 hp.

DRILLING SAFETY SYSTEMS

Blowout Preventers and Controls

1 - HYDRIL MSP 21 1/4" 2000 psi.

1 - HYDRIL GK 12-5/8" 5000 psi.

1 - HYDRIL double gate V 13-5/8" 5000 psi.

1 - HYDRIL single gate V 13-5/8" 5000 psi.

1 - 13 5/8" 5000 psi drilling spool with 2-4" flanged outlets.

1 - HYDRIL VALCON accumulator closing unit, 180 gallons, 3000 psi.

1 - CHOKE manifold 5000 psi.

Mud System Monitoring Equipment

- Mud pit livel indicator with visual and audio warning devices.

- Mud return indicator with visual and audio warning devices.

1 - 90 barrel trip tank.

- Gas detecting equipment.

Fire Fighting Equipment

17 - ANSULS hand-held extinguisher

CRITICAL OPERATIONS CURTAILMENT PLAN

Certain operations performed in drilling are more critical than others with respect to well control and for the prevention of fire, explosion, oil spills and other discharges or emissions. These operations will be limited or curtailed when particular meteorological, oceanographic or ice conditions exist or are predicted. The following are the more critical operations which will be limited or curtailed.

(1) Well production testing.

(2) Drilling into formations anticipated to be abnormally pressured.

These operations will be limited or curtailed if meteorological, oceanographic or ice conditions are or are predicted to be severe enough to shutdown logistical support of the drilling operation.

PUBLIC INFORMATION

TENTATIVE GRAPHICAL PROGNOSIS

FIELD: TERN EXPLORATION AREA

WELL: SHELL OCS Y-195 #1

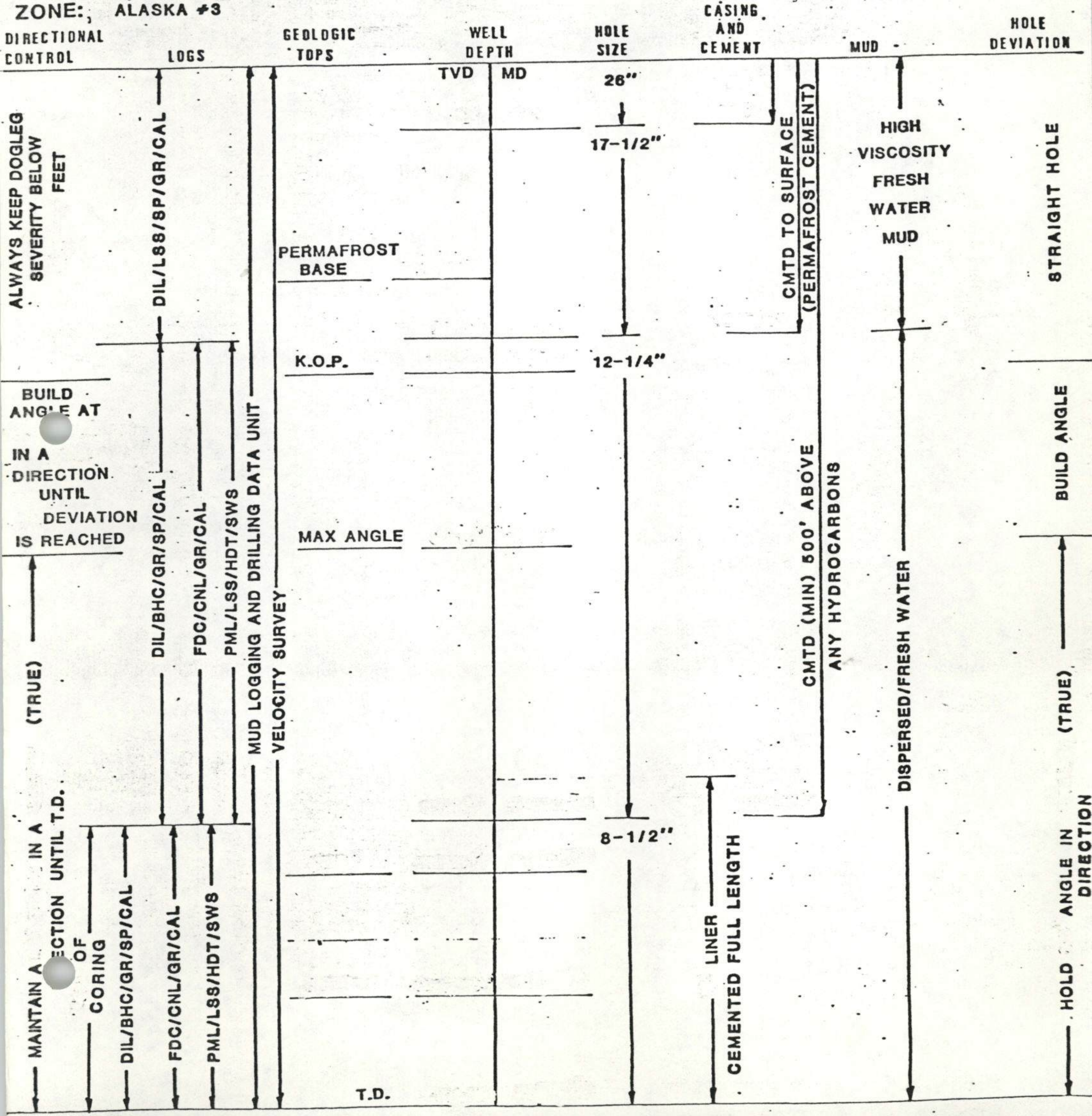
LOCATION:
Alaska State Zone 3
X- 315,209
Y-5,954,030
UTM Zone 6
X = 1,579,226'
Y = 25,580,453'
Lat = 70°16'45.9853"N
Long = 147°29'42.8288"W

ELEVATION: 30'± G.L.
60'± K.B.

OBJECTIVE: [redacted]

NORTH SLOPE BOROUGH, ALASKA

ZONE: ALASKA #3



OIL SPILL

CONTINGENCY PLAN

FOR

TERN "A"

GRAVEL ISLAND

EXPLORATORY WELLS

OCS-Y-0195, OCS-Y-0196
OCS-Y-0197

ISSUED: MAY 1981

REVISED: AUGUST 1981

TABLE OF CONTENTS

LIST OF FIGURES

SECTION I

INTRODUCTION

The purpose of this plan is to direct Shell Oil Company personnel in their response to an oil spill emergency and help them in their prevention and cleanup efforts by compiling sources of assistance and materials in such a way that they can be easily located and obtained.

Each recipient of this plan should read it thoroughly and familiarize himself with the response procedures. Personnel with job assignments under this plan should pay particular attention to their job descriptions, and the resources available to help them deal quickly and efficiently with any spill emergency.

Each recipient of this plan should record any pertinent changes or additions that come to his attention on his copy of the plan, and also notify the Division Safety and Environmental Conservation Manager. The Division SEC Manager will be responsible for notifying other recipients of any changes that come to his attention.

1.1 NAME OF FACILITY: Tern A

1.2 TYPE OF FACILITY: Exploratory Well(s) on a Gravel Island

1.3 LOCATION OF FACILITY:

+1,800' FWL and 5,700' FSL of Lease OCS-Y-0196
(Tract 42)

Alaska State Zone 3 Coordinates x = 315,209'
y = 5,954,030'
Lat = 70° 16'45.9853"N
Long = 147° 29'42.8288"W

UTM Zone 6 Coordinate x = 1,579,226'
y = 25,580,453'

Water depth at this location is 6.5 meters (21.5')

1.4 OPERATOR: Shell Oil Company
P. O. Box 527
Houston, TX 77001
(713) 870-2440
(713) 870-2441

1.5 PERSON ACCOUNTABLE FOR OIL SPILL PREVENTION:

W. M. Marshall
Division Production Manager
Pacific Division
P. O. Box 527
Houston, TX 77001
(713) 870-2440
(713) 870-2441

1.6 OBJECTIVE

Up to five wells will be drilled to a subsea depth of approximately 13,000 feet. The wells will be drilled to evaluate possible hydrocarbon accumulations. Maximum expected well rates are 50MM CFD for gas and 5000 BOD for oil.

1.7 SPILL PREVENTION

The rig contracted to drill this well will be equipped with all standard blowout control equipment. As required by the United States Geological Survey and Shell's Safe Drilling Practices, the blowout control equipment will be tested on a routine basis.

1.8 INSPECTIONS AND RECORDS

Shell Oil Company has written instructions incorporated as part of the well plan for each well as to procedures, test, inspections and reporting. This plan is very explicit about tripping, hole filling practices, and blowout preventer hook ups and use. The Contingency Plan will be on file along with the Well Plan at the Drill Site. Shell Oil Company's on-site supervisor will be responsible for seeing that procedures are carried out and that proper records are kept.

1.9 GRAVEL ISLAND SITE

The gravel island location will be designed and built to accommodate the drilling rig, camp, and necessary supplies for a year round drilling operation. The location will have a freeboard of 15 feet which is designed to resist ice override and lateral movement and is above the maximum indicated tide and storm surge based on observations along the surrounding coast.

If it is desired to later use this island for production purposes, it can be enlarged to meet this need. Note that in addition to the 15-foot freeboard, a 7-foot berm is planned for the perimeter of the island. Slope protection is also planned to control slope erosion. The rig and associated equipment and supplies will either be trucked over ice roads to the location or will be barged during the summer open water period.

1.10 GENERAL SITE DETAILS

The rig location and operating plan will be designed to provide containment of all drilling operation effluents that could be considered as pollutants. An impermeable sheet will be placed under the drilling rig to collect and divert any liquid waste for proper disposal. In addition to this, drip pans and other containment measures will be provided under the engines and rig machinery. Good housekeeping will be stressed on all parts of the location, with emphasis on minimizing contamination of the peripheral drainage from the island. Fuel will be stored in double-walled steel tanks located on an imperveous area inside a gravel berm. An impervious reserve pit will provide space for emergency discharge of fluids, if required, and will normally be kept dry to maximize storage capacity.

Additional precautions will be taken to prevent drainage of hydrocarbons to the sea. After freezeup, the surface of the island will be sprayed with water to form an impervious ice seal. This will enhance cleanup of liquids spilled. Also, any spills will be cleaned up as soon as possible. Snow contaminated by toxic substances will be incinerated on site or hauled to a disposal site on shore. The island surface will be thoroughly cleaned after clearing the island of all drilling equipment.

Mechanical devices including spill booms and skimming equipment outlined in the Oil Spill Containment and Cleanup Plan will be used to contain an open water spill. After freezeup, the natural snow surrounding the location will be used to stop the spread of any potential pollutants.

1.11 ON-SITE SPILL RESPONSE TEAM

Selected members of the drilling and roustabout crew, under direction of the Shell Drilling Supervisor, will be designated as the On-Site Spill Response Team. This team, along with on-site Shell and contract drilling supervisors, will be given periodic instruction in all phases of pollution control including the following:

A. Pollution prevention and good rig and location housekeeping practices.

B. Pollution detection methods under different climatic conditions.

C. Control and containment methods for toxic spills under different climatic conditions including drills in using the various items of containment and cleanup equipment listed below.

D. Cleanup and proper disposal procedures.

The ABSORB Manual will serve as a training manual for this instruction.

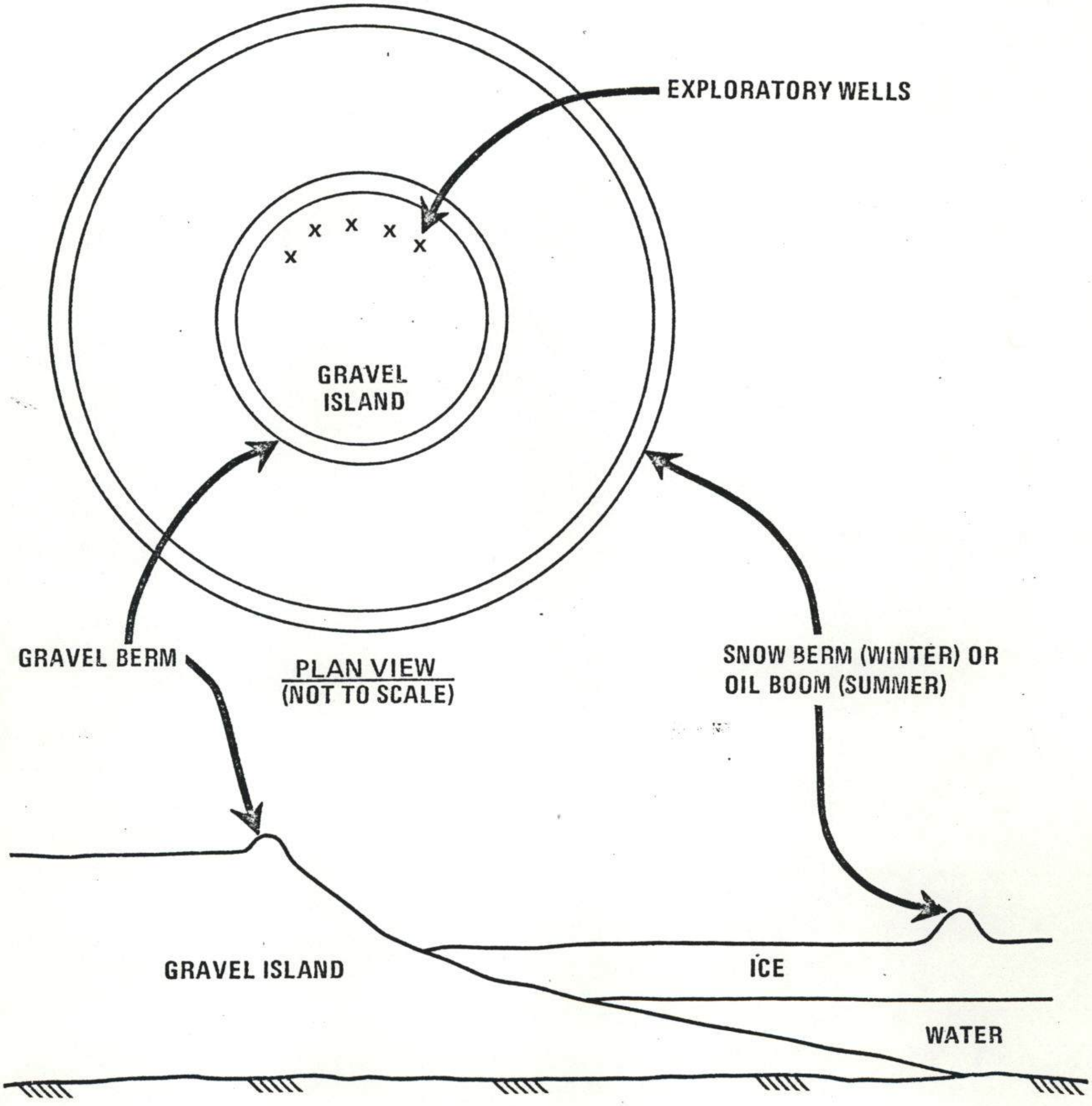
The On-Site Team will be responsible for investigating and handling all minor spills, both on location and between Deadhorse and the location. This team will be able to handle most minor operational spills of oil, which will be collected with sorbent material and disposed of by incineration. At the discretion of the Shell Drilling Supervisor, additional labor crews and material can be mobilized from Deadhorse to assist the Spill Team in cleanup.

1.12 SHELL OIL SPILL RESPONSE TEAM

For spills beyond the capability of the On-Site Team to contain or to clean up, the Shell Oil Spill Response Team, as outlined in Section 2.0 will be activated to the degree required by the severity of the spill up through complete loss of control and blowout of a well.

1.13 LARGE SPILLS

In the event of an uncontrolled blowout, a berm pre-built on the island perimeter will provide containment. Figure 1-1 outlines the containment berm. The berm will be constructed of sandbags and will be approximately 400 feet in diameter. The berm, which is seven feet in height, will contain over 100,000 BBLS of oil.



SECTION VIEW
(NOT TO SCALE)

SHELL OIL COMPANY
EXPLORATION ISLAND
NORTH SLOPE BOROUGH, ALASKA
EMERGENCY CONTAINMENT DIKE
IN CASE OF BLOWOUT

2Z01767-00

FIGURE 1–1

Assuming a 5,000 BBL per day blowout, the berm could contain up to 20 days of production.

This delay will provide adequate time to (a) activate the Oil Spill Response Team, (b) evaluate the alternatives available and the environmental risks posed and to form sound operational judgements including the possibility of ignition and/or (c) begin relief well activities.

If oil threatens to escape the island berm during winter, a snow and ice berm can be constructed around the island. During the open water season, containment booms and skimmers will be available.

Shell Oil Company is a member of the Alaska Beaufort Sea Oilspill Response Body (ABSORB) with full access to ABSORB facilities and management personnel. In addition, equipment and materials are available through a number of organization and service companies, such as Crowley Environmental, Arctic Oilfield Environmental Services, Inc., Gulf of Alaska Cleanup Organization (GOACO), Cook Inlet Response Organization (CIRO), Alyeska, Sohio, Arco and Exxon.

A complete detailed discussion of Gravel Island oil spill scenarios, communications, logistics, equipment, cleanup techniques and environmental data is provided in the "ABSORB Oil Spill Contingency Plan". The ABSORB manual is to be considered as an integral part of Shell's Oil Spill Contingency Plan.

1.14 AVAILABLE EQUIPMENT AND MATERIALS

To allow for deployment of pollution control equipment and construction of dikes, berms and other structures, the following equipment will be maintained on location and at Deadhorse:

On-Site

1 Caterpillar 966 Front Loader
1 Caterpillar D-7 Bulldozer
1 Spill Containment Boom
  (1,500 feet long)
1 Oil Skimmer
Dispersant & Sprayers
Tankage (1,000 BBL)

At Deadhorse**

Front End Loaders
Rollingons
Belly Dumps
Boats, Barges and Tugs
Labor Crews
Graders, Bulldozers, Trucks
Ditching Machines
ABSORB Co-op Equipment
Burners
Snow Machines
Vacuum Trucks
Dispersants

** Equipment available at Deadhorse is expected to require 6 to 12 hours to mobilize to the location, dependent upon weather conditions.

In addition to the equipment shown above, the following construction and absorbent materials will be maintained on location to combat oil spills:

Polyethylene Sheeting and Plastic Bags
10 Rolls - 5/8" x 3' x 150' Absorbent Sheeting
Barite
Bentonite
Lost Circulation Materials (Walnut hulls, cellulose, etc.)
Centrifugal Pumps and Hoses
Hand Tools

Additional spill cleanup equipment including oil mops and sorbent materials can be mobilized from Anchorage to Deadhorse within 6 to 48 hours. Also, additional personnel and equipment can be rapidly mobilized from the Alaskan Beaufort Sea Oil Spill Response Body (ABSORB) Organization, of which Shell is a member.

1.15 CONTAINMENT AND RECOVERY EQUIPMENT CAPABILITY

The above equipment is considered "state of the art" technology for the environmental conditions in which the equipment will be used. Contingency equipment and techniques will be effective for oilspills under, or on, solid ice cover.

1.16 CONTINGENCY EQUIPMENT RESOURCES

Initial response contingency equipment and techniques will be capable of recovering and storing or disposing of a minimum of 1,000 barrels of oil per day. Additional contingency equipment will be available in the event of larger oilspills.

1.17 SUPPORT VESSEL/VEHICLES

Vessel/vehicles needed for year-round deploying and operation of contingency equipment will be available in six hours for initial response and 48 hours for support response. The crews or operators of vessels/vehicles used in contingency operations will be trained and familiar with the equipment deployed and operated by or on the vessel/vehicle.

1.18 DISPERSANTS

Equipment for applying chemical dispersant will be available for use within a six hour response time. Enough chemical dispersant will be maintained on the island to continue application of dispersants until additional dispersants are available from secondary sources. The decision to use dispersants will be made using the criteria and procedures set forth in the Annex X of the National Contingency Plan.

1.19 SUPPORT PERSONNEL

Dedicated pollution response personnel shall be provided and available at the ABSORB warehouse at Deadhorse to insure that the equipment availability, capability, and response times can be met.

A professional cleanup manager will be available from ABSORB to direct pollution response efforts when the spill is beyond the capability of the on-site crew.

1.20 ABSORB EQUIPMENT ACQUISITION LIST

A detailed list of existing ABSORB equipment is shown in Section 4.

1.21 DRILLS

Shell or a contractor serving Shell will hold drills for familiarization with pollution control equipment and operational procedures. This will be done upon placement of the drilling rig on location prior to drilling operations and every six months thereafter, or upon continuation of the drilling operation into a new seasonal environmental condition (i.e., from ice cover to open water), whichever is first.

The personnel identified as the onsite oil spill response operating team in the Contingency Plan shall participate in these drills. The drills shall be realistic and shall include deployment of equipment. A time schedule with a list of equipment to be deployed will be submitted to the DCM, Offshore Field Operations, for approval. The drill schedule will provide sufficient advance notice to allow U.S. Geological Survey personnel to witness any of the drills. Drills will be recorded, and the records will be made available to U. S. Geological Survey personnel.

1.22 TRAINING

Shell will ensure that training classes for familiarization with pollution-control equipment and operational procedures are provided for the oil spill response operating team.

The supervisory personnel responsible for directing the oil spill response operations will receive oil spill control instruction suitable for all seasons. Shell will retain course completion certificates or attendance records issued by the organization where the instruction was provided. These records will be available to any authorized representative of the U.S. Geological Survey upon request.

1.23 OIL SPILL TRAINING PROGRAMS

ABSORB has begun a series of oil spill training schools geared specifically to the kinds of hardware/techniques used in the Beaufort Sea. These schools provide both classroom instruction and hands-on experience at the warehouse and in the field. A detailed description of planned schools is presented in Section 5. Selected Shell personnel and contractor representatives will attend these schools.

1.24 SITE SURVEILLANCE

Under normal drilling operations the Shell Drilling Supervisor will be responsible for conducting frequent reviews of the drill site to ensure that equpment maintenance is kept up to standards and that proper on-site procedures are followed. The items to be checked during site surveillance include, but are not limited to:

1. Mechanical condition of tankage, lines and pumps.
2. Correct positioning of flowline valves.
3. Operation of relief valves.
4. Fluid levels in drip pans, containment pits, etc.
5. Condition of drains (ensure clean and unfrozen).
6. General condition and cleanliness of rig.
7. Condition of spill removal equipment and material.
8. Proper operation of sewage treatment facilities.
9. Snow removal status.
10. Check outer edges of location to be sure no seepage from pad.

In addition, the following procedure will be followed while operating on these locations:

1. The Shell Drilling Supervisor will designate "Briefing Areas" where all personnel will meet in case of emergency and where emergency equipment will be kept.
2. The site will be equipped with a Shell operated radio system.
3. A list of current emergency telephone numbers and a map of the local area will be maintained by the Drilling Supervisor.

1.25 NOTIFICATION REQUIREMENTS (See Pages 3-10 thru 3-13)

In the event of an oil spill, the Shell Drilling Supervisor shall immediately contact the Anchorage Office and issue a report including the following information:

A. Date and time spill occurred or was first observed.

B. Where spill occurred and present location.

C. Estimate of amount and type of material spilled.

D. Environmental conditions (temperature, wind, etc.).

E. Description of area likely to be affected.

F. Cause of spill.

G. Action taken to combat spill.

The Shell Drilling Supervisor will be responsible for making contact with Division Drilling, Legal, and all required governmental agencies. General procedures for the Supervisor to follow in this regard are:

A. Contact U.S. Coast Guard by telephone and notify that spill has occurred and is being investigated, only if the spill threatens to enter any navigable waters (lakes, streams, ocean and/or ice).

B. Contact USGS by telephone immediately if spill is greater than 6.3 BBLS and within 12 hours if less than 6.3 BBLS.

C. Notify Headquarters Drilling of the spill providing available details.

D. Notify Alaska Department of Environmental Conservation by telephone for spills within three-mile limit.

1.26 OIL CONTAINMENT PLAN

A. Before Freezeup (Summer Operations)

In the event that an oil spill occurring before freezeup at the location cannot be contained on the drill site or in the contingency pit and pollutants reach open water, the following steps will be taken to contain the oil spill:

1. Stop the spill at its source unless it is the result of an uncontrolled blowout, in which case see Uncontrolled Blowout Plan.

2. Mobilize all equipment required to contain the spill fluid.

3. Ascertain the direction of current (general direction in which the spill is moving).

4. Using boats, deploy the spill containment boom to surround the spilled fluids, block the fluid flow, and collect the spilled fluids. As the 1,500 feet of boom will not surround the entire perimeter of the island, it will be necessary to place the boom to block the expected path of spill migration. A typical deployment diagram is shown in the attached Figure 2.

5. Once the spill containment boom is in place, deploy the oil skimmer directing it into the location of the highest oil concentration.

6. Make a sweep periodically of the outside perimeter of the containment boom to assess whether any oil has escaped to open water.

7. Mop up any residual fluids with absorbent materials and recover all contaminated ice, snow, and gravel, placing contaminated materials in containers for disposal.

B. <u>During Freezeup</u>

During freezeup limited operations may be possible to contain and mop up spilled fluid depending upon the extent of the ice cover and ice conditions.

If sufficient ice leads exists to allow navigation of small boats in and through open ice, the following procedures may be initiated:

a. Deployment of the spill containment boom may be feasible if open water exists around the drill site area.

b. The oil skimmer may be deployed in large ice leads to mop up isolated spills.

c. Sorbent materials should be used where applicable to clean up oil spilled in small ice leads.

d. An oil mop can be used in conjunction with a small boat to recover floating oil slicks in ice leads.

