OIL-SPILL CONTINGENCY PLANS FOR THE ALYESKA PIPELINE SYSTEM

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ABSTRACT

Alyeska Pipeline Service Company has aimed for zero oil spillage in the design of the Alyeska pipeline system. The extent of the technical studies and efforts to minimize environmental impact are unprecedented in the annals of pipeline design. Examples include special design and construction techniques in areas of permafrost, burial, and river crossings, and special designs to withstand earthquake effects and fault movements. In addition, all essential data related to leak detection will be monitored. Alyeska will also conduct regular aerial and ground patrols of the pipeline route. At the marine terminal at Port Valdez, Alyeska has identified sources of potential oil spills and has incorporated in the terminal's design facilities for reducing the probability of a spill and minimizing the effects of spillage should it occur.

In view of the above considerations, the probability of a major oil spill seems remote. However, Alyeska recognizes the need to respond rapidly and effectively to a spill.

Comprehensive oil-spill contengency plans are being prepared to ensure that immediate steps are taken to protect the environment, to contain and clean up any spill, and to restore any affected areas. These are probably the most thorough and comprehensive plans of this nature yet developed. If a spill occurs on land or water, these plans assign immediate what-to-do and how-to-do-it actions to designated individuals.

INTRODUCTION

Alyeska Pipeline Service Company has aimed for zero oil spillage in the design of the Alyeska pipeline system. The extent of the technical studies and efforts to minimize environmental impact are unprecedented in the annals of pipeline design. Examples include special design and construction techniques in areas of permafrost, burial, and river corssings, and special designs to withstand earthquake effects and fault movements. In addition, all essential data related to leak detection will be monitored. Alyeska will also conduct regular aerial and ground patrols of the pipeline route. At the marine terminal at Port Valdez, Alyeska has identified sources of potential oil spills and has incorporated in the terminal's design facilities for reducing the probability of a spill and minimizing the effects of spillage should it occur.

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The overall approach to the development of a viable comprehensive plan and the concepts involved in that development are explained here. However, the plan itself is subject to the approval of the U.S. Department of the Interior and the Alaska State Pipeline Coordinator's office. The plan will be thoroughly reviewed by those regulatory agencies and will be revised or supplemented at their direction.

Related studies

The development of Alyeska's oil-spill contingency plans required consideration of many factors. Geographical elements (location of spill, drainage characteristics, surface conditions, type of soil, type of shoreline, and accessibility of spill site), environmental elements (weather conditions, surface currents, wave action), and ecological elements (existence and location of areas sensitive because of fish, vegetation, and wildlife) are of major significance. Equally important are oil elements (potential spill volumes, characteristics of the oil, and its behavior in water or on snow or ice), and available equipment and technology (booms, skimmers, absorbents, and surface tension modifiers).

Prior to and during the development of Alyeska's oil-spill contingency plan, additional studies were conducted to obtain information related to contingency planning. These studies included:

a. pipeline drainage calculations
b. hydrological factors
c. selection of containment sites
d. reclamation of affected land areas
e. environmental considerations.

Pipeline drainage calculations. A computer program has been developed to calculate the potential dynamic drainage from a worst-case situation of total line rupture at any location along the Alyeska pipeline system. Dynamic drainage takes into account static drainage and the time required for instruments to detect a line break or leak, dispatcher reaction time, valve closure time, and pump station shutdown time. The program calculates for a split or crack in the 48-inch diameter mainline pipe. This type of rupture represents a full line break.

The calculations are based on the following information:

a. A line profile giving milepost (MP) designations and corresponding elevations for selected points along the route. These points are chosen so that all features significant to drainage, particularly valleys where oil will be trapped, are represented in the data.

b. Valve locations, types, and times of closure; block valves, check valves, and combinations of both. Check valves are assumed to block drainage from the downstream direction for all sizes of leak.
c. Line diameter, fluid viscosity, leak size and type, and maximum throughput of 2 million bbl per day.

Hydrological studies. A detailed hydrological study was conducted by Michael Baker, Jr., Inc., to define the limits of the major drainage basins and their subsections along the entire 800-mile-long pipeline route. The study provided information on surface water runoff and major stream flows. Drainage maps for each major drainage course were prepared and each drainage map included a tabulation of the following information:

a. drainage area (square miles)
b. estimated 50-year runoff (cubic feet per second [cfs])
c. estimated 50-year runoff velocity
d. estimated mean annual runoff (cfs)
e. estimated mean annual runoff velocity.

The information from these studies made it possible to estimate oil-spill travel times from source of leaks to potential containment locations.

Selection of containment sites. The entire pipeline route was surveyed from the ground or by helicopter to select locations for installation of containment systems to prevent the spread of potential oil spills. The following factors were considered in the selection of containment sites:

a. location of existing features (man-made and natural) suitable for use as containment structures
b. access routes and trafficability to containment sites
c. reaction and travel time of response personnel to implement containment action
d. travel time of oil from source of leak to sensitive areas.