If sufficient ice leads do not exist and/or only a thin continuous ice layer exists, the general perimeter of the spill should be staked and movement of the spill area

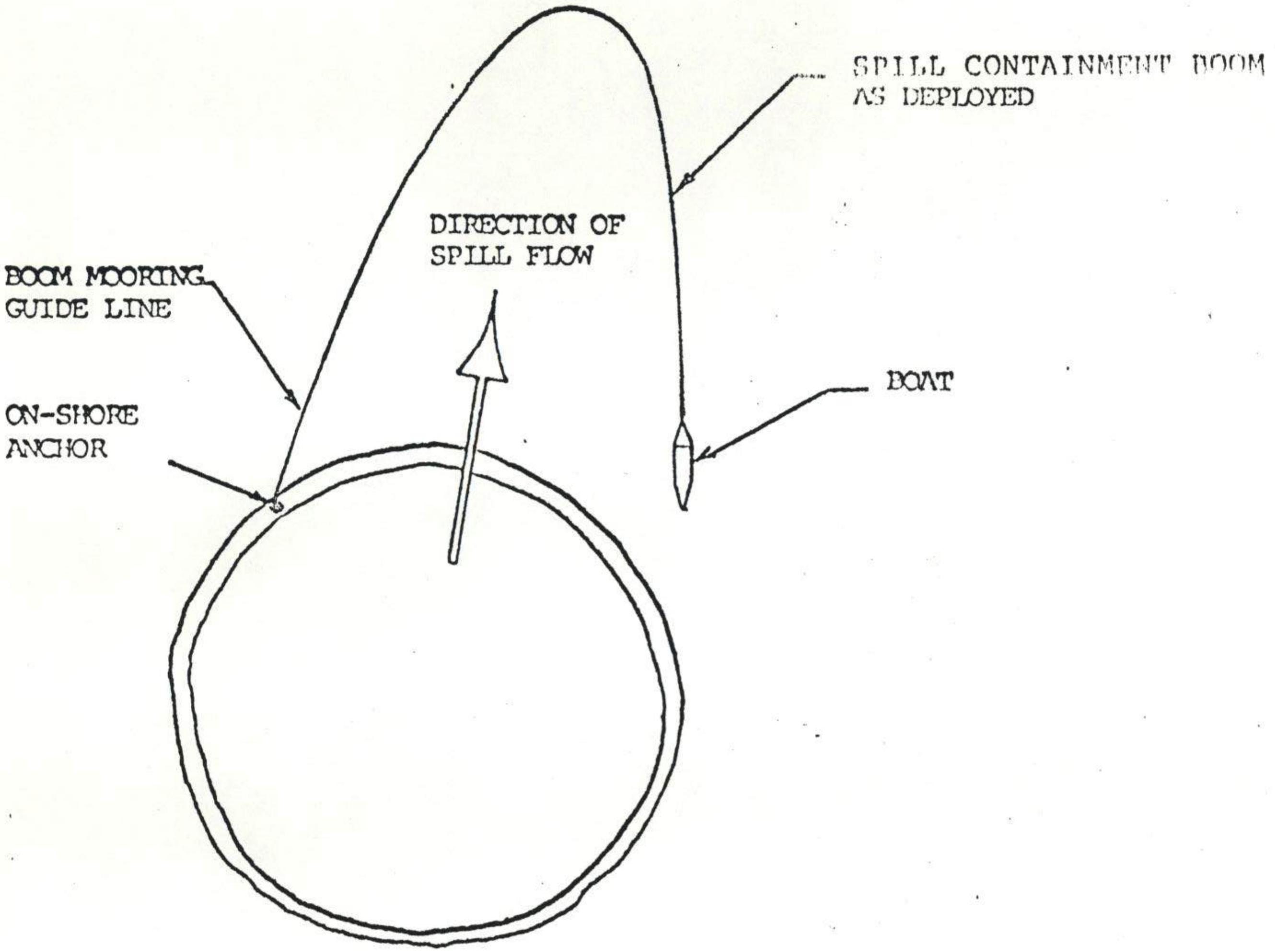


FIGURE 2
TYPICAL DEPLOYMENT OF THE SPILL CONTAINMENT BOOM (SUMMER OPERATIONS ONLY)

closely monitored. In this case, the procedure will be to allow the ice pack to freeze sufficiently so that equipment and personnel can be mobilized for cleanup procedures identified in the after freezeup section.

NOTE: SAFETY OF PERSONNEL IS A MAJOR CONSIDERATION WHILE CONDUCTING CLEANUP OPERATIONS DURING THE PERIOD OF FREEZEUP. PERSONNEL SHOULD NOT OPERATE ON ICE PACKS HAVING QUESTIONABLE INTEGRITY OR ON FREE-FLOATING ICE.

Oil entering the water during freezeup will eventually become entrained in the sheet ice. Later into the winter, this oil could be mechanically recovered or burned in place as conditions warrant.

C. After Freezeup (Consolidated ice pack existing.)

After freezeup the primary defense outside the island perimeter will be the naturally occurring snow on top of the ice. Recent information indicates this is preferable to building a snow berm around the location for limiting the spread of a spill.

Cleanup operations after freezeup should be aided by the increased viscosity of fluids at low temperatures. Recovered fluids and contaminated cleanup materials (snow, ice, absorbents, etc.) should be placed in steel containers for disposal.

D. Breakup

As spring breakup approaches, any oil that has been frozen into ice will tend to rise to the surface through brine drainage channels in the sea ice. This oil could be mechanically recovered or burned in place as conditions warrant.

Access to a spill site during breakup will be provided by helicopter or hovercraft, amphibious vehicles or specialized boats.

As more and more ice melts with the coming of summer, small boats and specially-designed skimmer vessels could be employed to remove any oil that may have been trapped by or on the ice.

Recovered oil could be burned offshore on a barge, or transported to shore where it could be burned, injected back underground through a disposal well, or salvaged and processed for flow through the trans-Alaska pipeline with other oil produced from the Prudhoe Bay field.

1.27 SPILL CLEANUP PROCEDURES

The spill cleanup efforts at the locations will be directed toward returning the affected area to as near natural state as possible. Minor spillage of fluid will be cleaned by use of absorbent materials and recovery of contaminated materials such as gravel, etc. These soaked materials will be placed in containers for future disposal. Major oil spillage will be handled by use of conventional skimming equipment. Snow, absorbent materials, and other contaminated materials will be recovered and processed by incineration.

1.28 FUEL TRANSFER PROCEDURES

Operations involving fuel transfer are critical in that mistakes occurring at this time will likely lead to an oil spill. It is the Drilling Supervisor's responsibility to ensure that proper procedures are implemented during each fuel transfer. General guidelines for these operations are:

A. Ensure by testing or inspection that all equipment and lines are in proper working order before each transfer begins. Lines are to be pressure tested to 1.5 times the maximum anticipated transfer pressures.

B. Review procedures with all personnel involved to ensure that everyone knows his job.

C. Double check that all valves are positioned correctly before transfer begins.

D. Make a visual inspection of equipment once transfer begins. Keep track of volumes and pressures during pumping. Shut down operations immediately at the first sign of pressure loss or leakage.

1.29 ABSORB COASTLINE SENSITIVITY ATLAS

If a major oil spill occurs in the nearshore Alaska Beaufort Sea, it is possible that not all spilled oil will be contained and cleaned up offshore. Oil escaping containment will likely move east southeast down wind toward sections of the Beaufort Sea coast.

Since it is not possible to protect an entire coastline, methods have been developed to evaluate the relative sensitivity of each stretch of coast so that the most sensitive areas threatened by a spill can be protected first. Oil spill countermeasures can then be directed at minimizing the impact of the oil on other threatened areas.

ABSORB is now developing a Coastline Sensitivity Atlas showing locations and rankings of sensitive areas, along with specific methods to protect each area from an oil spill.

The draft atlas is currently (July 1981) being reviewed by interested government agencies. The final study should be complete and available for utilization by Shell and ABSORB by the end of 1981 before drilling commences on the island.

For each segment of Beaufort Sea coast, the Coastline Sensitivity Atlas will identify response priorities based on the variety of factors that can influence the behavior of an oil spill, i.e., currents, wind, ice and the biological, social and economic values to be protected. The completed atlas will describe countermeasures recommended to minimize the impact of the spill on particular environments. The countermeasures and priorities for protection given in the atlas will be subject to periodic review and revision as information becomes available.

1.30 OIL SPILL HANDBOOK

An oil spill handbook is currently being compiled by ABSORB and will be available by November 1, 1981 before drilling commences on the island.

1.31 UNCONTROLLED BLOWOUT (RELIEF WELL) PLAN

A. Scope

This section of the Contingency Plan covers action to be taken to initiate relief well operations in the event of an uncontrolled blowout in the area of operations. The possibility of this occurring is considered extremely low because of the extensive precaution to be taken to prevent loss of well control. This section does not deal with control of pollution resulting from the blowout. This is dealt with in the ABSORB Manual.

B. Well Ignition

The blowout well will be ignited at the discretion of the on-site Shell Senior Supervisor if there is immediate danger to personnel. Otherwise, the well will be ignited for safety and to limit the potential for adverse environmental impact only after evaluation of the alternatives available and after discussion with Shell management and the proper govermental agencies.

C. Equipment and Supply Mobilization

In the event of a blowout, all equipment necessary for constructing the relief well pad would be immediately mobilized from Prudhoe to the location. The equipment used and transportation method will depend upon the time of the year and availability. The ABSORB Manual contains comprehensive lists of construction companies located at Prudhoe. A drilling rig will also be located at this time and planned for mobilization as soon as the pad is available.

The relief well drilling rig could be any industry rig in current arctic service. If all adequate rigs are under contract and in use at the time of the spill, current oil industry practice dictates that one or two will be released from their commitments to enable their use for relief well service.

If necessary, as a last resort, a Herc transportable rig could be flown into Deadhorse from another area.

Depending on the time of year the blowout occurred, it may be necessary to obtain a helicopter transportable rig. Supplies and equipment required for drilling the relief well would be obtained and located at a staging area at Deadhorse to permit rapid transportation to the location as soon as the relief well pad was completed. Gravel for the relief well pad would probably be obtained from the same gravel source as the original island or from Prudhoe sources during the open water season. It is anticipated that most rig and supply movement will take place over existing ice roads or by tug and barge during the summer season. During the periods of breakup and freezeup, all transportation will be by airplane, helicopter, or possibly air cushion vehicles.

D. Relief Well Location

The optimum location for a relief well pad is dependent upon several factors existing at the time of the blowout, including blowout well depth and both current and projected wind and current conditions at the location. In this nearshore area, currents are strongly influenced by wind direction. Wind patterns have been recorded on a monthly basis at the Prudhoe airport. An attempt would be made to place the location in minimum water depth at a distance from the blowout well to provide optimum directional drilling parameters for the relief well. In case the blowout well was directional, an attempt would be made to locate the relief well pad such that the relief well could be drilled as nearly as possible as a straight hole to intercept the blowout wellbore. In all cases, the relief well pad will be placed a sufficient distance from the blowout well to ensure personnel and equipment safety for the duration of the anticipated drilling program. It is anticipated that in most cases the relief well pads would be located in water depth similar to the original pad.

E. Pad Construction

After freezeup a gravel location large enough to accommodate the drilling rig and kill equipment would be constructed using construction techniques similar to those used for the original pad. All available equipment that could be used efficiently would be utilized. As soon as pad size is large enough to support the drilling rig and associated drilling support equipment, the rig and equipment may be mobilized to the pad over ice roads, ice conditions permitting. Pad size could then be expanded as necessary to accommodate the kill equipment and fluids which will not be required until the relief well is drilled to TD. Another possibility, depending on timing, is that the kill equipment could be brought to the location on barges after breakup.

During open water periods, a relief well gravel location would be constructed by the proven technique of using barges and tugs to transport the gravel from the Prudhoe Bay West Dock to the location.

During periods of breakup and freezeup, pad construction would not be attempted until such time as conditions were safe for personnel and equipment to operate. In this case, all supplies, equipment, and material necessary for construction would be assembled at the nearest staging point such that construction could begin immediately when safe to do so.

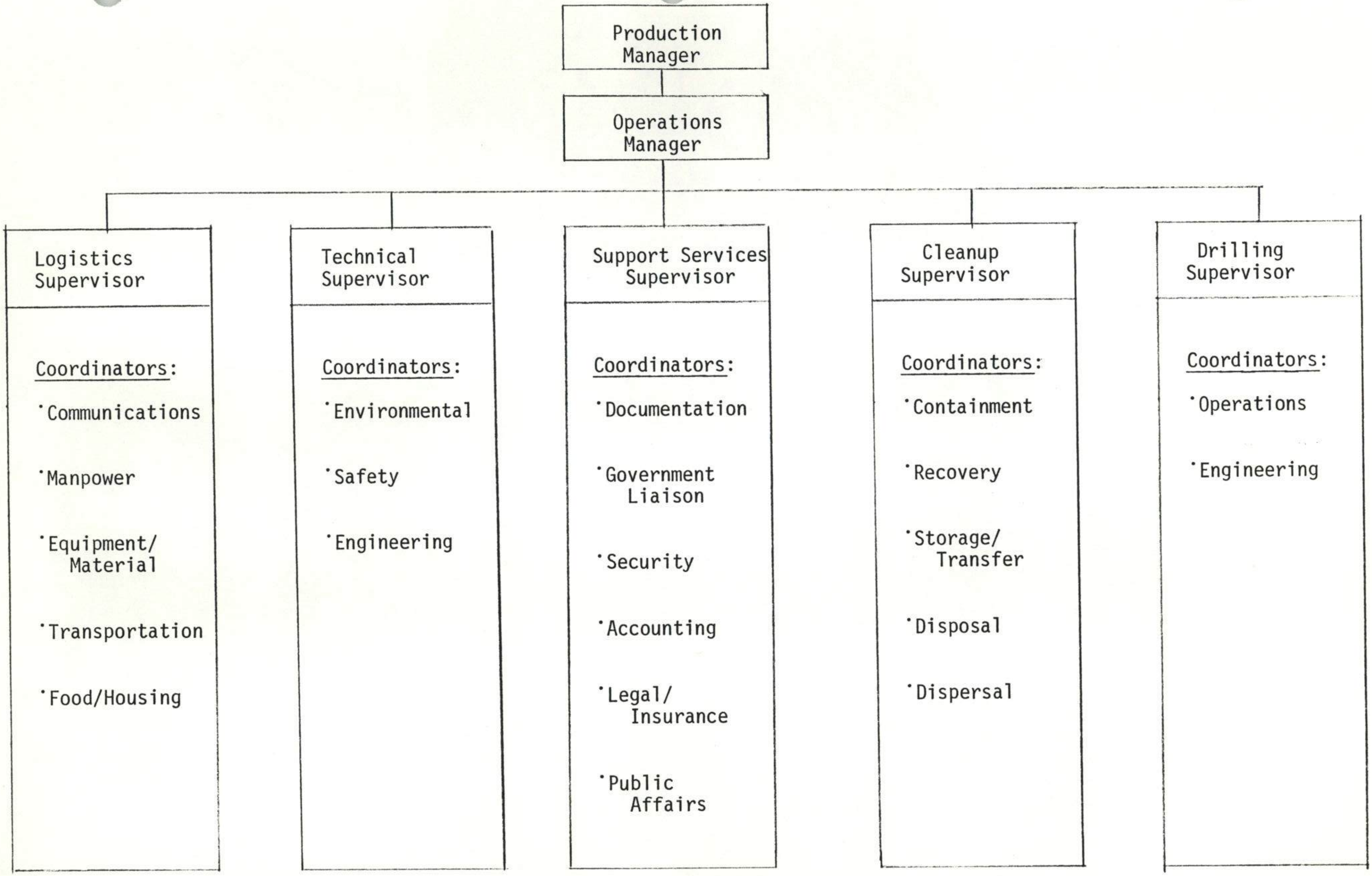
2. ORGANIZATION AND NOTIFICATION PROCEDURES:

2.1 General Organization

The purpose of this section is to describe Shell's administrative organization and the assignment of duties for an oil spill cleanup operation. The procedures for documenting spills are also discussed, along with guidelines for coordination with the government, the media, and the public.

Figure 2-1 shows the organization which would be required for a full-scale response to a major spill. For a small spill, only the Operations Manager and several members of his staff may be needed, depending on the particular expertise required. In some cases each supervisor may elect to assume the responsibilities of all or several of his coordinators.

The Operations Manager will obtain as much labor support as necessary at the time of an actual spill emergency. This help will come from contractors or from internal Shell sources as deemed feasible.



ORGANIZATION

Figure 2 - 1

Job Title	Assigned To	Company Assignment And Location	Telephone
Production Manager	W. M. Marshall	Production Manager Pacific Division Houston, TX	(713) 870-2440 (Office) (713) 461-7229 (Home)
	J. E. Dozier, Jr., Alt.	SEC Manager Pacific Division Houston, TX	(713) 870-2443 (Office) (713) 444-0325 (Home)
Operations Manager	L. P. Ramirez	Operations Manager Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 644-6785 (Home)
	G. T. Karnes, Alt.	Production Superintendent Northern Operations Ventura, CA	(805) 648-2751 (Office) (805) 644-1750 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Logistics Supervisor	J. H. Douglas	Production Foreman Alaska Operations	(907) 276 - 2545 (Office)
	H. A. Van Schelt, Alt.	Staff Facilities Engineer Alaska Technology Houston, TX	(713) 870-2676 (Office) (713) 376-4430 (Home)
Communications Coordinator	B. J. Nance	Technical Manager Products-Engineering Services Houston, TX	(713) 241-6853 (Office) (713) 729-9273 (Home)
	P. M. Molnar, Alt.	Communications Supervisor Operations/Pipelines West Coast Division Anaheim, CA	(714) 991-9200 (Office) (714) 630-1446 (Home)
Manpower Coordinator	E. W. Quayle	Services Supervisor Purchasing & General Services Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 642-5828 (Home)
Equipment/Material Coordinator	M. W. Dimock	Senior Materials Control Analyst Purchasing & General Services Pacific Operations Ventura, CA	(805) 643-6681 (Office) (805) 644-4996 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Transportation Coordinator	M. W. Dimock	Senior Materials Control Analyst Purchasing & General Services Pacific Operations Ventura, CA	(805) 643-6681 (Office) (805) 644-4996 (Home)
Food/Housing Coordinator	K. R. Granger	Senior Storekeeper Pacific Operations Long Beach, CA	(213) 435-3783 (Office) (714) 894-0347 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Technical Supervisor	M. R. Cornell	Manager, Alaska Technology Pacific Division Houston, TX	(713) 870-2674 (Office) (713) 729-2792 (Home)
	W. F. Simpson, Alt.	Staff Facilities Engineer Alaska Technology Pacific Division Houston, TX	(713) 870-2678 (Office) (713) 371-4137 (Home)
Environmental Coordinator	W. F. Gusey	Senior Staff Wildlife Specialist Environmental Affairs Head Office Houston, TX	(713) 241-4332 (Office) (713) 353-0052 (Home)
	J. P. Ray, Alt.	Staff Specialist - Marine Biology Environmental Affairs Head Office Houston, TX	(713) 241-3060 (Office) (713) 353-7400 (Home)
Safety Coordinator	H. B. Carlile	Staff Technical Safety Specialist Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 642-8861 (Home)
	G. B. Evans, Alt.	Safety Representative, SEC Pacific Operations Ventura, CA	(805) 643-1197 (Office) (805) 485-2025 (Home)

Technical Supervisor (continued)

Job Title	Assigned To	Company Assignment And Location	Telephone
Engineering Coordinator	J. Ward	Research Engineer Houston, TX	(713) 241-3769 (Office) (713) 392-3054 (Home)
	D. J. Agerton, Alt.	Civil Engineer Alaska Technology Pacific Division Houston, TX	(713) 870-2683 (Office) (713) 520-1920 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Support Services Supervisor	R. J. Pusanik	Division Engineering Manager Pacific Division Houston, TX	(713) 870-2442 (Office)
	G. L. Jemmott, Alt.	Senior Staff Facilities Engineer Beaufort Sea Development Pacific Division Houston, TX	(713) 870-2685 (Office) (713) 444-7619 (Home)
Security, Documentation Coordinator	H. L. Biggers	Safety Representative Pacific Operations Ventura, CA	(805) 645-2751 (Office)
	C. Z. Lindner, Alt.	Safety Representative Pacific Operations Ventura, CA Long Beach Unit	(213) 597-7128 (Office) (714) 897-5286 (Home)
Government Liaison Coordinator	J. E. Dozier, Jr.	SEC Manager Pacific Division Houston, TX	(713) 870-2443 (Office) (713) 444-0325 (Home)
	C. F. Martin, Alt.	Staff Engineer, SEC Pacific Division Houston, TX	(713) 870-2446 (Office) (713) 836-2095 (Home)

Suppor Services Supervisor (continued)

Job Title	Assigned To	Company Assignment And Location	Telephone
Accounting Coordinator	S. S. Walker	Pacific Division	(805) 648-2751 (Office) (Home)
Legal Coordinator	B. G. Warren	Legal Manager West Coast Legal Office Anaheim, CA	(213) 589-6661 (Office) (714) 499-3856 (Home)
Public Affairs Coordinator	M. H. Boeger	Public Affairs Manager Western E&P Operations Houston, TX	(713) 241-3881 (Office) (713) 664-8467 (Home)
	B. G. Scrimpshire, Alt.	Senior Representative West Western E&P Operations Houston, TX	(713) 241-4542 (Office) (713) 498-1537 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Cleanup Supervisor	C. J. Frazier	Production Superintendent Beta Production Unit Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 646-5190 (Home)
	J. W. Books, Alt.	Production Superintendent Central Operations Ventura, CA	(213) 648-2751 (Office) (805) 646-2260 (Home)
Containment Coordinator	F. N. Crabill	Production Foreman Coastal Operations Long Beach Unit, CA	(213) 597-8033 (Office) (714) 531-5709 (Home)
	M. L. Fisher, Alt.	Training Specialist, SEC Pacific Operations Brea, CA	(213) 691-8091 (Office) (714) 960-1276 (Home)
Recovery Coordinator	R. F. Honer	Production Foreman Beta Production Unit Pacific Operations Long Beach, CA	(213) 435-3783 (Office) (714) 891-7541 (Home)
Storage/Transfer Coordinator	W. R. Dietze	Construction Superintendent Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 649-9505 (Home)
	F. N. Crabill, Alt.	Production Foreman Coastal Operations Long Beach Unit, CA	(213) 597-8033 (Office) (714) 531-5709 (Home)

Clean Supervisor (continued)

Job Title	Assigned To	Company Assignment And Location	Telephone
Disposal Coordinator	H. W. Wurner	Operations Foreman Coastal Operations Yorba Linda Unit, CA	(714) 528-7076 (Office) (714) 891-1100 (Home)
Dispersal Coordinator	L. L. Marshall	Operations Foreman Coastal Operations Ventura Unit, CA	(805) 643-2027 (Office) (805) 648-6894 (Home)

Job Title	Assigned To	Company Assignment And Location	Telephone
Drilling Supervisor	M. L. Woodson	Production Superintendent Alaska Operations Anchorage, AK	(907) 276-2545 (Office)
	E. C. Johnson, Alt.	Drilling Superintendent Pacific Operations Ventura, CA	(805) 648-2751 (Office) (805) 642-5876 (Home)
Operations Coordinator	W. F. Bangs, Jr.	Drilling Foreman Pacific Operations Ventura, CA	(805) 643-8231 (Office) (805) 659-1163 (Home)
	D. O. Webster, Alt.	Drilling Foreman Pacific Operations Ventura, CA	(805) 643-3681 (Office) (805) 647-5313 (Home)
Engineering Coordinator	D. E. Smith	Division Drilling Engineer Pacific Division Ventura, CA	(805) 648-2751 (Office)
	L. A. Primm, Alt.	Senior Drilling Engineer Pacific Division Ventura, CA	(805) 648-2751 (Office)

Proper record-keeping is essential to an efficiently run cleanup operation and is the responsibility of all members of the response team. All coordinators will report daily to the Documentation Coordinator or at a minimum, provide documentation of key transactions and decisions to ensure that a complete spill history is being maintained. The subject of record-keeping is addressed in more detail in Section 2.3.

The following subsections contain detailed descriptions of the duties of each member of the Operations Manager's staff.

2.2 Response Team Job Descriptions

OPERATIONS MANAGER

- In compliance with company policy and in coordination with senior management, has complete responsibility and total authority for directing field operations and for making or revoking decisions regarding procedural matters.
- Reports directly to spiller company management and represents their interests throughout the cleanup operation.
- Is the only member of the Response Team with authority to contract for services and equipment from ABSORB or other sources. He may delegate this authority to the Logistics Supervisor.

- Establishes the field command post.
- Directs all line supervisors.
- Establishes priorities on use of radios and telephones.
- With the daily input of his supervisors, monitors the spill and its cleanup to determine if more manpower and/or equipment are required.
- Oversees and approves the deployment of men and equipment.
- Approves the movement and activities of all visitors (press, public, etc.) on-scene. Provides liaison with these groups as necessary through the Support Services and Logistics Supervisors.
- Clears all press releases after they are checked by the Legal/Insurance Coordinator and sends them on to spiller company upper management for approval.
- Meets routinely with government on-scene observers and as necessary with Regional Response Team (RRT) personnel to discuss cleanup plans and priorities and the adequacy of results.
- Directs preparation of daily reports and a final written report on the cleanup operation, with assistance from the Documentation Coordinator.

LOGISTICS SUPERVISOR

- Supports the field operation by acquiring and sending to the spill site the manpower and equipment requested by the Operations Manager.
- Is responsible for directing the efforts of the Communications Coordinator, Manpower Coordinator, Equipment/ Materials Coordinator, Transportation Coordinator, and the Food/Housing Coordinator.
- Depending on the size of the spill cleanup operation, may elect to assume the responsibilities of one or several of these coordinators.

Communications Coordinator

- Sets up and maintains the field communications system.
- Sees that a detailed log of all communications (other than routine operational transmittals) is kept by command post personnel manning telephones and radios. Provides this log to the Documentation Coordinator.
- Checks out portable radios to authorized personnel according to the provisions of this contingency plan.
- Assigns a dispatcher as necessary to take and relay messages.

Manpower Coordinator

- Arranges for manpower needs as requested by the cleanup coordinators.
- Keeps time records of all workers.
- Keeps current list of all personnel involved in the cleanup operation.
- Provides necessary personnel information to the Accounting Coordinator for maintenance of payroll records.

Equipment/Materials Coordinator

- Serves as the clearinghouse for requests for equipment and supplies.
- Maintains careful records of company, contractor, and other equipment being used. Records should cover such items as location of use, hours of use, supplies used, spare parts and replacements needed, etc.
- Sets up and runs a maintenance shop for equipment being used for the cleanup operation.
- Manages mechanics and laborers assigned to maintenance.
- Provides spare parts and gas, oil, and other supplies as needed for cleanup equipment.
- Spot checks contractor maintenance procedures on critical equipment.
- Handles inventory and distribution from staging areas.

Transportation Coordinator

- Arranges for transportation of all personnel and material to the spill site.

- Coordinates with airlines, service companies, etc. to fill requests for transportation.
- Combines small shipments into larger ones to reduce equipment use.
- Keeps careful records of requests and expenditures.
- Establishes and manages a staging area for shipment of men and materials to the spill site.

Food/Housing Coordinator

- At the request of the Operations Manager, arranges for the mobilization of required portable camp facilities.
- Coordinates meals and lodging at available facilities at Prudhoe Bay.
- Supervises efforts of workers assigned to food preparation and housekeeping at the portable camps.
- Arranges for acquisition and delivery of food supplies.

TECHNICAL SUPERVISOR

- Is responsible for providing the Operations Manager and the other supervisors with the technical information they need on equipment and the environment and for ensuring the safety of the operation.
- Directs the Environmental Coordinator, the Safety Coordinator, and the Engineering Coordinator, but will assume their roles for a smaller operation.

Environmental Assessment Coordinator

- Maintains liaison in the field with environmental/scientific representatives of governmental agencies. Coordinates with the Government Liaison Coordinator.
- Provides the Operations Manager with damage assessments.

- Surveys the spill area and advises the Operations Manager of environmentally sensitive areas to protect.
- Responds to requests for technical information concerning environmentally sensitive areas.
- Coordinates wildlife rehabilitation activities.
- Provides liaison between the spiller company and environmental groups.
- Monitors the spill cleanup to ensure proper cleanup and restoration procedures are followed.
- Establishes sampling programs to determine the environmental effects of the spill.
- Maintains an awareness of the coastal ecology in the response area.
- Maintains up-to-date files of environmental information on the response area.
- Works with the Engineering Coordinator to determine best disposal techniques.
- Works closely with the Dispersal Coordinator and Government Liaison Coordinator on questions of use of dispersants.
- Advises the Operations Manager on adequacy of cleanup.
- Establishes liaison as required with environmental specialists from other companies or consultants. Obtains from the National Weather Service and other sources weather and ice forecasts, satellite photos, and information on tides and currents.

Safety Coordinator

- Determines precautions to be taken to minimize the hazards of explosion, fire, vapor inhalation, or any other possible accident.
- Regularly inspects the scene of the cleanup operation to identify and eliminate safety hazards.
- Checks safety features of equipment being sent to the spill site and advises on safe operation of all equipment.

- Dispenses first-aid, safety, and survival equipment and maintains the inventory of these items.
- Coordinates the staging of fire control equipment.
- Arranges for procurement and distribution of safety equipment and survival gear as requested by the Logistics Supervisor.
- Contacts first-aid centers at the North Slope and hospitals in Anchorage and Fairbanks to prepare them for possible injured Response Team members.

Engineering Coordinator

- Determines the magnitude of the spill and associated flowrates.
- Monitors spill movement and behavior.
- Advises the Operations Manager on technical aspects of containment and cleanup, i.e., adequacy of techniques and equipment, effects of ice and reduced temperatures, etc.
- Advises on physical/chemical aspects of ice loading, oil combustion, strength of materials, etc.
- Works with the Environmental Coordinator to determine best disposal techniques.
- Provides needed technical information from company files and establishes liaison as necessary with engineers from other companies and with consultants.

SUPPORT SERVICES SUPERVISOR

- Handles the public affairs, legal, governmental, and financial aspects of the cleanup operation.
- Is responsible for providing clerical help and security for the cleanup operation.
- Supervises the Documentation Coordinator, Government Liaison Coordinator, Security Coordinator, Accounting Coordinator, Legal/Insurance Coordinator, and Public Affairs Coordinator and may assume their functions for a small operation.
- The Support Services Supervisor and his staff maintain close liaison with any counterparts in Anchorage.

Documentation Coordinator

- Keeps a detailed daily log of the following:
  - Events and their timing
  - Communications by radio or telephone (other than routine operational transmittals)
  - Minutes of meetings
- Uses the log to write brief narratives of each day's events for distribution to management and for use in the spill history.
- Coordinates the record-keeping of all other staff members to ensure that the proper data is being recorded.
- Arranges for a photographer to record important events of the spill cleanup.
- Maintains a complete file of all correspondence, reports, data sheets, etc. on the cleanup operation.
- Arranges for the collection of newspaper clippings and other information on media coverage of the spill cleanup operation. Includes monitoring radio and television broadcasts.
- Assists in the preparation of a comprehensive final report and in submitting required reports to government agencies (this task is to be coordinated with the Government Liaison Coordinator).

Government Liaison Coordinator

- Reports the spill to appropriate local, state and federal agencies as requested by spiller company upper management.
- At the request of the Operations Manager, obtains necessary government approvals and permits for actions subject to regulation such as use of dispersants, access to lands, location and use of disposal sites, use of government-owned equipment, etc. Coordinates with the Environmental Coordinator on these matters.

- Establishes and maintains contact with representatives of government agencies and conveys information and requests to the Operations Manager.
- With approval of the Operations Manager, arranges for observation visits to the spill site by representatives of government agencies and serves as a guide during these visits.
- Works closely with the Environmental Coordinator, sharing the responsibility of conducting site visits with government on-scene observers.
- Serves as spiller company representative to the Regional Response Team or any other committee formed by government to assist in the cleanup.
- Keeps accurate notes for use in the spill history.

Security Coordinator

- Insures that only authorized personnel enter the field office and spill cleanup zone.
- Assigns security officers to area as required.
- With approval of Operations Manager, issues passes to members of the press, government agencies, and other visitors.
- Provides badges as necessary for Response Team and support (contract) cleanup personnel.

Accounting Coordinator

- Documents labor, materials, and services used for the cleanup operation. Keeps records of:
  - Labor breakdown by hours and rates
  - Equipment rentals
  - Materials and supplies purchased or rented
  - Time and contracts cost
  - Freight charters
  - Food and lodging
- Prepares bills, pays invoices, and audits contractors as necessary.

- Advises the Operations Manager of costs and prepares daily cost forecasts.
- Assists in preparation of a detailed financial report at end of project.

Legal/Insurance Coordinator

- Provides legal advice to the Operations Manager to point out potential legal actions and areas of liability.
- Is thoroughly familiar with all applicable local, state, and federal laws and regulations affecting the member company's cleanup efforts.
- Advises the Documentation Coordinator at the start of an operation of which records are necessary to properly document the spill and cleanup operation in anticipation of potential lawsuits and insurance claims.
- Reviews press releases.
- Provides qualified claims adjusters to investigate claims of damage.
- Obtains rights-of-way and permits as necessary for a cleanup operation.
- Handles inquiries from insurance companies and accompanies claims adjusters on tours of site.

Public Affairs Coordinator

- Deals with the news media as stipulated in Section 2.4, Public Relations.
- Coordinates with public relations representatives assigned to the spill site.
- Prepares regular press releases and statements for release after approval by spiller company management, the Operations Manager, and the Legal/Insurance Coordinator.
- Arranges for and chaperones tours by members of the news media.

- Maintains a close working relationship with the news media, government agencies, conservation groups, and public organizations during the cleanup operation.
- Keeps accurate notes for use in the spill history.

CLEANUP SUPERVISOR

- Is responsible for directing the cleanup crews.
- Directs the Containment Coordinator, Recovery Coordinator, Storage/Transfer Coordinator, Disposal Coordinator, and Dispersal Coordinator, but will assume their roles for a small cleanup operation.

Containment Coordinator

- Directs all containment operations.
- Determines action required and assigns work crews and equipment.
- Arranges for men and equipment through the Logistics Supervisor.
- Monitors performance of field foremen and work crews, directs crew shifts, settles disputes, insures that safety procedures are followed, and signs daily worksheets.

Recovery Coordinator

- Directs operation of oil recovery equipment.
- Determines action required and assigns work crews and equipment.
- Arranges for men and equipment through the Logistics Supervisor.
- Monitors performance of field foremen and work crews, directs crew shifts, settles disputes, insures that safety procedures are followed, and signs daily worksheets.

Storage/Transfer Coordinator

- Directs the movement of oil from recovery devices to transfer vessels to storage or disposal locations.
- Determines action required and assigns work crews and equipment.
- Arranges for men and equipment through the Logistics Supervisor.
- Coordinates with the Recovery and Disposal Coordinators.
- Monitors performance of field foremen and work crews, directs crew shifts, settles disputes, insures that safety procedures are followed, and signs daily worksheets.

Disposal Coordinator

- Arranges for disposal of oil and oily waste as directed by the Cleanup Supervisor.
- Checks with the Government Liaison Coordinator to ensure that government approval has been obtained for in-situ burning, incineration, and any other disposal techniques requiring government approval.
- Arranges for men and equipment through the Logistics Supervisor.
- Monitors performance of field foremen and work crews, directs crew shifts, settles disputes, insures that safety procedures are followed, and signs daily worksheets.

Dispersal Coordinator

- Directs any dispersal operations at the request of the Cleanup Supervisor and only after requisite government approvals have been obtained through the Government Liaison Coordinator.
- Arranges for men and equipment through the Logistics Supervisor.
- Coordinates with the Environmental Coordinator.
- Monitors performance of field foremen and work crews, directs crew shifts, settles disputes, insures that safety procedures are followed, and signs daily worksheets.

DRILLING SUPERVISOR

- Responsible for ongoing drilling operations in the event that additional rigs are brought in to assist in emergency situations, i.e., to drill relief wells, etc.

Drilling Coordinator

- Advises Drilling Supervisor on operational aspects of techniques and equipment required for relief well or other activities.

Engineering Coordinator

- Advises Drilling Supervisor on technical aspects of techniques and equipment required for relief well.
- Provides needed technical information from Company files and establishes liaison as necessary with engineers from other companies and with consultants.

2.3 DOCUMENTATION PROCEDURES

Because of potential legal and public relations problems, the maintenance of thorough records of all events which transpire during an oil spill cleanup operation is extremely important. The early hours of a spill response are extremely hectic, with the potential for numerous conflicting requests. A complete log of events and communications makes the task of reconstructing the spill much easier. The following paragraphs present instructions for maintaining the necessary spill history information.

2.3.1 Initial Reporting

Figure 2-3 is a copy of the Initial Report Form to be filled out.

Several government agencies require verbal reports of a spill, and it is the responsibility of the spiller company to see that these reports are made. Either a telex or letter should be sent immediately to provide documentation of the verbal report. A verbal reporting checklist is presented in Figure 3-8 in Section 3.

2.3.2 Spill Logs

The principal spill log will be maintained by the Operations Manager, with assistance from the Documentation

INITIAL REPORT FORM

I. SPILL DATA

TIME OF CALL ______________ DATE ______________

PERSON REPORTING SPILL ______________

AFFILIATION ______________

(Specify) Company ______________

____

Government Agency ______________

SPILL LOCATION ______________ TYPE OF OIL ______________ EST. GRAVITY ____

SPILL SOURCE (Blowout, Tank rupture, etc.) ______________

VOLUME/FLOWRATE ______________ FLOW STOPPED? ☐ Yes ☐ No

SPILL DESCRIPTION (Into Water? Ignited? Areal Extent? Etc.) ______________

____

ACTIONS TAKEN (Briefly): ______________

____

____

EQUIPMENT DEPLOYED (Major Pieces); ______________

____

____

AGENCIES NOTIFIED ______________

II. ENVIRONMENTAL CONDITIONS AT SITE

WIND (Speed & Direction) ______________

TEMPERATURE ______________ VISIBILITY ______________

ICE CONDITIONS ______________

SEA STATE ______________

ENVIRONMENTAL DAMAGE (Real or Potential) ______________

INITIAL REPORT FORM

III. INVOLVEMENT

EQUIPMENT REQUESTED (Specify quantity of each)

Facilities

___ Office Equipment
___ Warehouse Equipment
___ Miscellaneous Tools & Equip.
___ Field Command Post
___ Field Camp

Transportation

___ Workboat
___ Jon Boat

Detection

___ Gas Detector
___ Current Meter
___ Ice Auger

Containment

___ Heavy-Duty Containment Boom
___ Compactible Containment Boom
___ Boom Accessories

Recovery

___ Rope Mop Skimmer
___ Vessel Skimmer
___ Portable Weir-Type Skimmer
___ Sorbents

Storage

___ Portable Containment Device
___ Towable Bladder
___ Bladder Tank

Transfer

___ Arctic Hose & Fittings
___ Pump (Viscous)
___ Pump (Diaphragm)
___ Pump (Centrifugal)
___ Trans-Vac System

Disposal

___ Igniters
___ Burner
___ Incinerator
___ Dispersant
___ Dispersant Boat Equip.

Logistical Support

___ Radios
___ Communications Trailer
___ Bird Rehab. Equip.
___ Bird Scarer & Float
___ Generator
___ Auxillary Lighting System
___ Air Compressor
___ Heater
___ First-Aid Equipment
___ Chain Saw
___ Flotation Suit/Life Vest
___ Arctic Clothing & Equip.
___ Field Response Kits w/ hand tools
___ Welder's Tent

RESPONSE TEAM (Specify Members Requested)

*___ OPERATIONS MANAGER
*___ LOGISTICS SUPERVISOR
___ Communications Coordinator
___ Manpower Coordinator
___ Equipment/Materials Coord.
___ Transportation Coordinator
___ Food/Housing Coordinator
*___ TECHNICAL SUPERVISOR
___ Environmental Coordinator
___ Safety Coordinator
___ Engineering Coordinator

*___ SUPPORT SERVICES SUPERVISOR
___ Documentation Coordinator
___ Government Liaison Coord.
___ Security Coordinator
___ Accounting Coordinator
___ Legal/Insurance Coordinator
___ Public Affairs Coordinator
*___ CLEANUP SUPERVISOR
___ Containment Coordinator
___ Recovery Coordinator
___ Storage/Transfer Coord.
___ Disposal Coordinator
___ Dispersal Coordinator

* Most likely to be mobilized

Coordinator. Any log book should be sturdily bound (not loose leaf) with consecutively numbered pages, and all entries are to be made in handwriting in ink, dated, and signed by the person making the entry. Each page should be used completely; any unused space should be crossed out. All corrections must be initialled and dated. As much information as possible will be recorded, including but not limited to:

- Records of decisions
- Important communications
- Summary of the day's work, including measurement of area cleaned and amount of oil recovered.
- Meeting minutes
- Directives from government representatives
- Arrival and departure times for visitors and inspectors.
- Number of people involved on a daily basis.

It is especially important to record carefully all directives from government representatives. The person recording the order should sign the page and have the government representative countersign. In this way, later disagreement can be avoided.

For a large-scale operation, the Operations Manager will delegate the task of maintaining the principal log to the Documentation Coordinator, and other logs may be kept by the various supervisors.

2.3.3 Written Reports

A checklist of government-required written reports is presented in Table 2-1. Figure 2-4 contains a sample of the U.S. Geological Survey report form (9-1880). Other agencies do not have special forms for written reports. The Operations Manager is responsible for completing all written reports, with assistance from the Documentation Coordinator. In addition, daily written reports will be prepared by the Documentation Coordinator, and the Operations Manager will prepare a detailed final report upon completion of the cleanup.

2.3.4 Cost Accounting and Equipment Use Documentation

The Accounting Coordinator is responsible for maintaining a complete cost history of the cleanup operation. He will submit a detailed financial report to the Operations Manager following completion of the spill cleanup operation.

Equipment Use Log (Figure 2-5). A log of equipment used in cleanup operations is to be maintained. This log will show:

1) Description of equipment (with number)
2) Party using equipment

U.S. Geological Survey - (Form 9-1880)

- All verbal spill reports must be confirmed in writing, and give cause, location, volume of spill and action taken. (For spills >5 cubic meters (31.5 bbl), include sea state, meteorological conditions, and size and appearance of slick)

U.S. Environmental Protection Agency (40 CFR 112.4(a))

- For facilities requiring SPCC plans, a written report must be filed when the facility has either: one spill >1,000 gal <u>or</u> 2 spills in a 12-month period which cause a sheen. This report must include:

  (1) Name of the facility;

  (2) Name(s) of the owner or operator of the facility;

  (3) Location of the facility;

  (4) Date and year of initial facility operation;

  (5) Maximum storage or handling capacity of the facility and normal daily throughput;

  (6) Description of the facility, including maps; flow diagrams, and topographical maps;

  (7) A complete copy of the SPCC Plan with any amendments;

  (8) The cause(s) of such spill, including a failure analysis of system or sub-system in which the failure occurred;

  (9) The corrective actions and/or countermeasures taken, including an adequate description of equipment repairs and/or replacements;

  (10) Additional preventive measures taken or contemplated to minimize the possibility of recurrence;

  (11) Such other information as the Regional Administrator may reasonably require pertinent to the Plan or spill event.

TABLE 2-1 GOVERNMENT-REQUIRED WRITTEN REPORTS

Alaska Department of Environmental Conservation (18 AAC 75.110)

- Within 15 days after end of cleanup, a report must be submitted containing:

  (1) Date and time of discharge

  (2) Location of the discharge

  (3) Person or persons causing or responsible for the discharge

  (4) Type(s) and amount(s) of hazardous substance(s) discharged

  (5) Cause(s) of the discharge

  (6) Environmental damage caused by the discharge

  (7) Cleanup actions undertaken

  (8) Location and method of disposal of the hazardous substance and contaminated cleanup materials, including date of disposal

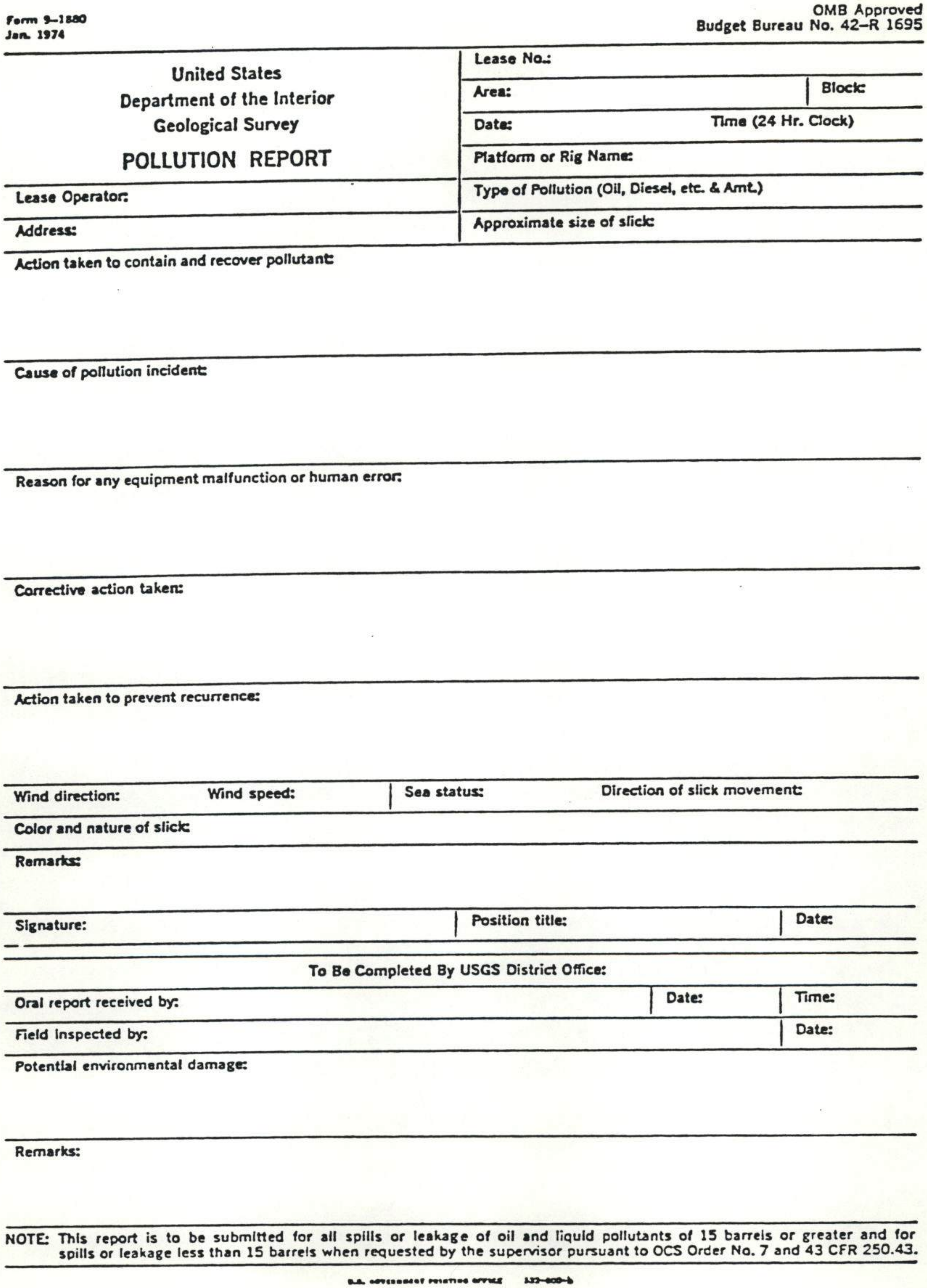
  (9) Actions being taken to prevent recurrence of the discharge

  (10) Other information ADEC requires in order to fully assess the cause and impact of the discharge

TABLE 2-1
(Cont'd)

GOVERNMENT-REQUIRED WRITTEN REPORTS

TO BE UPDATED



Form 9-1880
Jan. 1974

OMB Approved
Budget Bureau No. 42-R 1695

United States
Department of the Interior
Geological Survey

POLLUTION REPORT

Lease No.:

Area: | Block:

Date: Time (24 Hr. Clock)

Platform or Rig Name:

Type of Pollution (Oil, Diesel, etc. & Amt.)

Approximate size of slick:

Lease Operator:

Address:

Action taken to contain and recover pollutant:

Cause of pollution incident:

Reason for any equipment malfunction or human error:

Corrective action taken:

Action taken to prevent recurrence:

Wind direction: Wind speed: | Sea status: Direction of slick movement:

Color and nature of slick:

Remarks:

Signature: | Position title: | Date:

To Be Completed By USGS District Office:

Oral report received by: | Date: | Time:

Field Inspected by: | Date:

Potential environmental damage:

Remarks:

NOTE: This report is to be submitted for all spills or leakage of oil and liquid pollutants of 15 barrels or greater and for spills or leakage less than 15 barrels when requested by the supervisor pursuant to OCS Order No. 7 and 43 CFR 250.43.

FIGURE 2-4 USGS FORM 9-1880

DESCRIPTION	EQUIP. NO.	USER/ SPILL NAME	AUTHORIZED USER SIGNATURE	DATE/ TIME OUT	DATE/ TIME IN	CONDITION 1-New 2-Used 3-Damaged	FUEL D-Diesel G-Gas Used (gal)	REQUIRED REPAIRS	REP. INITIALS

FIGURE 2-5 EQUIPMENT USE LOG

3) Signature of person checking out equipment
4) Time and date checked out
5) Time and date returned
6) Condition of equipment
7) Fuel used
8) Required repairs when returned

2.3.5 Photography

As soon as possible after the initiation of the spill cleanup operation, arrangements will be made by the Documentation Coordinator for a photographer to record the operation. As a minimum, 35 mm slides and prints (color and black and white) will be taken; however, the Operations Manager may also request TV tape and/or movies if he deems them necessary. Photographic documentation should include and not be limited to wide-angle pictures; aerial shots; land, beach, and ice closeups; and pictures of equipment, people, and operations. For each picture taken, the following information should be recorded:

- Location and reference to landmarks
- Date and time
- Names of photographer and any witnesses
- Description of photograph
- Shutter speed, lens opening, and film type
- Weather conditions and angle of sun

2.4 PUBLIC RELATIONS

Oil spills, particularly moderate and major ones, generate public interest and its attendant media coverage. This simple fact can present a great deal of difficulty for a spiller if he does not have a consistent public relations policy with strong procedures and a single spokesman to put the policy and procedures into action. The purpose of this section is to provide guidelines for use in dealing with public relations problems during a spill.

2.4.2 Public Relations Guidelines

Spokesman

The only persons authorized to speak with the news media regarding the spill cleanup operation are the Operations Manager and the Public Affairs Coordinator or his designated representatives. Any statement will be made only after approval of spiller company management. As soon as the operational organization is functioning, a statement will be issued advising all media representatives to contact the Public Affairs Coordinator. All members of the Response Team are to refer any inquiries from the news media or public to the Public Affairs Coordinator and call him informing him of the inquiry. In addition, the team member receiving the inquiry will submit to the Public Affairs Coordinator a report on the Media Inquiry Form (Figure 2-8). The Public Affairs Coordinator fills in the "Action" section of the Media Inquiry Form. Depending on the situation, the Operations Manager may authorize supervisory personnel onsite or offsite to answer inquiries.

Press Releases

All press releases will be issued through the Public Affairs Coordinator and will be approved by the Operations Manager, the Legal/Insurance Coordinator, and spiller company management prior to release. It is very important that press releases accurately and succinctly explain to the public what has happened and what is being done about it. Press releases will not include speculations on the cause of the spill, responsibility, damage, or any other fact not properly determined by technically competent representatives of the spiller company management.

Appropriate information initially released to the media might include:

- Brief description of the events surrounding the spill.
- Amount of oil spilled (if accurately known)

MEDIA INQUIRY
FORM

DATE

TIME

CALLER

AFFILIATION

QUESTION/REQUEST

ACTION

Representative:

FIGURE 2-8 MEDIA INQUIRY FORM

- Agencies notified
- General types of countermeasures taken (men and equipment deployed)
- Special efforts to protect property or wildlife

Subsequent releases might explain the progress being made in terms of:

- Amount of oil recovered to date
- Specific techniques being employed
- Cooperation with government authorities
- Extent of contracted assistance
- Continued efforts to protect property or wildlife

It may be advisable to set up a recorded telephone message containing the above information and update it once or twice a day. Such a service could reduce the demand representatives of the media tend to make on the Public Affairs Coordinator's time.

Press Conferences and Briefings

At the outset of a spill cleanup operation, the Public Affairs Coordinator will generally hold a news conference as soon as possible. The first press release will normally be issued at this time, and reporters will be briefed on the procedures to be followed.