At selected locations, the use of permanent facilities to assist in containment is under study. Types of facilities include: stockpiled gravel, dirt, boom, etc.; abandoned material sites for oil diversion; and ponds to facilitate booming (created by widening and deepening fast streams). In determining the viability of permanent facilities, environmental factors are examined to ensure that any adverse impacts are minimized.

Reclamation of affected land areas. A series of studies is being conducted by Dr. Wm. W. Mitchell, Institute of Agricultural Sciences, University of Alaska, on procedures for the reclamation of land areas damaged by an oil spill. These studies, conducted on test plots under various environmental conditions, will determine:

a. plant materials that may be used under various environmental conditions to rehabilitate land areas affected by oil spills
b. the effects of oil applied at different rates to native vegetation
c. the effects of burning, tilling, and fertilizing in the reclamation of affected land areas
d. the residual effects of oil over different periods of weathering
e. the infiltration and oil-retention properties of tundra and forest soils.

Environmental considerations. Alyeska personnel to be assigned oil-spill task force responsibilities will be familiar with the environmental conditions along the pipeline route and within Port Valdez. An environmental atlas and other supporting documents have been prepared for areas along the pipeline which provide specific descriptions of biological environment, climatological conditions, hydrological conditions, and oceanography.

In addition, it is recognized that the environmental damage from an oil spill can be increased by the improper use of earthmoving equipment and other vehicles during oil-spill containment and cleanup.

To assist in planning containment and cleanup, the surface soils on and near the pipeline route were studied for their trafficability and thermal erosion characteristics. From this study, guidelines were drawn up in order to minimize ecological damage, particularly under summer conditions when thawing of ice-rich silts or clays is prevalent.

Planning concepts

The Alyeska Pipeline System oil-spill contingency plan consists of three parts: the general provisions, which apply to the entire pipeline system; district plans, which delineate specific response actions for a particular section of pipeline between pump stations; and area plans within each district, which give response actions for pipeline segments within specific drainage areas. Figure 1 shows the relationship between the various plans. (A contingency plan has also been designed specifically for operations at the Port Valdez Marine Terminal.) Figure 2 lists the contents of the general provisions, district plans, and area plans.

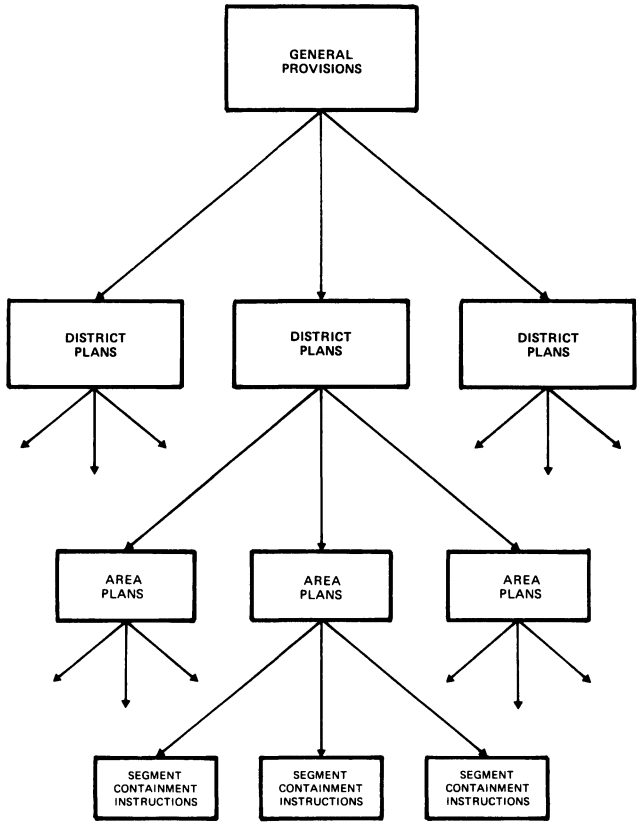

Figure 1. Relationship between plans

An effective contingency plan indicates actions to be taken, their sequence, and timing in relation to other events. Most existing contingency plans contain this information, but they assume that personnel implementing the plan are experienced and trained to judge what to do and how to do it. This is seldom the case.

The Woodward-Envicon, Inc., concept, based on the premise that a planned positive action is most appropriate, prescribes responses for implementation immediately after a spill has occurred. Preplanning, training, and experience will enhance the effectiveness of response actions.

During or immediately following an oil spill, the following sample actions may be taken:

a. Verify and locate a spill and notify response team members to institute emergency procedures.