If the response of the media warrants it, the Public Affairs Coordinator will arrange for transportation and lodging for a group of newsmen to visit the site, but only after approval by the Operations Manager and company management. Either the Public Affairs Coordinator or his designated assistant will accompany the group and chaperone them throughout their visit. From time to time, subsequent press briefings will be held to issue further press releases and to ensure that the media receives its information from one spokesman. At all times, media representatives are to be reminded that they should contact only the Public Affairs Coordinator and his designated assistants. Unless explicit permission is given by the Operations Manager, no members of the press are to interview other members of the cleanup operation either onsite or offsite.

Coordination With Government Spokesmen

As soon as possible at the start of the operation, the Public Affairs Coordinator and the Government Liaison Coordinator will contact the spokesmen for the state and federal on-scene representatives. Together, they will establish procedures for handling information dissemination to avoid the issuance of conflicting statements.

3. RESPONSE ACTION OUTLINE

3.1 INTRODUCTION

This section is designed to provide the user of this contingency plan with a reference guide to the decision-making necessary to conduct a spill response. The flowchart shown in Figure 3-1 on the next page gives a key to Section 3.

Five flowcharts presented in Figures 3-2 through 3-6 in Section 3.2 represent the heart of the Response Action Outline:

Figure No.	Flowchart
3-2	Initial Actions
3-3	Notification
3-4	Spill Evaluation
3-5	Response Planning
3-6	Response

Each flowchart details the decisions involved in that particular aspect of a spill response. These five flowcharts are supported by a series of figures which are referenced in the flowcharts and which are presented in order in Section 3.3, Supporting Figures.

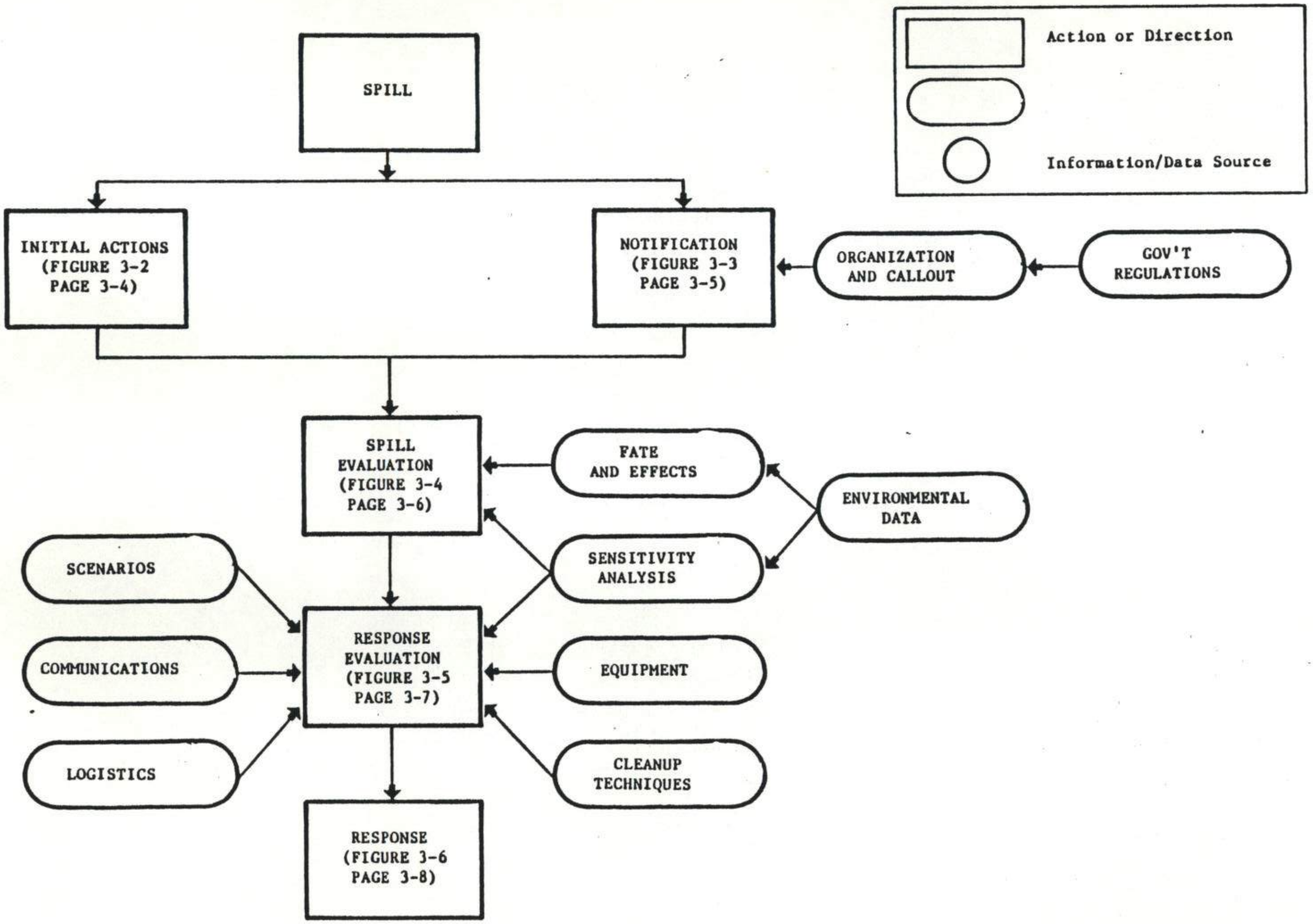


FIGURE 3-1 KEY TO CONTINGENCY PLAN

3.2 DECISION FLOWCHARTS

The flowcharts shown on the following pages provide a step-by-step guide to the decisions and actions involved in mounting a successful oil spill cleanup operation. Where appropriate, these flowcharts reference the supporting figures in Section 3.3.

Below is the key to the flowcharting system used in the Response Action Outline.

▭	Action or Direction
⬭	Other considerations
○	Information/Data Source
◇	Decision

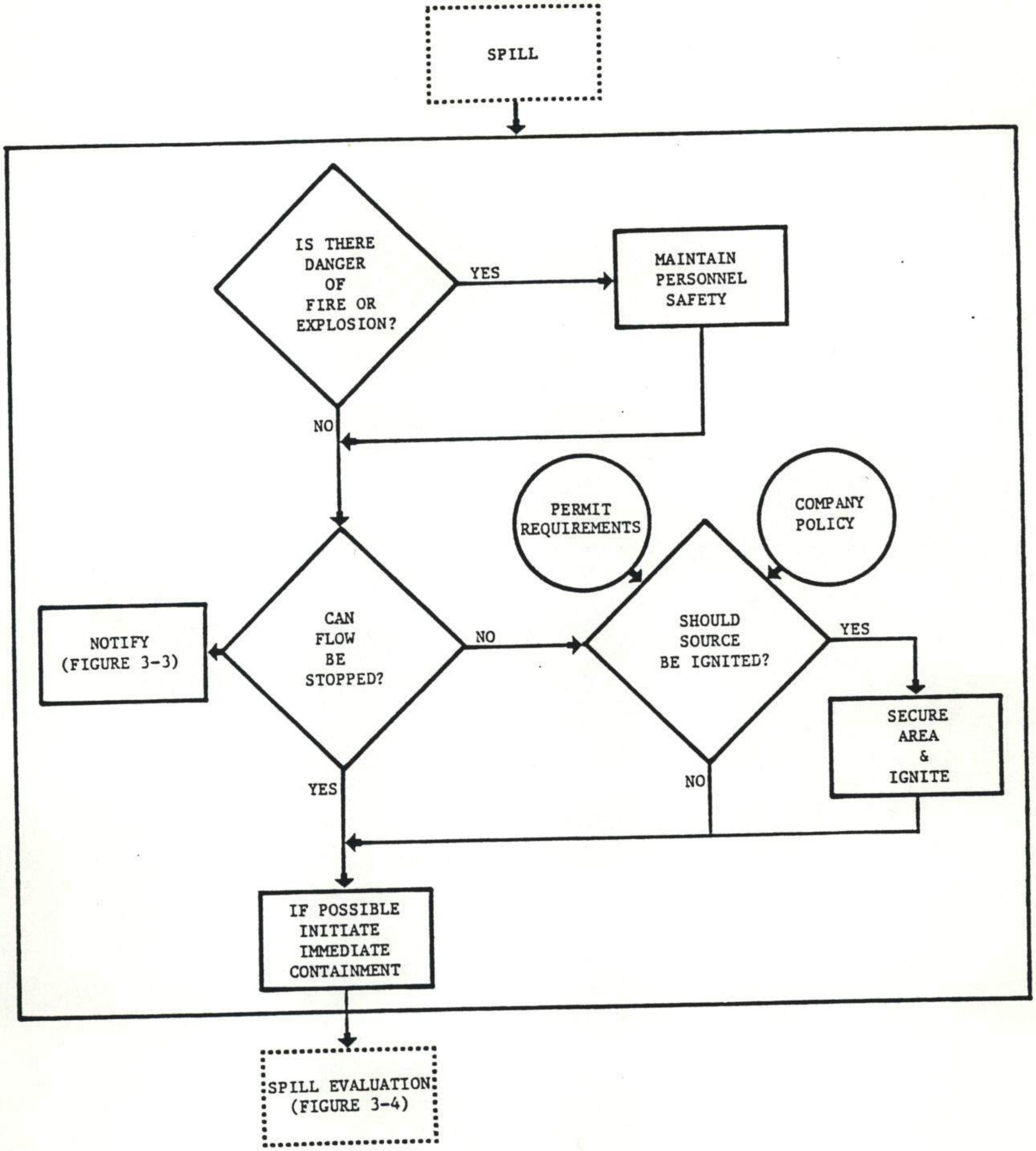


FIGURE 3-2 INITIAL ACTION

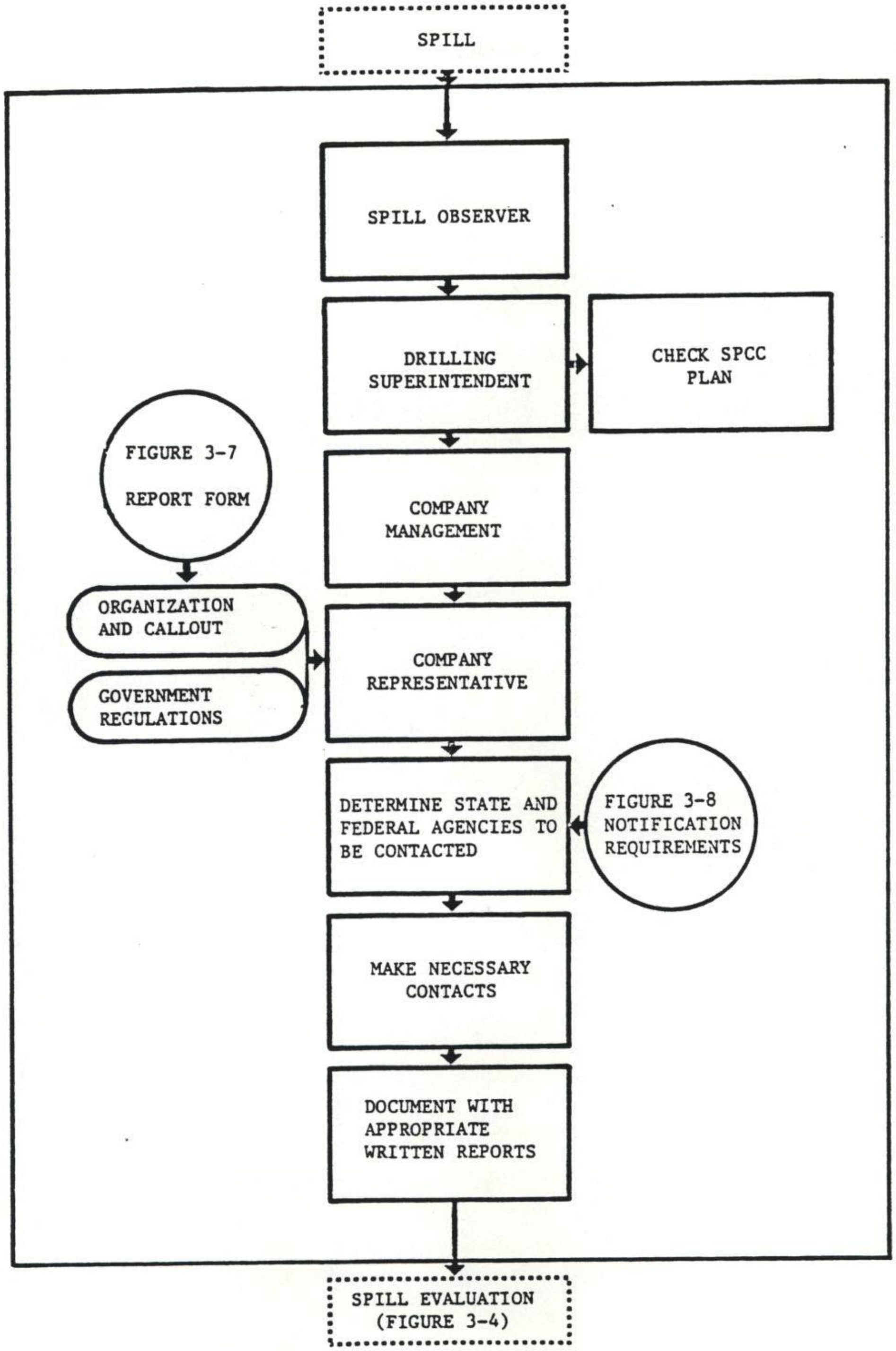


FIGURE 3-3 NOTIFICATION

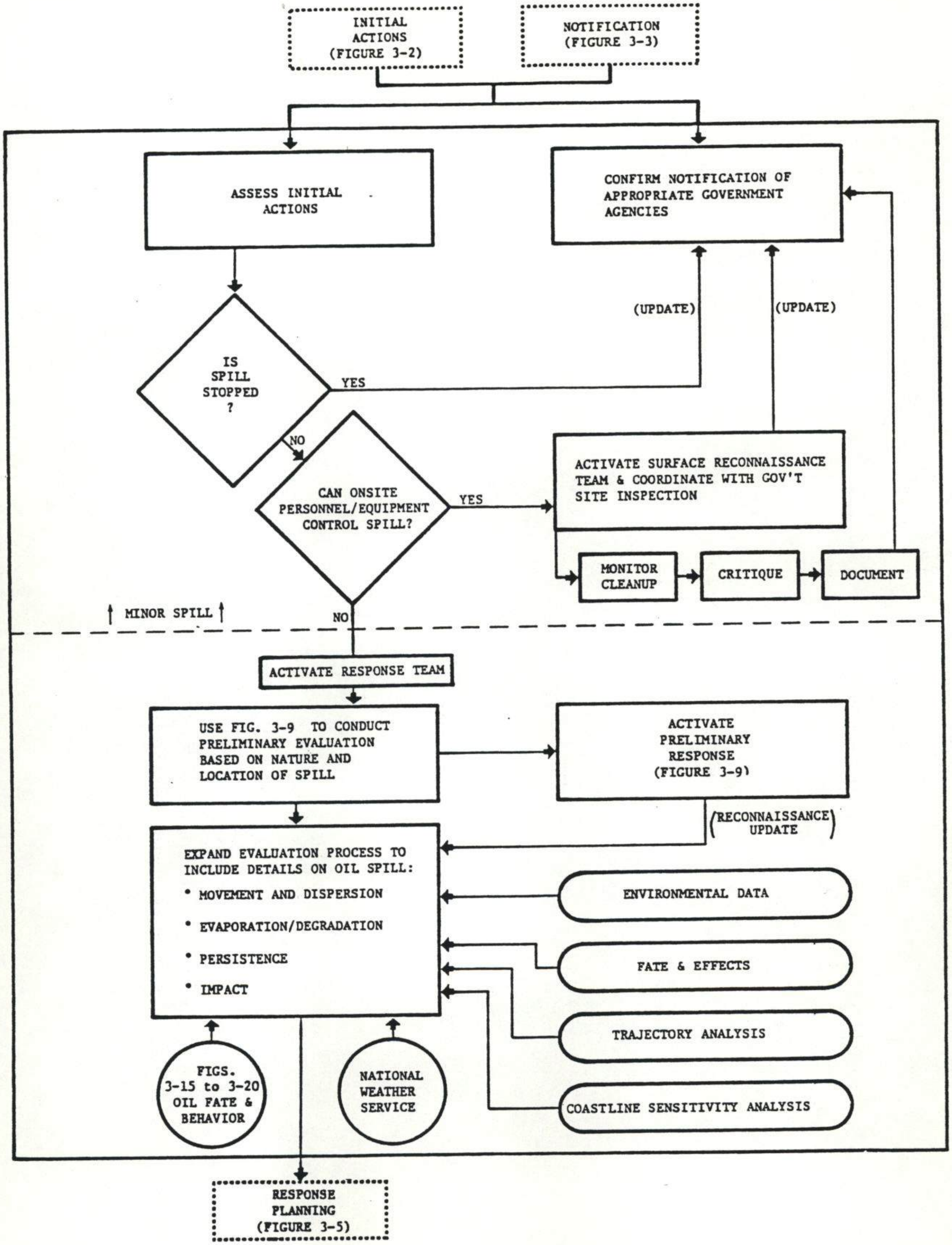


FIGURE 3-4 SPILL EVALUATION

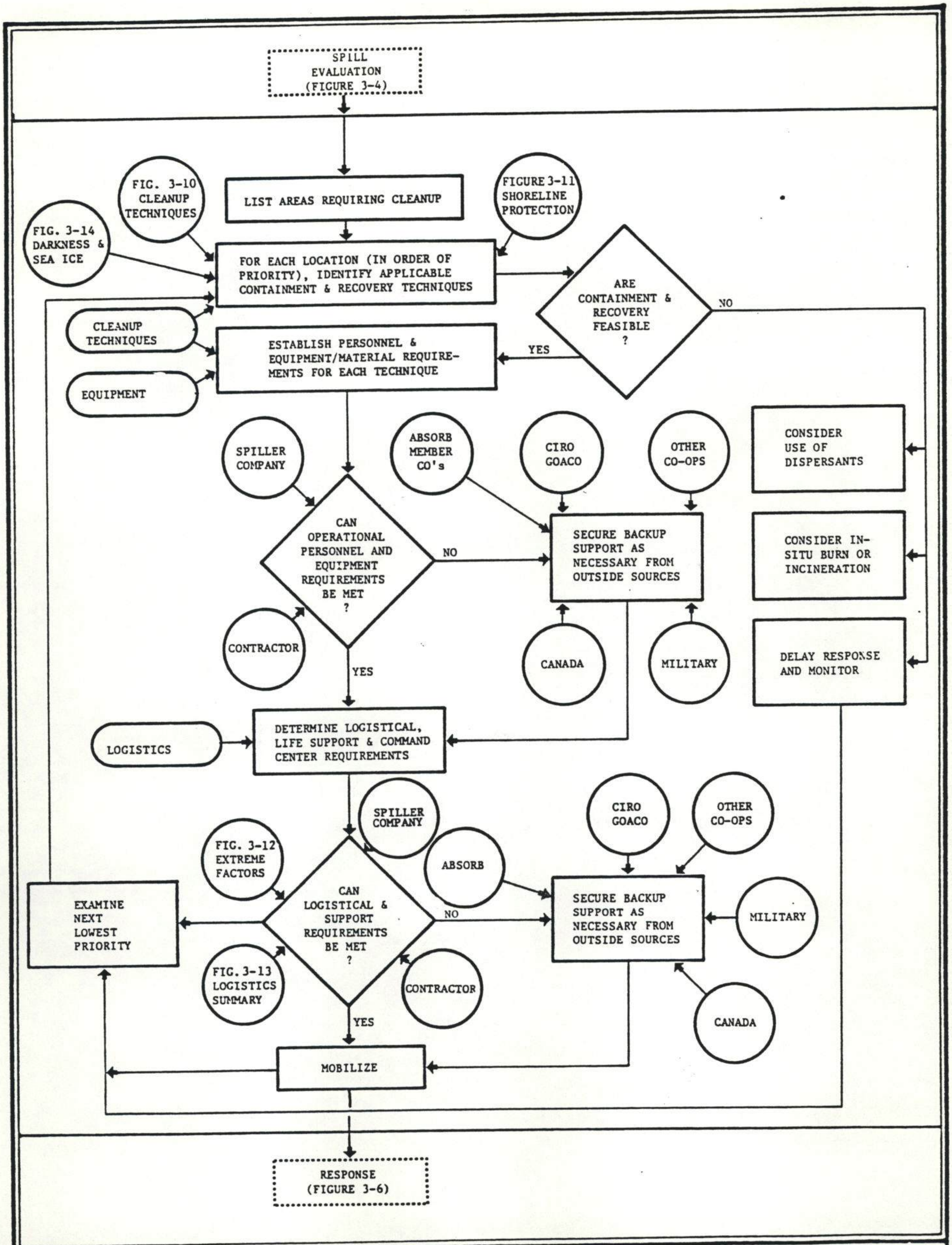


FIGURE 3-5 RESPONSE PLANNING

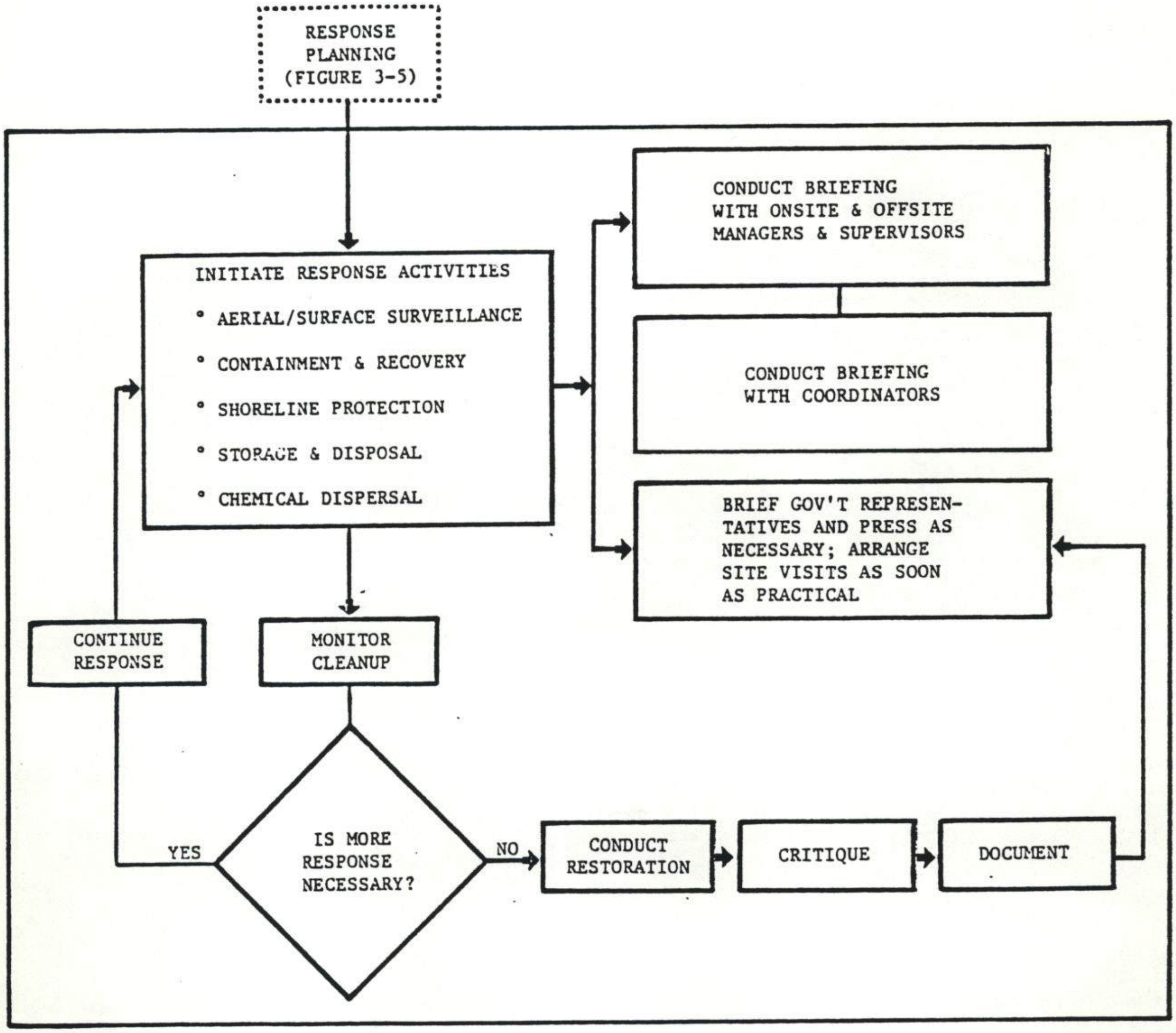


FIGURE 3-6 RESPONSE

3.3 SUPPORTING FIGURES

The illustrations presented in this section are designed to complement the five flowcharts in Section 3.2. They provide more detailed information that may be needed in making decisions indicated on the flowcharts.

FIGURE 3 - 6b

The following equipment and supplies, located in the Deadhorse Area, may be used in an emergency:

A. High Pressure Pumps, Cement and Bulk Handling Equipment.

1) Dowell	Telephone	659-2434
2) Halliburton	Telephone	659-2492

B. Mud and Weight Materials

1) IMCO Service	Telephone	659-2492

C. Oilfield Trucks, Floats, Tank Trucks, Vacuum Trucks, etc.

1) Mukluk Freight Lines	Telephone	659-2686
2) Kodiak Oilfield Haulers	"	659-2648

D. Contruction Equipment - Dozers, Fork Lifts, Scrapers, Dump Trucks, Front End Loaders, Water Trucks, Belly Dumps, etc.

1) Frontier Rock and Sand/Telephone		659-2565
2) Kodiak Oilfield Haulers	"	659-2648
3) Alaska General Const. Co	"	659-2445
4) S. & G Construction (Equipment on remote North Slope Wellsite)	Telephone	272-4512

E. Helicopter and Air Transportation

1) ERA Avionics	Telephone	659-2465
2) Sea Airmotive	Telephone	659-2646

F. General - BP Alaska and ARCO have large stockpiles of materials and equipment that they will make available for emergencies.

1) BP Alaska	Telephone	659-2662
2) ARCO	Telephone	659-3106

NOTE: These are Deadhorse telephone exchange telephone numbers with the 659 prefix.

INITIAL REPORT FORM

I. SPILL DATA

TIME OF CALL ____________________ DATE ____________________

PERSON REPORTING SPILL ____________________

AFFILIATION ____________________

(Specify) Company ____________________

____

Government Agency ____________________

SPILL LOCATION ______________ TYPE OF OIL ___________ EST. GRAVITY__

SPILL SOURCE (Blowout, Tank rupture, etc.) ____________________

VOLUME/FLOWRATE ______________ FLOW STOPPED? ☐ Yes ☐ No

SPILL DESCRIPTION (Into Water? Ignited? Areal Extent? Etc.) __________

____

ACTIONS TAKEN (Briefly): ____________________

____

____

EQUIPMENT DEPLOYED (Major Pieces); ____________________

____

____

AGENCIES NOTIFIED ____________________

II. ENVIRONMENTAL CONDITIONS AT SITE

WIND (Speed & Direction) ____________________

TEMPERATURE ______________ VISIBILITY ____________________

ICE CONDITIONS ____________________

SEA STATE ____________________

ENVIRONMENTAL DAMAGE (Real or Potential) ____________________

INITIAL REPORT FORM

FIGURE 3-7
(Cont'd)

PAGE TWO

III. INVOLVEMENT

EQUIPMENT REQUESTED (Specify quantity of each)

Facilities

___ Office Equipment
___ Warehouse Equipment
___ Miscellaneous Tools & Equip.
___ Field Command Post
___ Field Camp

Transportation

___ Workboat
___ Jon Boat

Detection

___ Gas Detector
___ Current Meter
___ Ice Auger

Containment

___ Heavy-Duty Containment Boom
___ Compactible Containment Boom
___ Boom Accessories

Recovery

___ Rope Mop Skimmer
___ Vessel Skimmer
___ Portable Weir-Type Skimmer
___ Sorbents

Storage

___ Portable Containment Device
___ Towable Bladder
___ Bladder Tank

Transfer

___ Arctic Hose & Fittings
___ Pump (Viscous)
___ Pump (Diaphragm)
___ Pump (Centrifugal)
___ Trans-Vac System

Disposal

___ Igniters
___ Burner
___ Incinerator
___ Dispersant
___ Dispersant Boat Equip.

Logistical Support

___ Radios
___ Communications Trailer
___ Bird Rehab. Equip.
___ Bird Scarer & Float
___ Generator
___ Auxillary Lighting System
___ Air Compressor
___ Heater
___ First-Aid Equipment
___ Chain Saw
___ Flotation Suit/Life Vest
___ Arctic Clothing & Equip.
___ Field Response Kits w/ hand tools
___ Welder's Tent

RESPONSE TEAM (Specify Members Requested)

*___ OPERATIONS MANAGER
*___ LOGISTICS SUPERVISOR
___ Communications Coordinator
___ Manpower Coordinator
___ Equipment/Materials Coord.
___ Transportation Coordinator
___ Food/Housing Coordinator
*___ TECHNICAL SUPERVISOR
___ Environmental Coordinator
___ Safety Coordinator
___ Engineering Coordinator

*___ SUPPORT SERVICES SUPERVISOR
___ Documentation Coordinator
___ Government Liaison Coord.
___ Security Coordinator
___ Accounting Coordinator
___ Legal/Insurance Coordinator
___ Public Affairs Coordinator
*___ CLEANUP SUPERVISOR
___ Containment Coordinator
___ Recovery Coordinator
___ Storage/Transfer Coord.
___ Disposal Coordinator
___ Dispersal Coordinator

* Most likely to be mobilized

	AGENCY				
SPILL LOCATION	U.S. COAST GUARD	U.S. ENVIRONMENTAL PROTECTION AGENCY	U.S. GEOLOGICAL SURVEY	AK DEPT. OF ENVIRONMENTAL CONSERVATION	AK OIL & GAS CONSERVATION COMMISSION
ON LAND ONLY			✓ 1/	✓	✓ 2/
ON LAND BUT THREATENING OR IN INLAND SURFACE WATER		✓	✓ 1/	✓	✓ 2/
ON WATER (Within 3-nautical-mile limit)	✓			✓	✓ 2/
ON WATER (Between 3- and 200-nautical-mile limit)	✓		✓ 1/		

✓ = NOTIFICATION REQUIRED

1/If oil is from a well on a federal oil lease
2/If oil is from a well on a state oil lease

FIGURE 3-8 GOVERNMENT NOTIFICATION REQUIREMENTS FOR SPILLS IN THE BEAUFORT LEASE SALE AREA

Page 1 of 2

AGENCY	SPILL SIZE	VERBAL REPORT	PHONE NUMBER	WRITTEN REPORT *
U.S. COAST GUARD	All Spills	Immediately	(211) ZENITH 5555 or 271-5137	Recommended but not required
U.S. ENVIRONMENTAL PROTECTION AGENCY	All Spills	Immediately	(211) ZENITH 5555 or 271-5083 (Days) 344-9327 (Nights)	For facility requiring SPCC Plan if spill is > 1000 gallons or if spill is second spill in 12 months
U.S. GEOLOGICAL SURVEY	$\geq$ 1 cu. meter (6.3bbl)	Immediately	271-4348 (Days) 271-4303 (Nights)	All spills (Form 9-1880)
	< 1 cu. meter (6.3bbl)	Within 12 hours		
AK DEPT. OF ENVIRONMENTAL CONSERVATION	Water			
	>55 gal or 1000 sq. ft. sheen	Immediately	(211) ZENITH 9300 or 452-1714 (Fairbanks)	Within 15 days of end of cleanup operation
	Hazardous material other than oil	Immediately		
	< .5 pt or < 100 sq. ft.	7 days		
	All other water spills	24 hours		
	Land			
	>55 gal	5 hours	(211) ZENITH 9300 or 452-1714 (Fairbanks)	Within 15 days of end of cleanup operation
	10 to 55 gal	24 hours		
	<10 gal	7 days		
	Any other hazardous material	Immediately		
OIL & GAS CONSERVATION COMM.	All Spills	Immediately	279-1433	Within 5 days of spill report

*See Section 2.3.3 for details of report requirements.

FIGURE 3-8
(Cont'd)

GOVERNMENT NOTIFICATION REQUIREMENTS FOR SPILLS IN THE BEAUFORT LEASE SALE AREA

Page 2 of 2

PRELIMINARY RESPONSE ACTIVITY	BLOWOUT		TRANSPORTATION SPILL (Barges & Tank Trucks)		STORAGE SPILL		MINOR OPERATIONAL SPILL	
	OFFSHORE	ONSHORE	OFFSHORE	ONSHORE	OFFSHORE	ONSHORE	OFFSHORE	ONSHORE
Surface Well Control	✶	✶	—	—	—	—	—	—
Relief Well	✶	✶	—	—	—	—	—	—
Surface Reconnaissance	✶	✶	✶	⊘	✶	⊘	⊘	⊘
Aerial Reconnaissance	✶	⊘	✶	⊘	⊘	⊘	—	—
ABSORB Manager Support	✶	⊘	✶	⊘	✶	⊘	—	—
Spiller Company Personnel	✶	✶	✶	✶	✶	✶	✶	✶
Other ABSORB Member Support	○	—	—	—	—	—	—	—
Contractor Support	●	●	○	○	○	○	—	—
Customs Support	○	—	—	—	—	—	—	—
Spiller Company Equipment	✶	✶	✶	✶	✶	✶	✶	✶
ABSORB Equipment	●	●	⊘	○	⊘	○	—	—
Other ABSORB Member Equipment	○	—	—	—	—	—	—	—
Contractor Equipment	○	○	○	○	○	○	—	—
Military Personnel & Equipment	○	—	—	—	—	—	—	—
Canadian Personnel & Equipment	○	—	—	—	—	—	—	—

KEY

	ACTIVATION LEVELS				
	✶ - HIGHEST	● - HIGH	⊘ - MODERATE	○ - LOW	— LOWEST
Personnel	Activate as soon as possible	Key personnel and field supervisors report immediately for briefing; backup crews on alert.	Key personnel report for briefings; field supervisors and backup crews on alert	Key personnel on alert.	Not applicable or delay response
Equipment	Mobilize support equipment as soon as possible	Major and minor response equipment and all logistical support readied for immediate mobilization	Minor response equipment and light logistical support readied for mobilization	Equipment/material availability confirmed; storage and staging areas identified and prepared	Not applicable or delay response

FIGURE 3-9 RESPONSE ACTIVATION LEVELS (ASSUMING ONSITE PERSONNEL/EQUIPMENT CANNOT HANDLE SPILL)

	Spill Control Technique / Operating Environment	WATER								BEACH		DRY LAND	
			BROKEN ICE (% Coverage)				SOLID ICE Oil Located:						
		ICE FREE	<25	25 - 50	50 - 75	>75	ON	IN	UNDER	ICE FREE	WITH SNOW AND ICE	WITH-OUT SNOW	WITH SNOW
CONTAINMENT	Conventional Booming	●	○										
	Ice Deflect/Filter Booming		▨	○									
	Ice Subsurface Barriers								●				
	Bottom-Anchored Barriers	●	●	●	●	●	●	●	●				
	Ice/Snow Surface Barriers						●				●		●
	Bubble Barriers	▨	○										
	Chemical Collectants	▨	○										
	Surface Spraying	●	○							▨	○	▨	○
	Land Surface Modifications									●	▨	●	▨
RECOVERY	Vessel-Mounted Skimmers	●	▨	▨									
	Portable Skimmers	●	▨	○					●				
	Direct Pumping	●	▨	○			▨	▨	▨	▨	▨	▨	▨
	Mechanical Removal						▨	▨		▨	▨	▨	▨
	Sorbents	●	●	▨			●			●	●	●	●
DISPOSAL	In-Situ Burning	●	●	▨	○	○	●			●	▨	●	▨
	Onsite Incineration	●	▨	▨			▨	○		●	●	●	●
	Offsite Incineration	●	▨	○			●	○		●	●	●	●
	Onshore Disposal Pits	○	○	○			○	○		○	○	○	○
DISPERSAL	Chemical Dispersants	○	○							○			

FIGURE 3-10 APPLICABILITY OF MAJOR CLEANUP TECHNIQUES

● Applicability - Good
▨ Applicability - Fair/Limited
○ Applicability - Has Potential

	CHEMICAL DISPERSANTS	HIGH-PRESSURE HOSES	STEAM CLEANING	SAND BLASTING	LOW-PRESSURE HOSES	MIXING	GRADER/SCRAPER	FRONT-END LOADER	BULLDOZER	DRAGLINE/ CLAMSHELL	SUMP/PUMP	MANUAL REMOVAL	MANUAL CROPPING	BURNING	BEACH-CLEANING MACHINES
Rock	+	+	+	+	✓	-	-	-	-	-	✓	✓	-	-	-
Man-Made	+	✓	✓	✓	✓	-	-	-	-	-	-	✓	-	-	-
Mud	x	x	x	x	x	x	x	+	x	x	+	✓	-	x	x
Sand	+	x	x	x	x	+	✓	+	+	+	✓	✓	-	x	✓
Pebble	+	x	x	x	x	+	+	+	+	+	+	✓	-	x	✓
Cobble	+	+	x	x	+	+	-	+	+	+	+	✓	-	x	+
Boulder	+	+	x	x	+	-	-	-	-	-	-	✓	-	x	-
Mixed Sediment	+	x	x	x	x	+	x	+	+	+	+	✓	-	x	✓
Marsh	x	x	x	x	✓	x	-	x	x	x	+	✓	✓	+	-

x NOT Recommended

- Not Applicable

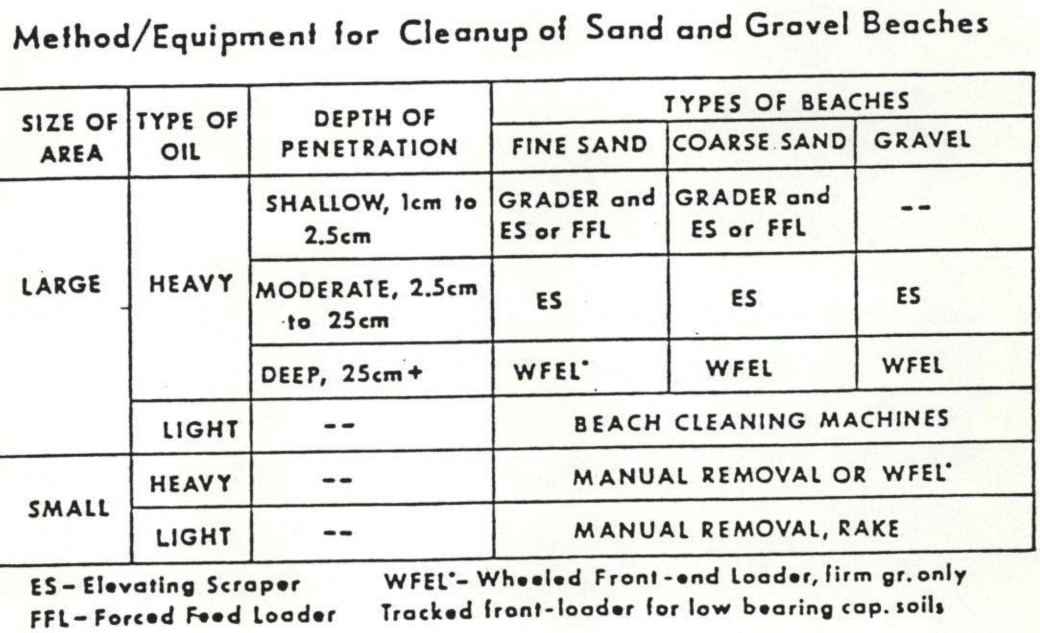
✓ Recommended

+ Applicable and possibly useful

Source: Owens, 1977

FIGURE 3-11 SHORELINE PROTECTION CONSIDERATIONS

Page 1 of 2



Method/Equipment for Cleanup of Sand and Gravel Beaches

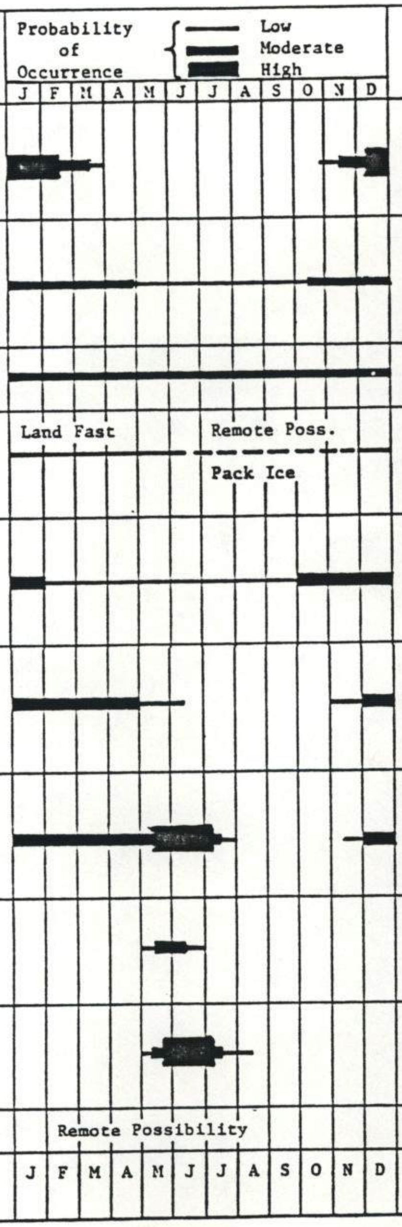
SIZE OF AREA	TYPE OF OIL	DEPTH OF PENETRATION	TYPES OF BEACHES		
			FINE SAND	COARSE SAND	GRAVEL
LARGE	HEAVY	SHALLOW, 1cm to 2.5cm	GRADER and ES or FFL	GRADER and ES or FFL	--
		MODERATE, 2.5cm to 25cm	ES	ES	ES
		DEEP, 25cm+	WFEL*	WFEL	WFEL
	LIGHT	--	BEACH CLEANING MACHINES		
SMALL	HEAVY	--	MANUAL REMOVAL OR WFEL*		
	LIGHT	--	MANUAL REMOVAL, RAKE		

ES – Elevating Scraper
FFL – Forced Feed Loader
WFEL* – Wheeled Front-end Loader, firm gr. only
Tracked front-loader for low bearing cap. soils

Source: Sartor and Foget, 1970

FIGURE 3-11 (cont'd) SHORELINE PROTECTION CONSIDERATIONS Page 2 of 2

EXTREME EVENTS



EVENT	Probability of Occurrence	NATURE OF INFLUENCE ON CLEANUP OPERATIONS
Extreme Low Temperatures		Reduced personnel exposure times and working efficiency; difficulty starting equipment; materials subject to fatigue and failure; viscosity of oil increases; rapid ice buildup.
Strong Winds		Reduced visibility from blowing snow and dust; ACVs and helicopters severely restricted; increased chill factor and chances for frostbite and hypothermia; ice buildup with spray; movement of oil slicks.
Low Visibility		Nearly all transportation and field cleanup activities halted.
Ice Over-Ride	Land Fast Remote Poss. Pack Ice	Drilling and field response activities temporarily halted; beach cleanup limited, if not stopped; access to contaminated shorelines prevented.
Storms Storm Surge		Strong wind and ice over-ride influences produced (above); high water and low water extremes occur, increasing oil contact zones; beach and offshore cleanup temporarily halted; moderate waves produced.
Ice Deformation (Compression)		Vehicle traffic over ice restricted; ACV movements possibly limited; relocation of offshore support camps and cleanup activity necessitated; airstrips and ice barriers destroyed; oil movement altered.
Ice Separation (Cracks & Leads)		Ice traffic seriously curtailed; transport limited to helicopters; relocation and eventual termination of offshore support camps and cleanup activity necessitated; most barriers destroyed; under-ice oil exposed.
Ice Surface Flooding (River Runoff)		Traffic seriously impeded off major river deltas because of inches to feet of water over ice; ice breakup processes accelerated; oil lifted from on and under ice and free to move.
Heavy Broken Ice Field		All offshore surface traffic halted except for large vessels with ice-strengthened hulls; air traffic by helicopter only; no oil recovery until ice concentrations well below 50% coverage.
Earthquake	Remote Possibility	No recorded earthquakes to date.

FIGURE 3-12 EXTREME ENVIRONMENTAL FACTORS

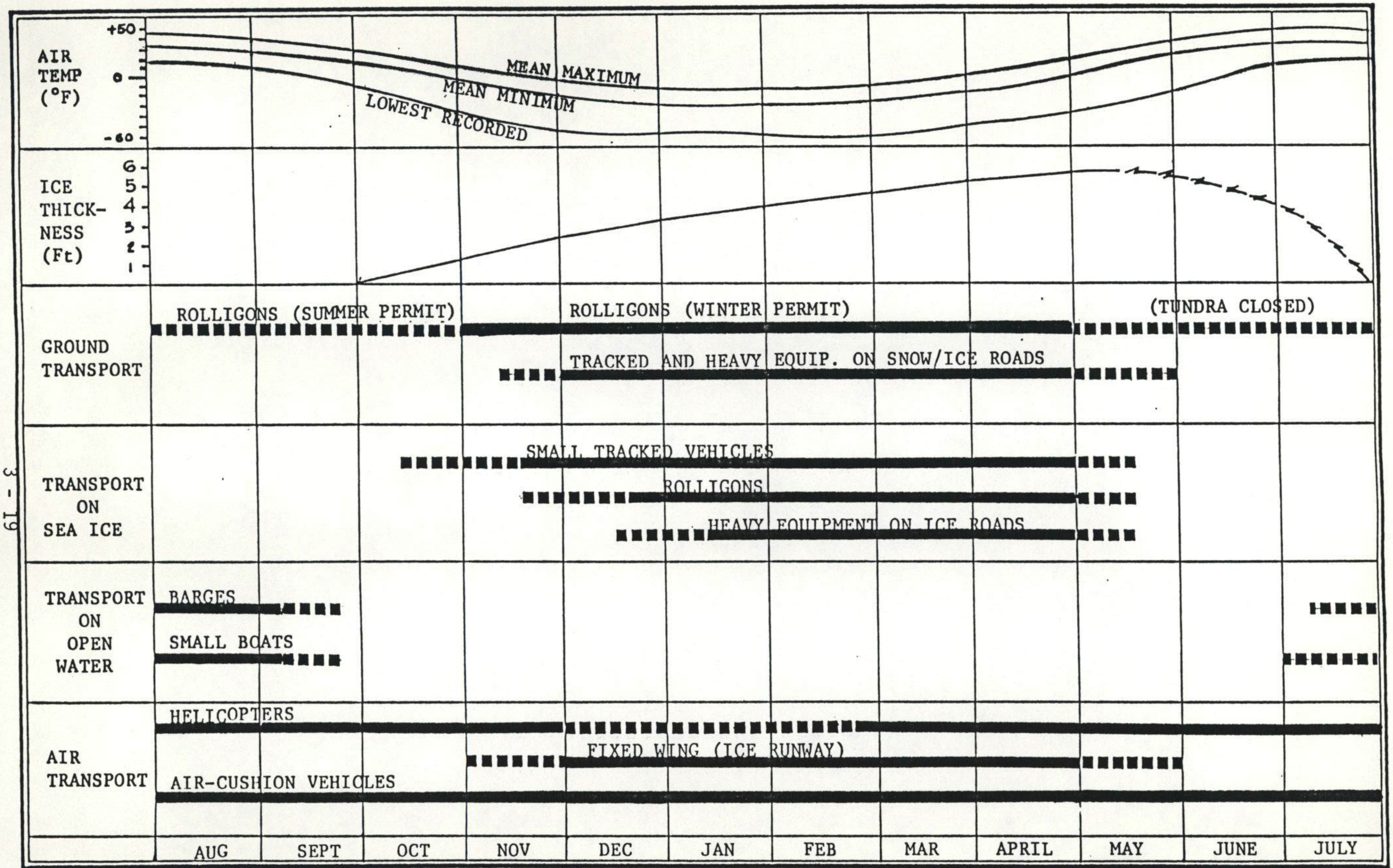


FIGURE 3-13 LOGISTICS SUMMARY

▬ Reliable

■■■ Questionable

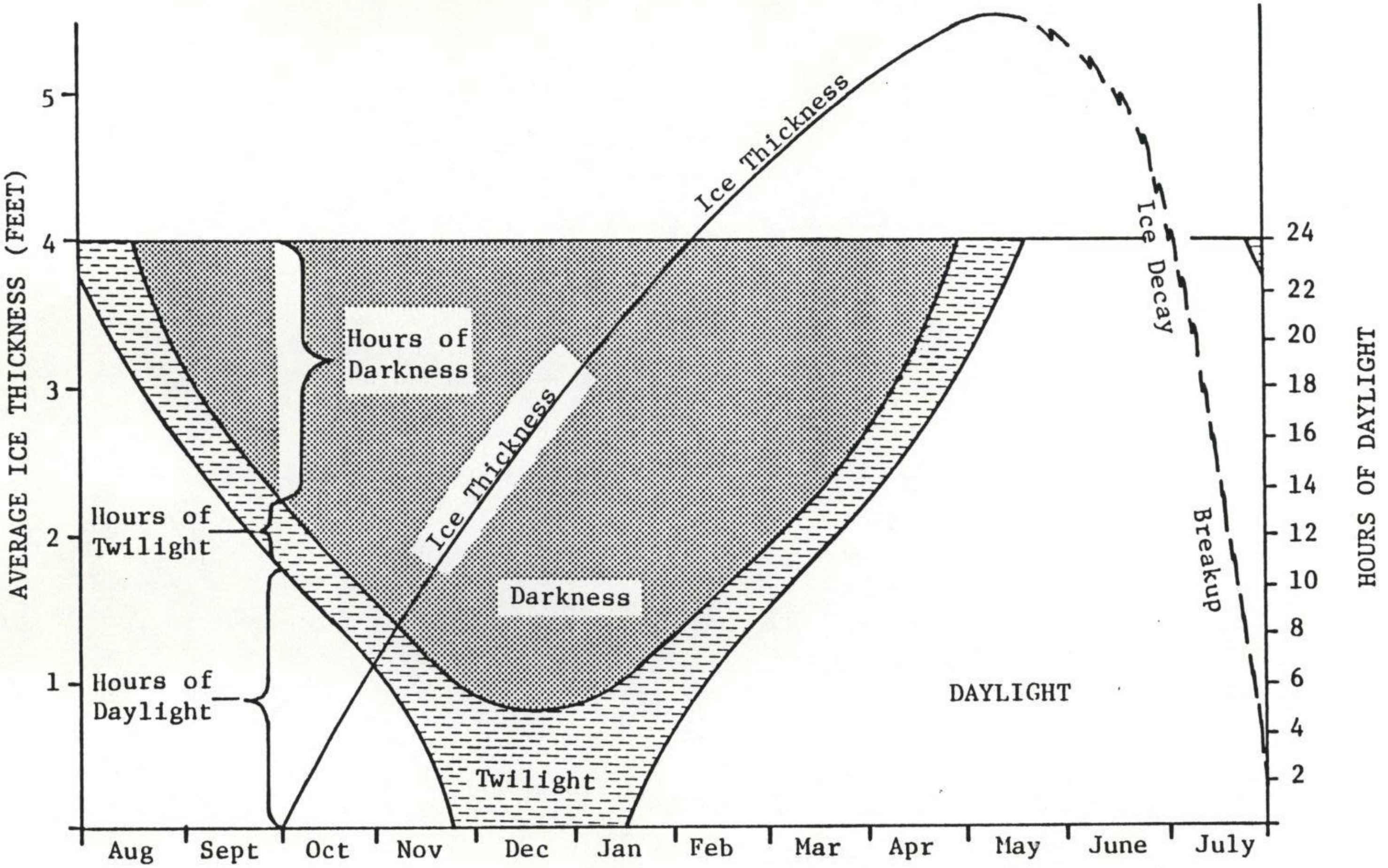
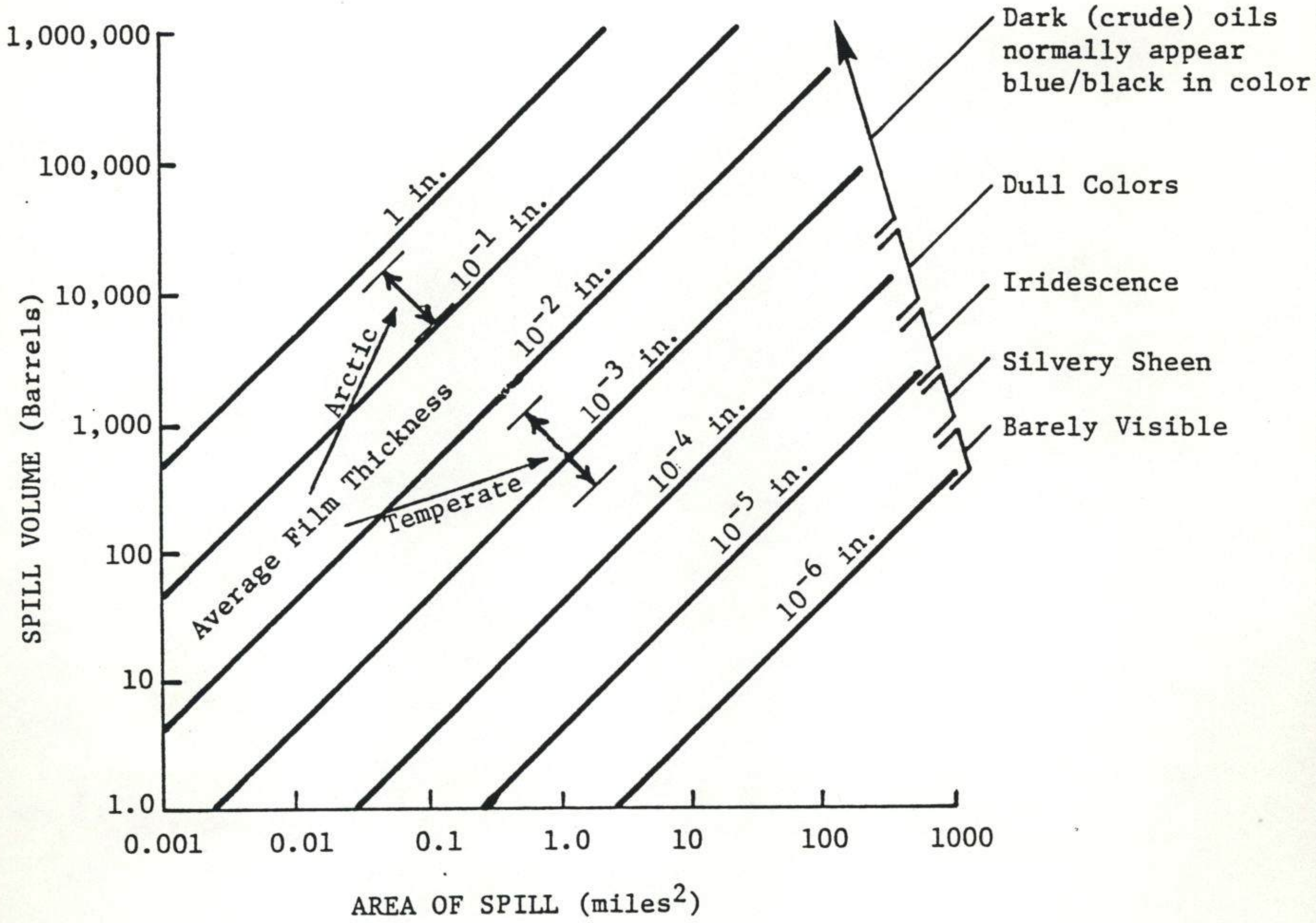
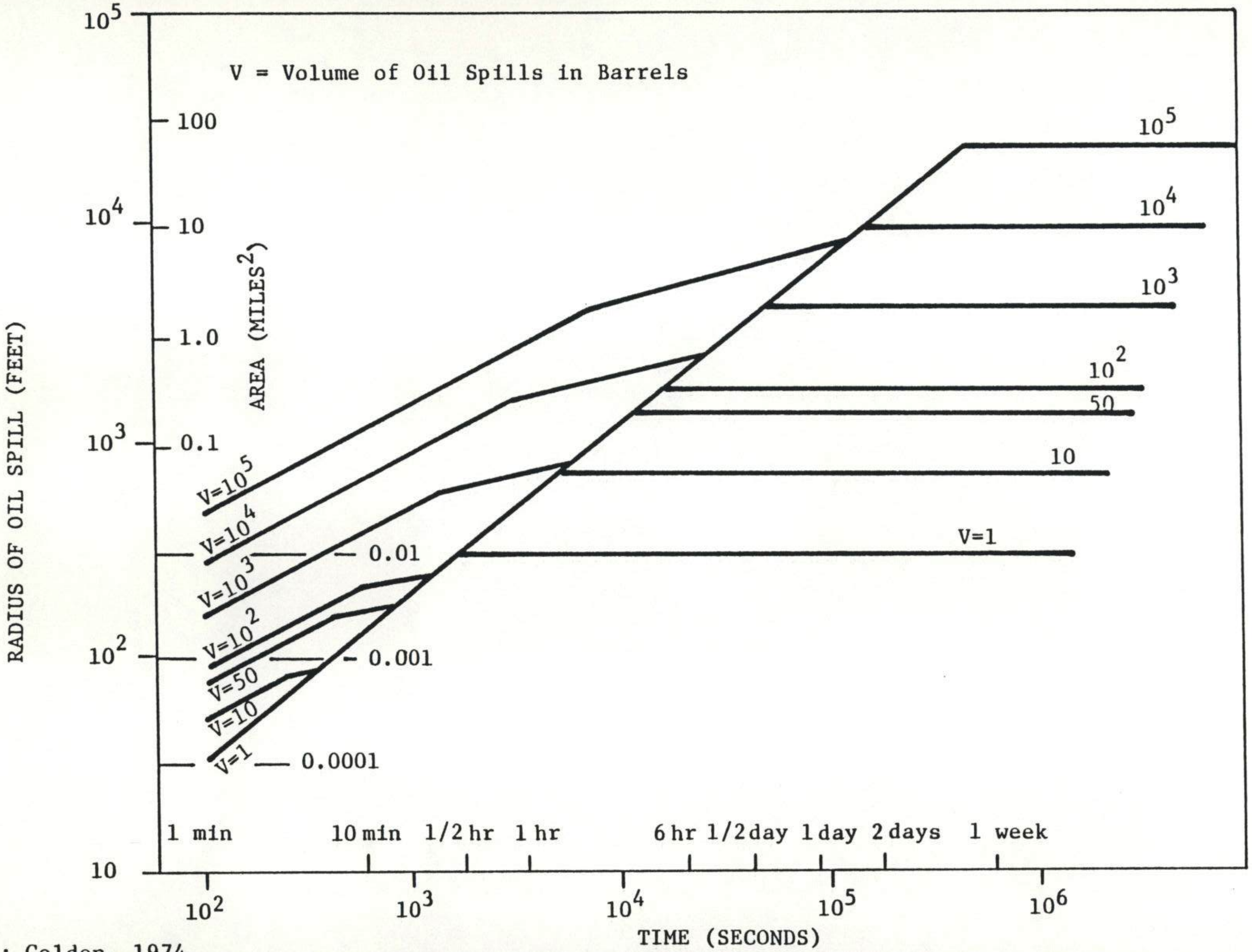


FIGURE 3-14 DAYLIGHT AND SEA ICE CONDITIONS - BEAUFORT SEA



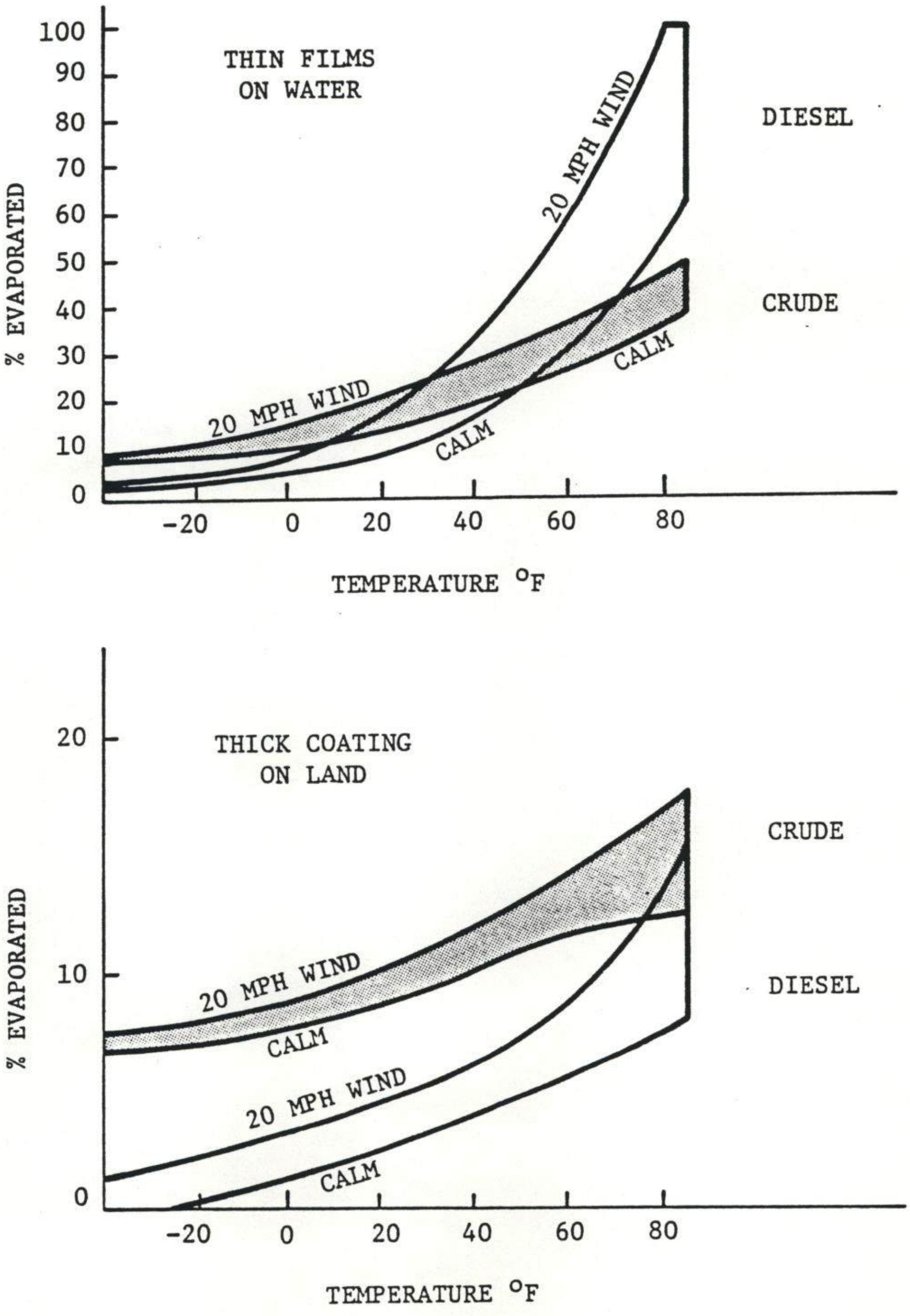
Source: Crowley Environmental Services Corp., 1978

FIGURE 3-15 VOLUMETRIC CHARACTERISTICS OF A VARIETY OF OIL SPILLS AFTER ACHIEVING A RELATIVELY STABLE CONDITION



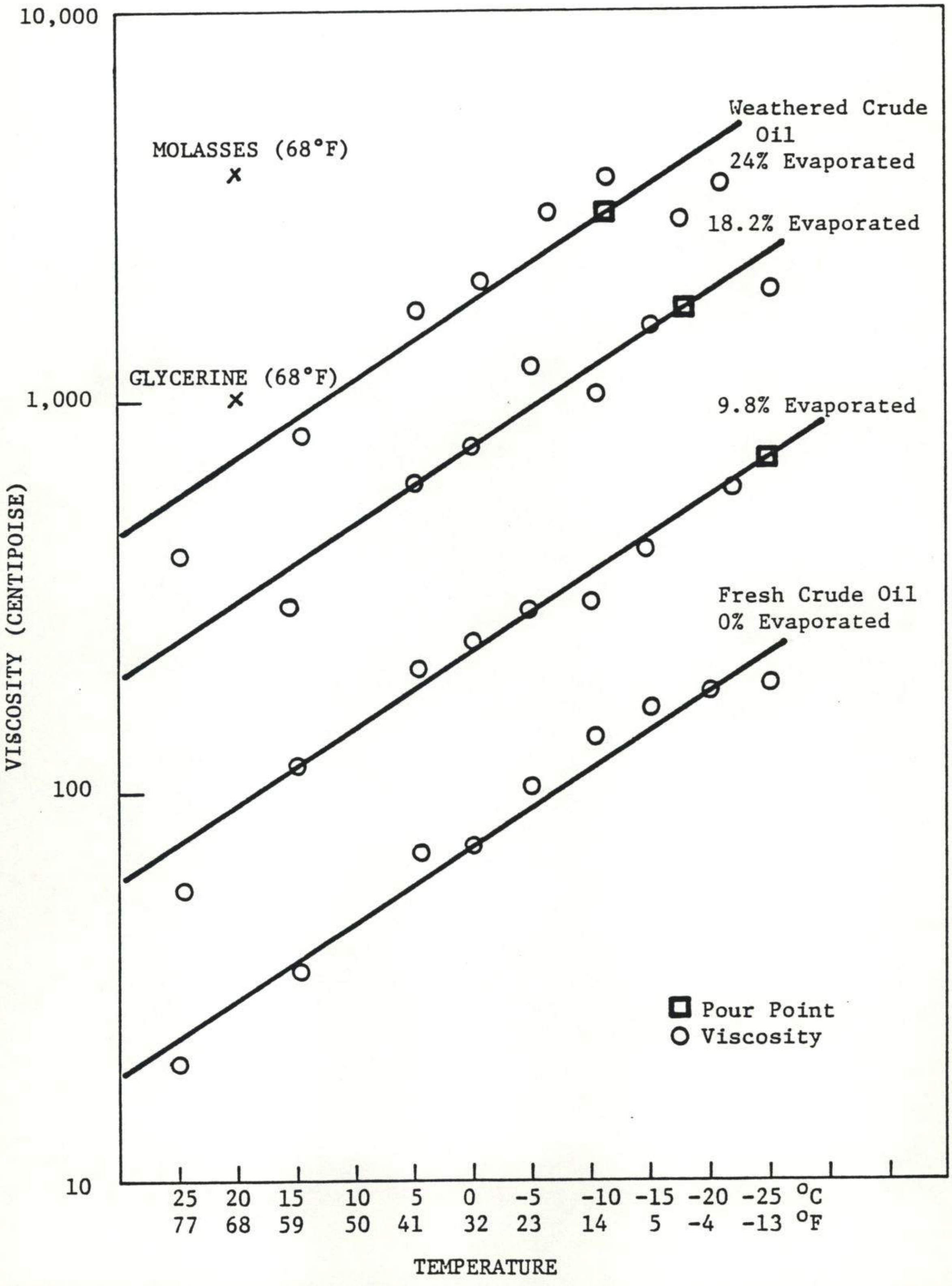
Source: Golden, 1974

FIGURE 3-16 SPREAD OF CRUDE OIL ON SEA WATER (TEMPERATE CLIMATE)



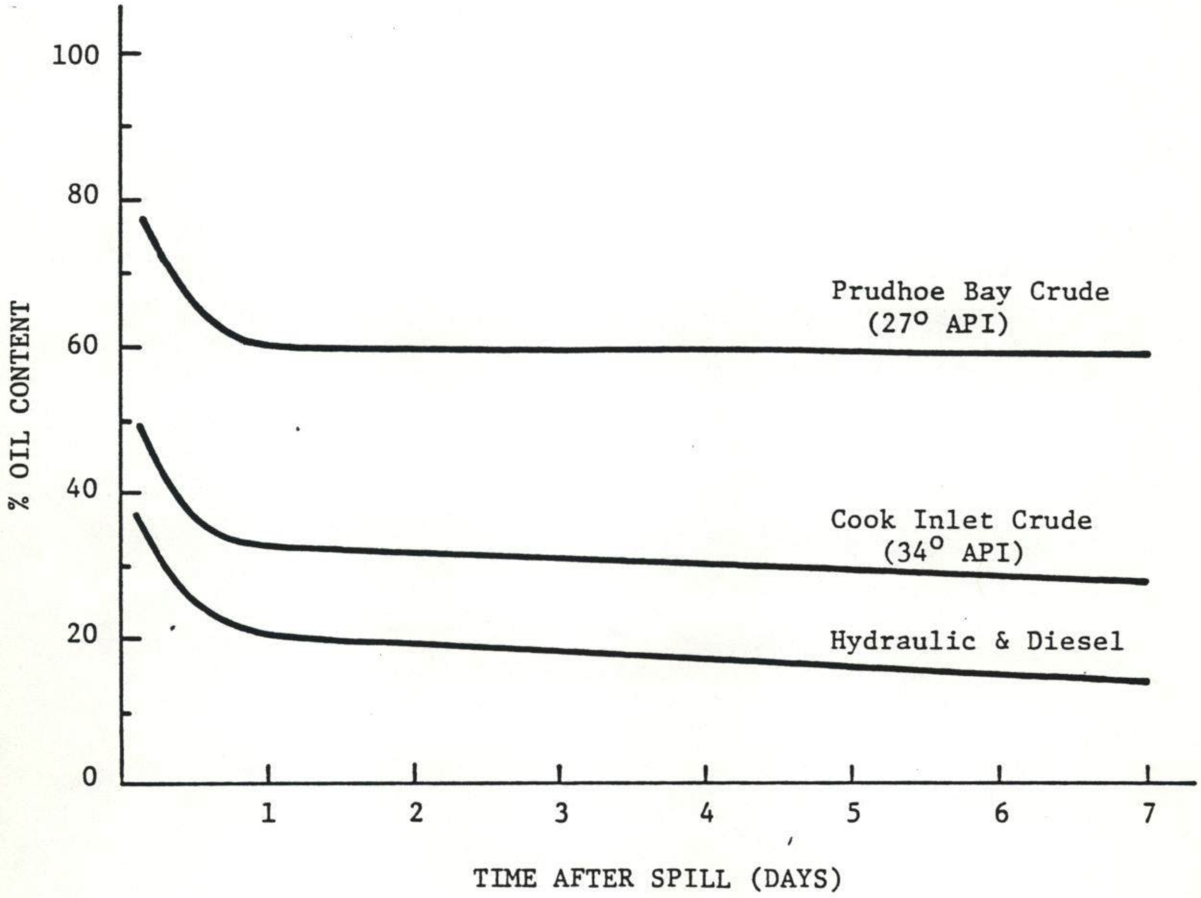
Source: Sohio-Alaska Petroleum Co., 1980

FIGURE 3-17	EVAPORATION AFTER 4 TO 8 HOURS FOR DIESEL AND CRUDE SPILLED ON WATER AND LAND



Source: Deslauriers et al., 1979

FIGURE 3-18 VISCOSITY OF PRUDHOE BAY CRUDE OIL VERSUS TEMPERATURE



Source: Allen, 1979

FIGURE 3-19 OIL CONTENT IN SNOW (PERCENT VOLUME AFTER SAMPLE MELTS)

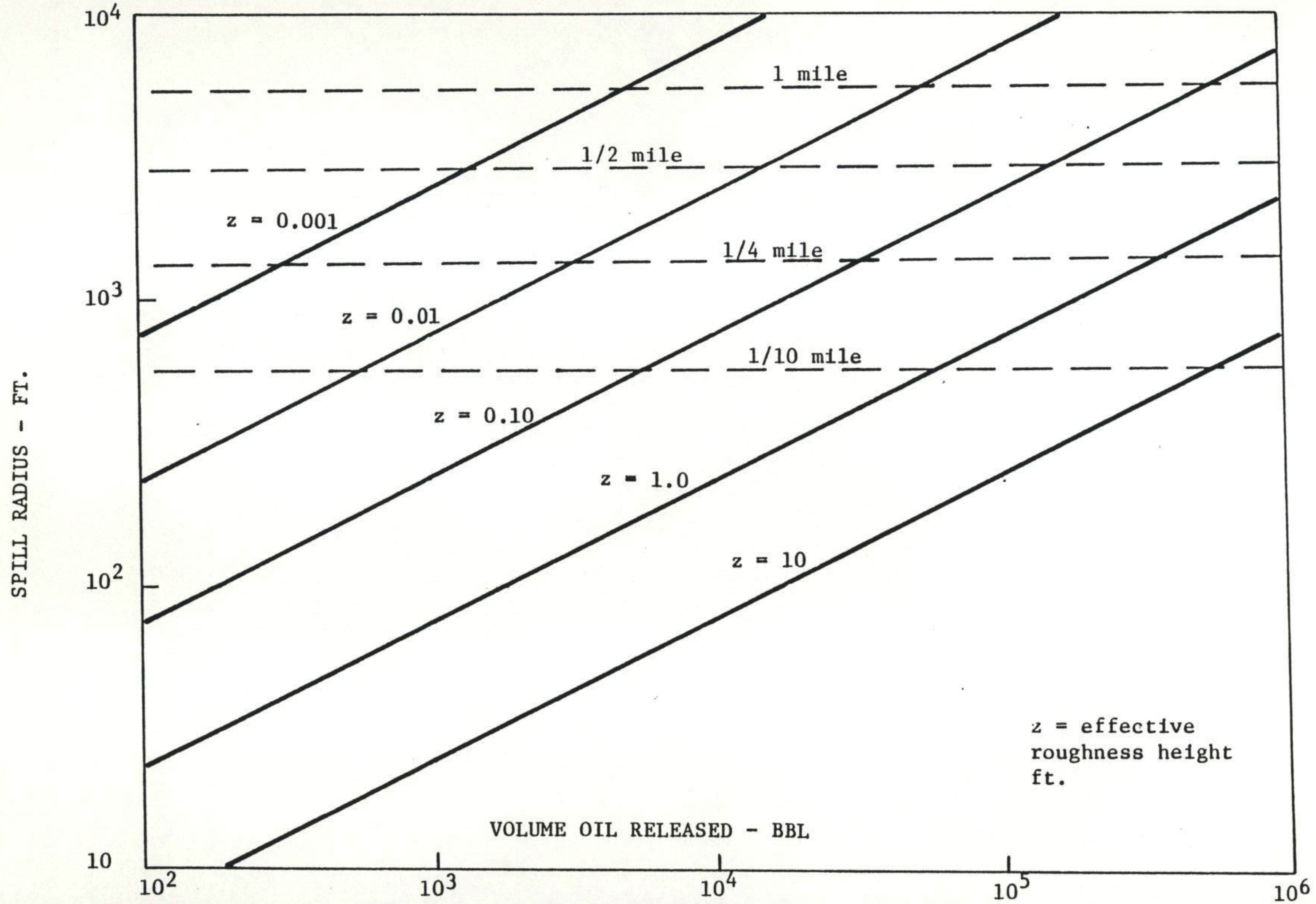


FIGURE 3-20 SPREAD OF OIL ON A FROZEN SURFACE

Source: McMinn, 1972

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SECTION 4

Alaskan Beaufort Sea Oilspill Response Body
6700 ARCTIC SPUR ROAD • ANCHORAGE, ALASKA 99502
TELEPHONE (907) 349-6491

August 3, 1981

TO: ABSORB Member Company Representatives
Technical Subcommittee Members
Chairman - Legal Subcommittee
Chairman - Accounting Subcommittee
Chairman - Communications Subcommittee

FROM: Al Allen, ABSORB Manager Al Allen

SUBJECT: Update on ABSORB State of Readiness

The following information is provided to assist you in developing site-specific spill contingency plans for the Beaufort Sea and in dealing with questions and/or concerns from government agencies regarding ABSORB's operational readiness.

CONTINGENCY PLAN

ABSORB's Oil Spill Contingency Plan has undergone an extensive review since its release in July, 1980. This review has resulted in a set of three revision packages. The first package, covering a few changes in wording and phone numbers, etc., was mailed to all plan holders on July 10, 1981. The second revision package, covering equipment specifications, site restoration, communications network, government agencies, personnel job descriptions and minor wording changes will be mailed within a few days of the completion of our annual meeting (August 18/19, 1981). This second mailing will include the names and phone numbers of the officers of ABSORB's Executive Committee for the remainder of 1981 and for the new fiscal year, 1982.

A third package of revisions is being planned for a November/December, 1981 mailout providing substantially new information on our training programs, sensitivity atlas and equipment/services resource inventory and retrieval system.

FIELD MANUAL (or HANDBOOK)

ABSORB is currently developing an Oil Spill Contingency Field Manual (or Handbook) with assistance from Crowley Environmental

Services, Anchorage. The field manual will be a condensed version of several chapters out of the larger ABSORB Oil Spill Contingency Plan. It will be a loose-leaf notebook approximately (6 1/2" by 9") prepared for use by operational personnel in the field.

This field manual will be prepared in a style and format to facilitate a simple conversion of the manual to a site-specific document for use by any of ABSORB's member companies. While serving as a useful field-oriented, mini-contingency plan for the ABSORB Response Team (ART), the manual will be easily converted, as necessary, for site-specific offshore drilling operations. The planning and preparation of the manual has been coordinated with Federal and State agencies to insure its adequacy in meeting all regulatory concerns.

FACILITIES

Anchorage - The ABSORB headquarters will relocate on or about September 1, 1981 from 6700 Arctic Spur Road to 201 Danner Avenue, Suite 170. The Cook Inlet Response Organization (CIRO) and Gulf of Alaska Cleanup Organization (GOACO) headquarters will also move to the same location. All existing telephone numbers should remain in effect.

The ABSORB warehouse in Anchorage (4,600 sq.ft.) is located at 525 Potter, Bay #1, and is currently used in receiving and preparing equipment for shipment to the North Slope warehouse, and for storing certain backup resources such as sorbents, containment boom and a complete bird rehabilitation center. These materials can be moved quickly to the slope or any other area of need upon demand.

North Slope-The ABSORB warehouse at Prudhoe Bay (10,800 sq.ft.) was completed in April 1981. The warehouse is located on Spine Road, next to the VECO camp and construction facilities, mid-way between the Deadhorse Airport and the ARCO airstrip. The warehouse contains wood and metal workshops, storage bins and racks, dispatch office, and a large room for training or for onshore support functions during an actual spill. The building together with approximately two acres of gravel pad, is capable of holding the entire inventory of ABSORB's oil spill response equipment, materials and support vehicles/vessels.

ABSORB's 20-man Herc-able camp, capable of supporting 20 to 40 personnel at a remote location if desired, is presently being set up next to the North Slope warehouse. The camp will be used for lodging warehouse personnel and instructors, and for a potential R & D program out on the ice this winter. The camp is connected by detachable walkways to our warehouse and to two equally mobile modules comprising our Command and Communications Center and a Government Liaison/Debriefing Room.

EQUIPMENT

As of August 1, 1981, approximately 95% of ABSORB's oil spill equipment inventory was in place at the North Slope warehouse, or enroute to arrive at Prudhoe Bay within a few days. The remaining portion of ABSORB's planned fiscal year 1981 equipment acquisitions will be in place by November, 1981. Additional equipment and materials have since been identified, and pending approval of the new budget for the rest of 1981 (September - December) and all of 1982, these items will be acquired and on board by June 1, 1982.

A list of our response equipment and materials, along with dates to be in place, has been attached for your review and use as desired.

TRAINING SCHEDULE

On July 27, 1981, I sent a complete breakdown of our planned training schedule to each of the recipients of this memo. As indicated, approximately ten separate training activities are planned between now and mid-November.

ABSORB
SPILL CLEANUP EQUIPMENT
(in place or enroute to Slope)

QUANTITY	DESCRIPTION	1981 AUG 1	1981 NOV 1
FACILITIES			
--	Major warehouse equipment	X	
--	20-man camp	X	
--	Anchorage warehouse (leased)	X	
--	Prudhoe Bay warehouse (leased)	X	
VESSELS			
1 ea	32' workboat	X	
1 ea	16' jon boat w/25hp motor and trailer	X	
VEHICLES			
1 ea	18' 6-ton van truck (4 wheel drive)	X	
2 ea	Snow machines & sleds	X	
DETECTION			
1 ea	Current meter (handheld)	X	
1 ea	Current meter (self-recording)		X
7 ea	Ice augers	X (2)	X (5)
3 ea	Vapor analyzers		X
CONTAINMENT EQUIPMENT			
2035'	Goodyear Sea Sentry boom	X	
1000'	Kepner Reel Pak boom (on two separate 500' reels)	X	

		1981	
QUANTITY	DESCRIPTION	AUG 1	NOV 1
CONTAINMENT EQUIPMENT (cont'd)			
2700'	Ocean Dike containment boom	X	
900'	Mini boom	X	
1000'	American Marine Simplex oil boom	X	
	An additional 10,000 to 15,000 feet of boom will be purchased following open water test and evaluation activities this summer. The additional boom should be on board by June, 1982.		
OIL RECOVERY EQUIPMENT			
10 ea	SLURP portable wier skimmers	X	
(Under-Review)	Rope Mop skimmers (small)		X
10,000'	3M type 280 sorbent boom	X	
457 rolls	3M type 100 sorbent rolls	X	
197 bales	3M type 157 sorbent	X	
100 bales	3M type 151 sorbent	X	
	Rop Mop and disc-type skimmers of various types and configurations are currently under review, and planned for purchase this summer. These additional recovery capabilities will be ready for use prior to breakup, 1982.		

		1981	
QUANTITY	DESCRIPTION	AUG 1	NOV 1
STORAGE EQUIPMENT			
1 ea	1000 gallon air berm storage containers	X	
2 ea	2000 gallon air berm storage containers	X	
2 ea	3000 gallon air berm storage containers	X	
20 ea	Firestone Fabritank 2250 gallon bladders		X
4 ea	Firestone Fabritank 4400 gallon bladders		X
	Dracone barges (500 bbl class) are currently under review and will likely be purchased within the next 6 months.		
TRANSFER EQUIPMENT			
1620'	2" B. F. Goodrich suction hose w/fittings	X	
4020'	3" B.F. Goodrich suction hose w/fittings	X	
10 ea	2" Multiquip QP20T self-priming trash pumps	X	
10 ea	3" Multiquip QPD302 diaphragm pump	X	
2 ea	Slickbar Trans-Vac, skid-mounted vacuum units w/skimmer heads	X	

		1981	
QUANTITY	DESCRIPTION	AUG 1	NOV 1
LOGISTICAL SUPPORT			
--	Communication system with value of $255,000, including:		
1 ea	G. E. Porta Mobil II UHF & VHF	X	
1 ea	G. E. Master II Mobil UHF & VHF	X	
20 ea	Motorola MX 360 UHF	X(5)	X(15)
5 ea	Motorola MX 360 VHF	X	
1 ea	G. E. Deskon II base controller	X	
1 ea	G. E. Mastr II UH & VHF repeaters	X	
1 ea	Comco 731 air to ground	X	
1 ea	Motorola Micom-Consolette single sideband H. F. tranceiver	X	
1 ea	Motorola VHF marine	X	
1 ea	G. E. Mastr II VHF	X	
1 ea	40 kw diesel generator and housing	X	
--	Bird rehabilitation center	X(partial)	X(complete)
16 ea	Bird scare-away cannons & floats		X
1 ea	1.5 kw Homelite generator/(gas)	X	
5 ea	Pincor 3.0 kw generators/(gas)	X	
5 ea	Pincor 5.0 kw generators/(gas)	X	
2 ea	Pincor 8.5 kw generators/(gas)	X	
2 ea	Pincor 13.0 kw generator/(diesel)	X	
9 ea	TPA500-4 tripod lights w/4 Tungston halogen flood lights	X	
1 ea	100,000 btu direct-fired space heater	X	

		1981	
QUANTITY	DESCRIPTION	AUG 1	NOV 1
LOGISTICAL SUPPORT (cont'd)			
9 ea	150,000 btu direct-fired space heaters	X	
2 ea	320,000 btu direct-fired space heaters	X	
3 ea	Chain saws, 2 w/36" bars; 1 w/7" bar	X	
10 ea	Response boxes Small hand tools Personnel protection gear Miscellaneous supplies-beach cleanup	X(partial)	X(complete)
3 ea	Weatherport shelters 12'x20' insulated	X	
60 ea	Life vests (Gentex Comfort King)	X	
60 ea	Mustang U-VIC jackets		X
4 sets	Arctic clothing and survival equipment	X	
OIL DISPOSAL EQUIPMENT			
10 drums	Dispersant (Corexit 9527)		X
10 drums	Dispersant (ARCO-chem)		X
(Under-Review)	Ignitors (for in-situ burning of oil)		X

A majority of the above resources are now owned or will soon be purchased by ABSORB. A small portion of ABSORB's equipment resources, however, has been, and will continue to be, leased. The following resources will likely remain in a lease-as-needed mode:

- Additional crew cabs and pickup trucks
- Special airborne oil detection sensors
- Aircraft, all-terrain vehicles, tribikes, etc.
- Additional workboats, tugs, barges, etc.
- Special ice harvesters & melters
- Aerial dispersant equipment/aircraft

Additional items may be placed into ABSORB's inventory under long-term lease agreements or other immediate-access arrangements. Such items include:

- Large storage barges
- Onshore emergency pipeline systems for waste oil transport
- Onshore storage tanks
- Flaring systems and waste oil incinerators

Alaskan Beaufort Sea Oilspill Response Body
6700 ARCTIC SPUR ROAD • ANCHORAGE, ALASKA 99502
TELEPHONE (907) 349-6491

July 27, 1981

TO: ABSORB Member Company Representatives
ABSORB Technical Subcommittee
Chairman, Legal Subcommittee
Chairman, Accounting Subcommittee
Chairman, Communications Subcommittee
Loren Gordon, Manager, Cook Inlet Response Organization
Budd Bernhardt, Manager, Gulf of Alaska Cleanup Organization

FROM: Al Allen, ABSORB Manager Al Allen

SUBJECT: Training Program - Summer/Fall, 1981

This year two 3-day Oil Spill Control Schools and a 1-day Dispersants Serminar have already been completed. These activities were classroom oriented and rather general in terms of the topics covered. In addition we held several R & D/training sessions on the ice as we concluded our in-house Oil & Ice research off West Dock. Representatives from the Technical Subcommittee, local contractors, the University of Alaska, Federal and State agencies, and the North Slope Borough took part in these exercises.

As you know, ABSORB's North Slope Warehouse has now been completed; our 20-man camp is presently being positioned next to the camp; and most of our spill response equipment is in place. We are now prepared to begin a series of oil spill training schools geared specifically to the kinds of hardware/techniques we will be dealing with in the Beaufort Sea. Some of these schools will still require a substantial amount of classroom instruction; however, every effort will be made to provide hands-on experience at the warehouse and in the field.

The training schools envisioned for the remainder of 1981 will fall into two basic categories:

1. ABSORB Sponsored -- Those provided as a portion of ABSORB's normal on-going training program (Appendix C, ABSORB Oil Spill Contingency Plan).

2. Operator Sponsored -- Those requested, attended and funded by specific operating companies within ABSORB to meet their in-house training requirements. This latter category will involve reimbursement to ABSORB for all costs incurred in preparing training materials and in conducting any field exercises.

The first category, open to participants from any member company, will involve training schools which are modular in nature, providing detailed, in-depth experience in the following areas:

1. Open Water Response (surveillance, containment, recovery, transfer, storage and disposal).

2. Shoreline Response (surveillance, containment, recovery, transfer, storage and disposal).

3. Solid and Broken Ice Response (surveillance, containment, recovery, transfer, storage and disposal).

4. Dispersant Application (basic chemistry, regulations, fate & behavior, biological effects, application techniques).

5. Burning Techniques (safety, physics/chemistry of oil and combustion processes, materials/equipment handling, ignition systems).

6. Operations Management (government liaison, regulations, P. R., Logistics, technical support services, environmental and spill cleanup techniques).

7. Support Services (documentation, accounting, security, legal, insurance, public affairs).

8. Logistics (communications, manpower, equipment, material, transportation, food/housing, safety, engineering).

9. Environmental Coordination/Impact Assessment (biological effects, physical impacts, sampling, government liaison, response planning and impact assessment).

The second category, the need for which was requested by Exxon and approved by the Executive Committee, will typically involve 2-day schools at the ABSORB warehouse. It was agreed that only participants approved by the sponsoring operator company would be permitted to attend, and the school would be geared heavily toward the kinds of spills that could conceivably occur at the operator's specific drillsite. Typically, one day would be spent in the classroom while the second day would be devoted to hands-on work in the warehouse and/or the field.

It should be recognized that while only Exxon has requested training of its drillsite personnel in such operator-oriented schools, the Alaska Department of Environmental Conservation has specified that all offshore operators will be expected to provide such training for its drillsite supervisors. Should ABSORB be requested to coordinate individual operator-sponsored schools for each potential operating company this year, there would likely be an insufficient number of days to conduct all of the training schools needed. For this reason I am suggesting that 2 or 3 operating companies may wish to sponsor joint training sessions and share the costs. In any event, instruction during this latter school would include such topics as:

1. Organization, Authority, and Responsibilities of the Spill Response Team.

2. Fate and Behavior of Oil.

3. Equipment Sources and Availability.

4. Equipment Use, Advantages and Limitations.

5. Equipment Operation, Maintenance and Support.

6. Familiarization (hands-on experience) with the ABSORB-Owned Equipment.

It is very difficult to plan specific dates for the many training activities anticipated over the next few months because of uncertainties involving vessel availability, contractor/instructor availability, weather, etc. In addition, we will undoubtedly be requested to consider special operator-oriented schools for other member companies. Many participants have also expressed conflict periods, some of which overlap, thereby creating definite scheduling problems. I have therefore attempted to create a schedule that minimizes conflicts while permitting an efficient blend of school types and open-water experience prior to freeze-up (schedule attached). Some of the operator-sponsored training sessions (unrequested at this date) will undoubtedly have to shift into the late fall or be conducted jointly as suggested above.

After reviewing the attached Training Schedule, please determine the number of individuals your company will likely send to each of the training sessions. We would like to have the number of participants called in to the ABSORB office by August 15, 1981. If possible we would also appreciate the name, title and home office location of each participant. Participants for the Shoreline Response Workshop (No.5) must be identified by name by August 15th as we will want to fill every available space in the helicopters.

In all cases, participants should arrange for their own transportation to/from the slope, food & lodging, hip boots and all foul weather clothing. All participants should arrive at the slope no later than the night preceeding the school, be at the ABSORB warehouse (next to VECO) by 8:00 a.m., and plan to be available each day of each exercise until 6:00 p.m.. Bag lunches should be brought each day -- extra lunches can be arranged through VECO. Please do not hesitate to call any of the ABSORB personnel if you have any questions about these training exercises.

ABSORB Office (Anchorage)	(907) 349-6491
ABSORB Warehouse (Anchorage)	(907) 279-9033
ABSORB Warehouse (Slope)	(907) 659-2405

ABSORB
TRAINING SCHEDULE
(Summer/Fall 1981]

Date		Activity	Participants *
July 27	(1)	Kepner Boom-Field Test & Evaluation Deployment and recovery of Kepner Reel-Pack system at East Dock. Towing of boom in U-configuration with tensiometers.	Staff & Contractors
Aug. 3	(2)	Instructors Workshop Instruction techniques, materials preparation, audience control, preparation of visuals, etc., Begin at 8 a.m. in Exxon Conference Room, Calais II Bldg. Adjourn by 4:00 p.m..	Staff, Contractors & Member Company Personnel (Most candidate instructors have been notified already)
Aug 4-14	(3)	Equipment Test & Evaluation (General Shakedown) Deployment and recovery of boom systems (Kepner, Goodyear, Ocean dike, American Marine); Field testing of support equipment (North Star vessel, small boats, portable skimmers, pumps, generators, etc.); verification of logistics support requirements using over-land, vessel and air-lift transport systems.	Staff & Contractors (To be scheduled around other activity on the slope -- member personnel may request last-minute notification if desired).

Date		Activity	Participants *
Aug 24 & 25	(4)	Open Water Response Training School Field and classroom instruction focusing on the deployment, operation and recovery of equipment on open water off Prudhoe Bay. Classroom instruction will emphasize response equipment limitations and techniques, case examples, fate and effects of spills, and operations strategies. Field instruction will involve hands-on experience with a broad range of containment and recovery equipment and associated logistics support systems.	Staff, Contractors & Member Company Personnel
Sept 2-4	(5)	Shoreline Response Workshop Classroom and field instruction including helicopter transport to a number of shoreline types near Prudhoe Bay. Dr. Ed Owens of Woodward-Clyde, Victoria, will discuss and identify in the field those geologic and oceanographic factors that affect the distribution, impact and persistence of stranded oil. He will also describe onshore protection and cleanup methods as they apply to different shoreline types.	ABSORB staff and Member Company Personnel (Supervisor or Coordinator level, 1 person/ company)
Sept 9 & 10	(6)	Spill Control School - Operator Sponsored Classroom instruction and hands-on experience will be provided at Prudhoe Bay involving response team organization, oil fate and behavior, and equipment availability limitations, operation and maintenance.	Exxon Company Personnel

Date	Activity	Participants *
Sept 24 & 25 (7)	Shoreline Response Training School Classroom and field instruction at Prudhoe Bay covering shoreline protection and cleanup techniques, equipment transport and deployment, oil fate and behavior and case studies.	Staff, Contractors & Member Company Personnel
Oct 21 & 22 (8)	Spill Control School -Operator Sponsored Same as 6 above.	Exxon Company Personnel
Nov 4 & 5 (9)	Spill Control School-Operator Sponsored Same as 6 above.	Exxon Company Personnel
Nov 18 & 19 (10)	Environmental Coordination/Impact Assessment Training School Workshop oriented school designed for Environmental Supervisor/ Coordinator level personnel. Topics covered will include effects of oil on biological and physical resources, sampling techniques, government liaison, response planning and impact assessment. School likely to be held in Anchorage or Seattle.	Staff, Contractors & Member Company Personnel

* In all cases, contractor support personnel will be used as necessary to complement the ABSORB staff and member company instructors. CIRO and GOACO Managers are also encouraged to participate in all training exercises as time and space permit.

APPENDIX 4

HYDROGEN SULFIDE CONTINGENCY PLAN
TERN PROSPECT

I. Scope

This contingency plan is prepared on the basis that hydrogen sulfide is highly unlikely to be encountered in quantities dangerous to personnel or equipment. However, since there is no absolute assurance that hydrogen sulfide will not be encountered, the contingency plan provides for early detection and suspension of drilling operations before hydrogen sulfide would be dangerous to personnel or equipment. Further, the plan provides for orderly evacuation of personnel and protective equipment for those who may be required to shut in the well. Should hydrogen sulfide be encountered in unsafe levels and should it be decided to contine drilling with hydrogen sulfide present, a modified, more detailed plan will be prepared before drilling is again started.

II. Physical Properties - H_2S

Hydrogen sulfide is a colorless, transparent gas with a characteristic rotten-egg odor. The disagreeable odor of hydrogen sulfide occurs only at relatively low concentrations. Those who have been rendered unconscious from high concentrations and survived, report that they did not notice the so-called rotten-egg odor but rather that it had a sickening sweet odor. Others reported that the odor was sweet and not unpleasant. Just exactly at what concentration it becomes sweet-smelling is not known, but some believe it is around 500 to 1000 ppm. It should always be borne in mind that some people cannot detect the odor of H_2S.

H_2S is flammable in the range of 4.3 to 45.5 percent in air. A mixture of two volumes H_2S and 3 volumes oxygen will explode violently when ignited.

H_2S has a specific gravity of 1.192 (compared to 1.00 for dry air) or a molecular weight of 34.08 as compared to 29 for air. Hence, H_2S may be considered heavier than air and in concentrated form may collect in low places. However, at a concentration of 2,000 ppm, which may produce unconsciousness almost immediately, the specific gravity or density of the mixture of air and H_2S is only 1.003 so that the mixture for all practical purposes has the same density as air.

H_2S is readily soluble in petroleum hydrocarbons and is soluble in water at room temperatures at the rate of three volumes H_2S for one volume of water. Such things as heating and agitation of the water will reduce the concentration. This solubility and the effect of heat can account, for example, for open drainage ditches evolving dangerous amounts of H_2S during the heat of the day in cases where there was no significant amount found during the cool morning hours.

Information as to the concentrations of H_2S that are detectable by smell vary considerably. It is readily detected at about 5 ppm; however, it is generally accepted that concentrations as low as 0.025 ppm are detectable, 0.3 is distinct, 3 to 5 is strong and 20 to 30 ppm is strong but not intolerable. Above 30 ppm the odor does not become more intense as the concentration increases, and above 200 ppm the disagreeable odor appears less intense. These figures are based on initial perceptions. With continuous inhalation, the odors will appear less, due to olfactory fatigue. It must also be recognized that some other odors will mask even an odor as disagreeable as H_2S. For example, the odor of creosols effectively masks the odor of H_2S.

III. Physiological Effects - Hydrogen Sulfide

There are three principal effects from exposure to H_2S: 1) the irritant action of high concentrations on mucous membranes, 2) the effects on the eyes which may result from repeated exposures to low concentrations as well as short exposures to high concentrations, and 3) the most significant effect - paralysis of the respiratory nerve endings from exposure to relatively high concentrations of 500 to 700 ppm or more.

Aside from the irritant effects on the eyes, the principal mode of entry into the body is through the lungs. Skin contact even to high concentrations is not considered significant. It has been reported that a perforated ear drum can be a route of significant exposure. There is less resistance to outside atmosphere via the perforation than via the breathing apparatus, and therefore, it is reported, H_2S can be inhaled through the ear under such circumstances. Ear wax and ear plugs offer little protection.

Persons seriously exposed to H_2S but who recover may suffer some lung irritation which can lead to pulmonary edema or bronchial pneumonia.

The systemic effects from absorption of H_2S into the blood stream via the lungs is by far the most significant effect. Under normal circumstances, when absorbed into the blood stream, H_2S at low concentrations is oxidized rapidly to pharmacologically inert compounds such as thiosulfate or sulfate. When the amount absorbed into the blood stream exceeds that which is readily oxidized, systemic poisoning results in a general action on the nervous system; labored respiration occurs shortly, and respiratory paralysis may follow immediately. Death then occurs from asphyxiation unless the exposed person is removed immediately to fresh air and breathing is stimulated by artificial respiration before heart action has ceased.

In high concentrations of gas, the mechanics of this respiratory paralysis, formerly thought to involve a chemical reaction with the respiratory enzymes or with the hemoglobin or both, are now believed to be reflexes resulting from irritation of the carotid sinus. Moderately high concentrations on the other hand cause an arrest of breathing, but not respiratory paralysis, after overstimulation of the respiratory center. In such cases, resumption of breathing would probably occur, after removal from exposure, even without artificial respiration. Recovery from acute exposure to H_2S is usually considered complete, although sometimes prolonged for as much as several weeks, unless there has been damage to the brain due to prolonged oxygen deficiency. Transient and sometimes permanent psychic or nervous changes may be encountered if there has been damage to the brain. It is believed that the presence of alcohol in the blood potentiates the effects of H_2S in acute poisoning cases. Those recovering from acute poisoning and who have had alcohol during the past 24 hours reportedly become quite violent.

In cases of chronic, or perhaps more properly named sub-acute exposures, symptoms that occur include headache, dizziness, excitement, nausea or gastrointestinal disturbances, dryness and sensation of pain of the nose, throat and chest, and coughing.

The following indicates responses to various concentrations of H_2S in the atmosphere:

PHYSIOLOGICAL RESPONSE TO VARIOUS CONCENTRATIONS OF HYDROGEN SULFIDE

Response	Concentration PPM
Maximum acceptable concentration for prolonged exposure. (TLV)*	10
Minimum concentration causing eye irritation	10
Minimum concentration causing lung irritation	Moderately above 20
Slight symptoms after several hours	70-150
Maximum concentration for 1 hour without serious consequences	170-300
Dangerous after ½ hour to 1 hour exposure	400-700
Pulmonary edema or bronchial pneumonia from prolonged exposure	250-600
Rapidly produces unconsciousness, cessation of respiration and death	700-900
Unconsciousness at once, with early cessation of respiration and death in a few minutes	1000-2000

*TLV - Threshold Limit Value

Eyes can be affected by H_2S exposure. It is believed that the effect on the eyes is due to the caustic action of sodium sulfide formed by interaction of the H_2S and the alkali of the cells in the presence of moisture in the eyes. Symptoms and effects of exposure to the eyes that have been reported include blurred vision, as though viewing objects through a silk screen; appearance of colored rings around street or other lamps, car lights which appear to be dumbell-shaped, blurred and surrounded by colored halos; red and inflamed, eyes, somewhat resembling the "pink eye", and there may be a gritty feeling. There may be intense aching of the eyes, and the eyelids may go into spasms and be difficult to open. These symptoms may disappear overnight or may persist into the next day. Hydrogen sulfide may have a slight anesthetic effect on the eyes, as often the symptoms do not occur until the 2nd to 4th day of exposure. Estimates of minimum concentrations of H_2S required to cause eye effects are reported as ranging from 4 to 25 ppm.

IV. Physical Properties - Sulfur Dioxide

Sulfur dioxide is colorless gas or liquid. It has a pungent odor and is not flammable. It is formed when hydrogen sulfide is burned. The specific gravity of the vapor is 2.264 (compared to 1.00 for dry air). Anhydrous sulfur dioxide is non-corrosive to steel or other commonly used metals. In moist environments, it combines with water to form sulfurous acid, but it only very slowly oxidizes to sulfuric acid. In the presence of water, sulfur dioxide is corrosive to steel and other metals.

Concentrations of 6 to 12 ppm cause immediate irritation of the nose and throat. A level of 0.3 to 1 ppm can be detected by the average individual possibly by taste rather than by the sense of smell.

V. Physiological Effects - Sulfur Dioxide

Sulfur dioxide is intensely irritating to the eyes, throat and upper respiratory system. Its irritant properties are due to the rapidity with which it forms sulfurous acid on contact with moist membranes. An estimated 90 percent of all SO_2 inhaled is absorbed in the upper respiratory passages with only slight penetration in the lower respiratory tract.

Sulfur dioxide exerts its toxic influence on humans through acute and possible chronic effects. Acute symptoms of exposure are eye, mucosal and upper respiratory irritation. Potential chronic effects include nasopharangitis, reduction of pulmonary function and increased resistance to air flow.

Chronic effects of sulfur dioxide exposure may result from repeated bronchoconstriction. While bronchoconstriction is not itself a chronic effect, it is believed that continual exposure can lead to substantial permanent pulmonary impairment in excess of the normal gradual decrease in pulmonary function due to the aging process.

There are only limited epidemiological studies and a few animal studies which attempt to uncover any chronic effects due to sulfur dioxide exposure. Generally, the results indicate the possibility of permanent effects from continuous or long-term exposure but are inconclusive.

This material is so irritating that it provides its own warning of toxic concentrations. The TLV is 5 ppm. Fifty to 100 ppm is considered to be the maximum permissible concentration for exposures of 30 to 60 minutes. Four hundred to 500 ppm is immediately dangerous to life.

VI. H_2S Detection and Monitoring Equipment

A. Although hydrogen sulfide is not expected, monitoring is needed to alert personnel immediately to the presence of hydrogen sulfide in event it is encountered. To provide the necessary warning, International Sensor Technology H_2S Detectors or equivalent which are capable of detecting 5 ppm H_2S in the air will be installed to automatically monitor the shale shaker. In addition, the mud logging unit will be equipped with H_2S measuring equipment.

B. Two portable Draeger gas detectors and one portable International Sensor Technology H_2S detector or equivalent units will be available for spot-checking of H_2S.

VII. Personnel Protective Breathing Apparatus

Self-contained pressure demand air breathing apparatus will be available for each member of drilling crew on duty. Although normally a drilling crew consists of five men, ten self-contained units will be provided. Two spare air bottles will be available for each unit and a cascade air refill system with a nine-bottle refill capacity will also be provided. All units shall be stored on the rig floor. Personnel with perforated eardrums shall not be permitted to use this equipment in an H_2S environment.

Equipment:

Ten - Survivair 30-minute pressure demand units or equivalent.

One Cascade air refill system complete with regulator and three 300 cubic foot air cylinders.

VIII. Other Equipment

1. Six chalk boards and six note pads will be provided on the rig floor.

2. Two bull horns shall be provided.

3. Vapor tester (explosimeter).

4. Resuscitator with spare oxygen bottles.

5. Rope and harness sets for going into H_2S areas.

6. Stokes litter or equivalent.

7. Wind Indicators

   Windstocks, streamers, or other devices will be positioned around the location such that they can be seen from the rig floor and from any position around the location.

8. Mud Treatment and Checks

   In the event the mud becomes contaminated with sulfides, a supply of "Milgard" (100% zinc carbonate) or an equivalent scavenger will be available in Deadhorse in sufficient quantity to treat the entire mud system with 2 lbs per barrel.

   Below protective casing, daily mud checks will be made to determine the presence of sulfides in the mud using a Garrett Gas Train or equivalent.

9. Well Site Communication

   Portable two-way radios will be provided on location in order to permit rapid communication between supervisory personnel in case of an emergency.

10. "Danger - Hydrogen Sulfide - H_2S" signs will be displayed whenever hydrogen sulfide level is above 10 ppm outside of the rig floor, mud pit or shale shaker areas. Each sign shall have a minimum width of eight feet and a minimum height of four feet and shall be painted a high-visibility yellow color with black lettering of a minimum of 12 inches in height.

    All signs shall be illuminated under conditions of poor visibility and at night when in use.

IX. Briefing Areas

Two briefing areas will be designated at each location. The Shell Drilling Superintendent on location will designate which briefing area is to be used depending on wind direction.

X. Training

A. Self-Contained Breathing Apparatus

Personnel who may be required to use self-contained breathing apparatus in the event hydrogen sulfide is encountered shall be trained in the use and proper maintenance of breathing apparatus. All personnel shall be trained in use and proper maintenance of Robertshaw air capsules or equivalent. Personnel will also be required at least weekly to don this equipment to assure understanding in how to use it properly. A written record of this training will be kept.

B. Hydrogen Sulfide Detection Equipment

Personnel required to operate permanent or portable monitoring equipment will be trained in the proper use and maintenance of units.

C. Evacuation Procedures

All personnel will be advised of evacuation procedures, alarms, reporting areas and steps to take in event of a hydrogen sulfide emergency. Training will be provided permanent personnel to assure effective operation of evacuation equipment and understanding of evacuation procedures.

D. First-Aid Course

All personnel in the drilling crews shall be trained in basic first aid.

E. Safety Meetings

Safety meetings will be held at least monthly. These meetings will include review of hydrogen sulfide hazards, warning systems, location of safe briefing areas and training sessions on equipment. Records of attendance will be maintained on the drilling facility.

F. No Smoking

Areas where smoking is permitted will be established and identified. Should an alert be called, smoking shall not be permitted during the alert. All personnel shall be informed of no smoking areas and regulations pertaining to smoking.

XI. H_2S Emergency Procedures

A. If at any time as much as 10 ppm of H_2S is detected, the following steps will be taken:

1. The person detecting the H_2S must immediately notify the Driller. He must then notify the Shell Drilling Supervisor and contract Toolpusher.

   The Shell Drilling Supervisor and contract Toolpusher will bring portable gas detectors to the rig floor in order to find the source of H_2S.

2. Upon notification of the emergency, the Driller will shut down mud pumps and continue to rotate the drill pipe.

3. The rig floor and supervisory personnel will immediately put on gas masks. All other personnel will immediately leave the area and go to the upwind briefing or other safe area.

4. The contract Toolpusher will alert all personnel that an H_2S emergency exists. He should be prepared to shut off the Forced Air Circulation System in the living quarters.

5. The Mud Engineer will run a sulfide determination on the flowline mud.

6. A maximum effort must be made by supervising personnel to resolve the cause of the H_2S and to suppress the H_2S as quickly as possible. Drilling must not proceed until the cause of the H_2S is determined and the well is circulated. Rig floor and mud pit personnel will keep breathing equipment on while monitoring this circulation.

7. The contract Toolpusher will make sure all nonessential personnel are out of the potential danger area, i.e., mud pit area, mudlogger unit, mud storage room, etc. All persons who remain in the potential danger areas must utilize the "buddy system."

8. The Shell Drilling Supervisor in charge will notify the Shell Operations Superintendent of current conditions and actions taken.

9. The on-duty Shell Drilling Supervisor will see that all monitoring devices are functioning properly and reading accurately and will increase gas monitoring activities with portable Drager units.

10. The Shell Drilling Supervisor in charge will notify all approaching vehicles and helicopters to stay upwind and to be prepared to evacuate nonessential personnel.

11. The Shell Drilling Supervisor in charge will alert the Deadhorse dispatcher to assure continuous radio watch. The U.S. Geological Survey and U.S. Coast Guard must also be notified.

B. If the H_2S concentration exceeds 20 ppm (from an increase in gas cut mud) and the well is not attempting to flow, the following steps will be taken:

1. The person detecting the H_2S must immediately notify the Driller. He must then notify the Shell Drilling Supervisor and contract Toolpusher.

2. Driller will shut down mud pumps and continue to rotate drill pipe.

3. The rig floor and supervisory personnel will immediately put on air breathing units. Any other personnel in the high concentration area should hold their breath nd evacuate to a safe area.

4. Once air breathing equipment is on, the Driller should:

    a. Stop rotary.

    b. Pick up kelly above rotary table.

    c. Be ready to hang off and close the BOP's if necessary.

    d. If well control problems develop, shut in the well.

5. The contract Toolpusher will alert all personnel that an H_2S emergency exists. He must shut off the forced Air Circulation System in the living quarters.

6. All personnel not listed above must report to the upwind safe briefing area for further instructions from the off-duty-Toolpusher or Supervisor. If you are located on the downwind side of the rig when the alarm is sounded, hold your breath and proceed to the upwind safe briefing area.

7. Always put on a portable air breathing mask before proceeding to assist one affected by the gas and utilize the "buddy system." If the affected person is stricken in a high concentrated area, put on a safety belt with 50 feet of tail line and obtain standby assistance before entering the area. Always use the "buddy system" when entering possible contaminated areas.

8. The Shell Drilling Supervisor in charge will notify all approaching vehicles and helicopters to stay upwind and to be prepared to evacuate nonessential personnel.

9. Notify dispatcher to alert heliport and establish 24-hour watch. Notify appropriate state agencies in addition to USGS and USCG.

10. DO NOT PANIC

C. The Shell Drilling Supervisor and contract Toolpusher will assess the situation and assign duties to each person to bring the situation under control. When the severity of the situation has been determined, all persons will be advised. The Shell Drilling Supervisor and contract Toolpusher will:

1. Direct corrective action.

2. Notify the Shell Operations Superintendent in Anchorage on action being taken.

APPENDIX 5
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GEMDAS XI - SYSTEMS DESCRIPTION

A. GENERAL

A fully winterized skid mounted logging unit to accommodate the equipment to perform GEMDAS service. Working space is provided for client's representative, in addition to Consultant's personnel.

Unit Specifications: Dimensions - 8' x 26' x 8½'
Shipping Wt.- 20,000 lbs.
Power System - 440 VAC, 3 phase, 30 KVA

B. EQUIPMENT CONFIGURATION

1. Operating Systems

1.1 Internal Pressurization System. To prevent hazardous gas buildup within unit.

1.2 Internal Hydrocarbon Safety Monitor. To monitor unit atmosphere for hazardous gases.

1.3 Shunt Diode Safety Barrier Box. To prevent hazardous voltages exiting unit to sensors.

1.4 Flame Ionization total Gas and Chromatograph for more sensitive detection of hydrocarbons.

1.5 Hydrogen Sulfide (H2S) continuous monitor - Monitoring ditch gas plus four remote stations located around the rig. Each station individually alarmed for low and high concentrations of H2S. Calibrations performed every 2-3 days or on demand.

1.6 Depth Recording System.

1.7 Analog Chart Recorders for Data Output.

1.8 Patch Panel for routing of data to chart recorders.

1.9 Drill Monitoring Panel (DMP) to display and record normal drilling parameters. These parameters are computed to aid pore pressure prediction.

1.10 Mud Monitoring System (flow, density, temperature, resistivity). All systems measure mud in and mud out automatically with data being displayed around rig.

1.11 Pit Volume Totalizer (PVT), Microprocessor System. Capable of monitoring up to 12 pits with ± 2 bbl. accuracy.

5. Formation Evaluation Systems

5.1 Binocular Microscope

5.2 Ultra Violet Viewing Box

5.3 Sample Drying Oven

5.4 Typewriter with geological symbols

5.5 Field copying machine.

5.6 Equipment to aid in ditch cuttings analysis

5.7 Equipment to aid in drilling mud analysis

5.8 Single Solution Shale Density System

5.9 Light Table

6. Data Monitoring And Acquisition System

6.1 Two computers with 64K memory are interfaced with the drilling data sensors via a multiplexer unit.

6.2 Computers provide time sharing capability.

6.3 Two display terminals interfaced with computers allows data entry combined with a display facility.

6.4 Six Tape Drives are used for program and data storage.

6.5 Two Printer-Plotters are linked with the computational hardware.

6.6 Five CRT information Systems provide real-time drilling data throughout the unit with capacity for remote stations on the rig.

6.7 An uninterruptible power supply provides a minimum of 20 minutes of AC power in the event of a rig power failure.

6.8 Three remote CRT's supplying critical drilling data around rig (e.g. on rig floor, and drilling superintendents quarters).

7. Software Support Systems

7.1 With computation and processing equipment described, drilling performance functions can be calculated automatically on a continuous basis using field proven programs developed by Exploration Logging. Exploration Logging provides a library of programs to aid data acquisition and interpretation at the wellsite. Programs available include:

7.1.1 Real Time Monitors
Drill, Trip and Kill Monitors with output of critical data to data tape, printer and CRT display.

7.1.2 Offline and Data Processing Programs -
Offline Prints
Offline Plots

Data Editing
Lag Data Storage and Formatting
Data Re-evaluation and Analysis
Data Tape Copying

7.1.3 Engineering Assistance Programs -

Complete Mud Hydraulics Analysis
Swab and Surge Calculation
Bit Hydraulics Optimization
D-exponent Analysis
Advanced D-exponent Analysis
Normalized Exponent Analysis
Formation Abrasiveness and Tooth Wear
Bit Cost/Foot Breakeven Analysis
Fast Kick Analysis
Complete Kick Analysis
Fracture Gradient Analysis
Overburden Gradient Computation
Directional Survey Computation and Graphical Presentation
Cementation Volume Calculation
Pressure Build-up Analysis
Electric Log Analysis Including:
  Resistivity Crossplots
    FDC, CNL Plot -
    M&N Plot
    SW, SXO, Porosity Calculation
    Shaly Sand Calc
    RT, RXO Crossplot
    RWA, SP Crossplot
    SW By Ratio Method
    RW Determination Form SP

GEMDAS: STANDARD FORMATION EVALUATION

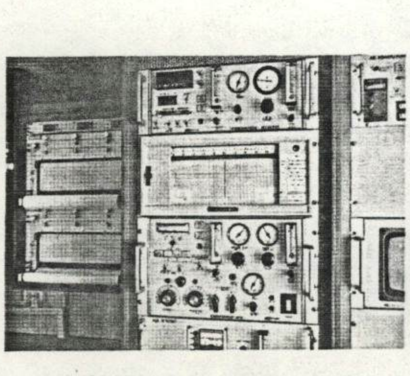
The integration of Exlog's geological formation evaluation services with the engineering data base yields a most comprehensive picture of drilling-in-progress. Formation evaluation remains an important and complementary part of GEMDAS.

Geological services include:

- Show evaluation
- Total gas curve plotting
- Drilled cuttings gas analysis
- Chromatographic gas analysis
- Lithological analysis

Computerized drilling data analysis benefits the wellsite geologist in several important areas:

- Formation tops may often be more accurately predicted by evaluation of changes in drilling parameters.
- Torque and drilling exponent plots may help interpret lithology and assist in detecting fractures and faults.
- Geological data entered into the computer can be plotted alongside data from offset wells as a powerful aid to correlation.
- Correlation of formation tops in deviated wells is simplified by the automatic computation of true vertical depth.
- Tooth wear estimates may aid in evaluating drilling breaks.
- Formation porosity and pore pressure estimates may aid in evaluating hydrocarbon shows.
- Temperature regression analysis yields the estimated bottom hole temperature, aiding in determining temperature gradient.

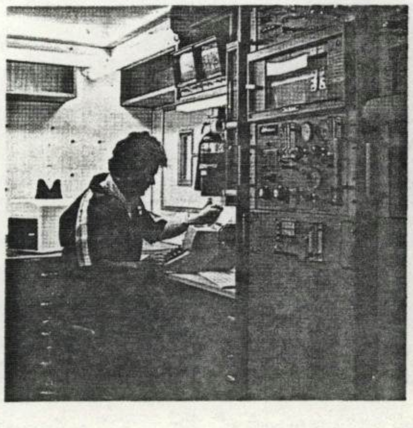


Standard Equipment

- Full GEMDAS instrumentation and analysis equipment
- H_2S Detector (continuous recording type)
- Continuous resistivity "in" and "out"
- Shale density
- Binocular microscope (10x30)
- Ultra Violet viewing box (fluoroscope)
- Oil show evaluation chemicals
- Blender and cuttings gas detector
- Chemical testing equipment
- Sample drying oven
- Copy machine

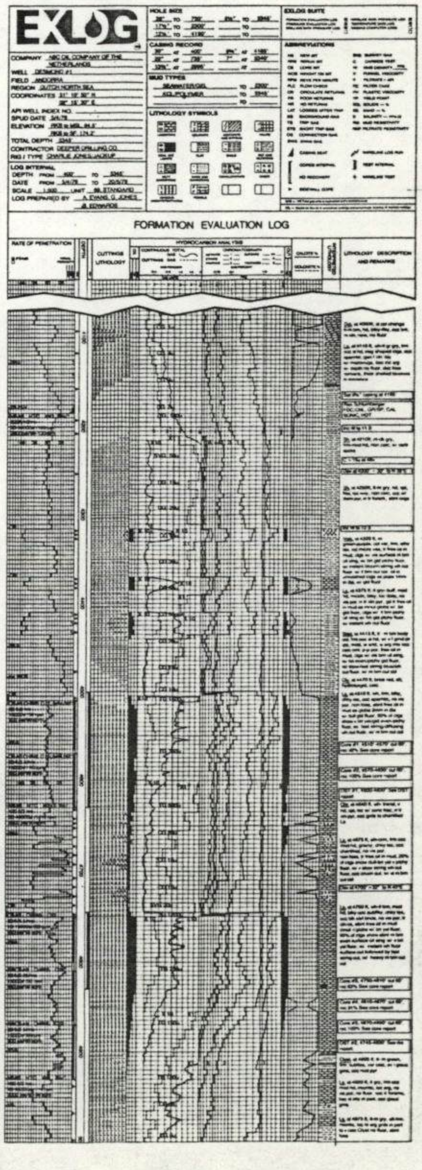
Specialized Equipment:

- CO_2 analyzer (continuous recording type)
- H_2S tube indicator
- O_2 detector
- Continuous conductivity "in" and "out"
- Portable resistivity meter
- Nitrate ion tracer testing kit
- Shale factor
- Autocalcimeter (quantitative carbonate analysis)
- Rock stain kit (carbonate, evaporite)
- External alarm system (audio and/or optical)
- Intercom System
- Wellsite mud check and special mud test equipment
- Additional video monitors
- Wellsite core analysis (porosity, permeability, SG and oil/water saturation)
- Core slabber
- Plastic heat sealer
- Geothermal and air/foam equipment service



Two principle wellsite tools provide geologists and engineers with the basic data needed to make recommendations for further exploration, deepening, stepouts, or abandonment. Exploration Logging's Masterlog, illustrated below, is one of these tools. It provides a unique "first-look" prior to extensive invasion or formation damage and can reveal features easily lost with other post-drilling investigative methods. Often the only chronological record of the well encompassing both geological and engineering features, the Masterlog delineates potentially productive zones and provides detailed evaluation of shows.

FIGURE 3



GEMDAS: QUALITY SENSORS ON THE JOB

Any automated data acquisition system must be based on safe, reliable, conveniently-placed sensors. Exlog sensors pass the test. In cases where suitable sensors have not been commercially available, we have developed our own.

Some of the benefits of Exlog sensors include:

- Safety — Sensors are installed in explosion-proof housings and are connected to the GEMDAS unit through a safety barrier system. This shunts sensor power and prevents shorting should a sensor cable be inadvertently cut. Exlog sensor systems are designed and installed to satisfy the most stringent installation requirements of national regulatory authorities and international agencies.
- Reliability — Sensor housings are constructed of materials such as stainless steel that can best withstand the corrosive wellsite environment.
- Ease of Replacement — In the advent of a failure, the majority of our sensors may be replaced in a matter of minutes. In some cases, a spare sensor is mounted within the housing.
- Convenience — Designed to be connected to existing rig equipment without causing undue interference with the drilling operation.

Sensor Systems

Listed below are calculated parameters and the sensor system from which each is derived. Figures 4 and 5 illustrate sensor system flow and sensor locations, respectively.

1) Kelly Height — Hydraulic pressure from kelly sensor converted to electronic signal at rig floor level by a pressure transducer, motion compensated for offshore drilling operation.
2) Total Depth — Incremented in 1/10 ft. intervals from kelly position transducer. Software drill logic control.
3) Rate of Penetration — Electronically derived from kelly position transducer, motion compensated for offshore drilling operations.
4) Pump Pressure — Independent standpipe pressure transducer (over-range rating 20,000 psi; accuracy 0.5% on 1-10,000 psi range).
5) Casing Pressure — Independent choke line pressure transducer.

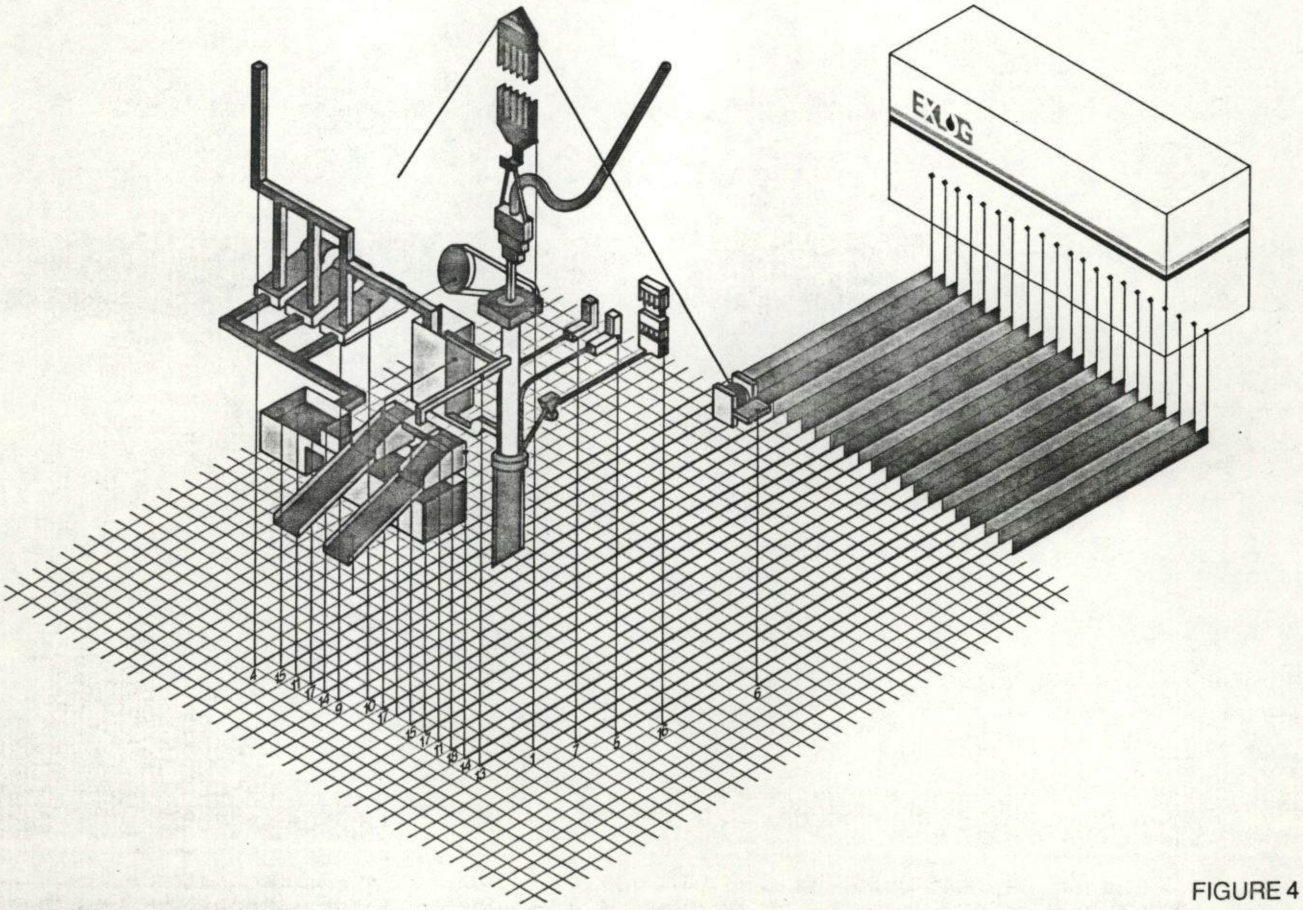
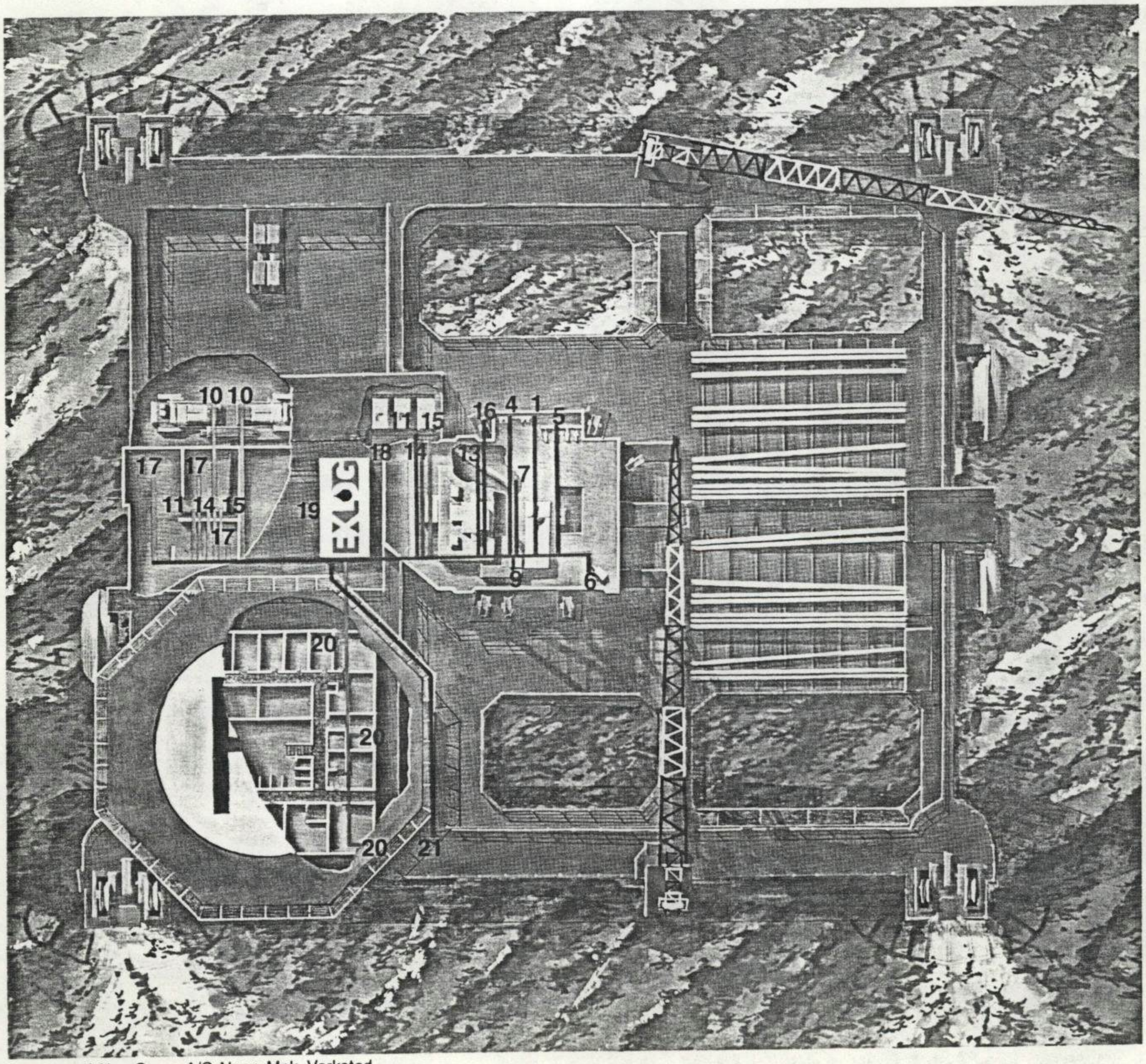


FIGURE 4

6) Hookload/WOB — Strain gauge transducer (attached to rig deadline gauge system).
7) Rotary Speed — Magnetic proximity switch.
8) Total Bit Revolutions — Accumulative digital electronic count device using impulses received from Rotary Speed sensor.
9) Rotary Torque — Electrical or mechanical (may be independent or slaved to rig sensor).
10) Pump Stroke — Microswitch counter.
11) Mud Weight In and Out — Strain gauge transducer.
12) Mud Flow In — Pump stroke sensor.
13) Mud Flow Out — Strain gauge transducer.
14) Mud Temperature In and Out — Platinum thermistor.
15) Mud Resistivity In and Out — Induction closed loop.
16) Rig Heave — Magnetic/reed switch type (attached to Rucker tensioner).
17) Pit Volume — Magnetic/reed switch type.
18) Gas Detectors — Catalytic and flame ionization methods.
19) GEMDAS Unit.
20) Remote Video Displays
21) Pressurization Line Intake.

FIGURE 5



Courtesy of Aker Group A/S Akers Mek. Verksted.