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GENERAL PROVISIONS	DISTRICT PLAN	CONTINGENCY AREA
100 INTRODUCTION	100 INTRODUCTION	100 INTRODUCTION
101 BACKGROUND	101	101
102 POLICY	102	102
103 SCOPE	103 SCOPE	103 SCOPE
104 PLAN CONCEPT	104 PLAN CONCEPT	104
105 PLAN FORMAT	105 PLAN FORMAT	105
200 CONTINGENCY RESPONSE ORGANIZATION	200 CONTINGENCY RESPONSE ORGANIZATION – DISTRICT	200 CONTINGENCY RESPONSE ORGANIZATION – AREA
300 IMMEDIATE RESPONSE ACTIONS	300 IMMEDIATE RESPONSE ACTIONS – DISTRICT	300 IMMEDIATE RESPONSE ACTIONS – AREA
301 DETECTION	301 DETECTION	301 DETECTION
302 ALERT PROCEDURES	302 ALERT PROCEDURES	302 ALERT PROCEDURES
303 CONTAINMENT	303 CONTAINMENT	303 CONTAINMENT
304 EQUIPMENT	304 EQUIPMENT	304 EQUIPMENT
305 PIPELINE OPERATIONAL ACTIONS	305 PIPELINE OPERATIONAL ACTIONS	305 PIPELINE OPERATIONAL ACTIONS
306 LOCATION CROSS REFERENCES	306	306
400 CONTINGENCY PLAN	400 CONTINGENCY PLAN	400 CONTINGENCY PLAN
401 SYSTEM DESCRIPTION	401 DISTRICT DESCRIPTION	401 AREA DESCRIPTION
402 OIL SPILL DETECTION	402 OIL SPILL DETECTION	402
403 ASSESSMENT	403 ASSESSMENT	403
404 CONTAINMENT	404 CONTAINMENT	404 CONTAINMENT
405 EXCLUSION	405 EXCLUSION	405 EXCLUSION
406 CLEANUP	406 CLEANUP	406 CLEANUP
407 DISPOSAL	407 DISPOSAL	407
408 RESTORATION	408 RESTORATION	408
409 DOCUMENTATION	409 DOCUMENTATION	409
500 ENVIRONMENTAL PARAMETERS	500 ENVIRONMENTAL PARAMETERS	500
501 BIOLOGICAL ENVIRONMENT	501 BIOLOGICAL ENVIRONMENT	501
502 METEOROLOGY	502 METEOROLOGY	502
503 OCEANOGRAPHY	503 OCEANOGRAPHY	503
504 HYDROLOGY	504 HYDROLOGY	504
600 TRAINING PROGRAM	600 TRAINING PROGRAM	600
700 RESPONSE PLAN ANNEXES	700 RESPONSE PLAN ANNEXES	700 RESPONSE PLAN ANNEXES
701 GOVERNMENTAL RELATIONS	701 GOVERNMENTAL RELATIONS	701
702 THIRD-PARTY CONTRACTORS	702 THIRD-PARTY CONTRACTORS	702
703 LOGISTICS	703 LOGISTICS	703
704 COMMUNICATIONS	704 BOOMS	704
705 ALYESKA OIL SPILL TASK FORCE DIRECTORY	705 SKIMMERS	705
706 PIPELINE DRAINAGE CALCULATIONS	706 SORBENTS	706
707 BOOMS	707 REVEGETATION	707
708 SKIMMERS	708 WILDLIFE CARE & REHABILITATION	708
709 SORBENTS	709 COMMUNICATIONS	709
710 MANPOWER	710 OIL-ON-WATER SENSORS	710
711 REVEGETATION	711 PORTABLE LIGHTERING SYSTEMS	711
712 OIL-ON-WATER SENSORS	712 PUBLIC RELATIONS GUIDELINES	712
713 PUBLIC RELATIONS GUIDELINES	713 TELEPHONE ADDRESSES – COMPANY PERSONNEL – DISTRICT	713
714 POPULATION CENTERS	714	714
715 AIRPORTS & LANDING STRIPS	715	715
716 COMMERICAL FOOD & LODGING FACILITIES	716	716
717 ACADEMIC INSTITUTIONS & LABORATORIES	717	717
718 OIL SPILL COOPERATIVES	718 AIRPORTS & LANDING STRIPS	718
719 WILDLIFE CARE & REHABILITATION	719	719
720 LIGHTERING SYSTEMS	720 COMMERCIAL FOOD & LODGING FACILITIES	720
800 BIBLIOGRAPHY		

Figure 2. Contingency plan content

b. Control or limit the amount of oil spilled. Act to exclude or prevent the spread of oil to sensitive areas where effects may be severe.
c. Determine the extent of the spill and predict the subsequent dispersion as a function of time.
d. Plan and direct overall operations; provide administrative support, liaison with government/local officials, and public information.
e. Remove and clean oil from contaminated land areas, shoreline features, and water surfaces.
f. Document all phases of oil-spill incidents and subsequent cleanup activities.

Selection of the action to take at different times during a spill depends on: (a) the location and nature of the spill; (b) the quantity and type of oil; (c) the hydrology, topography, and soil types; and (d) sea state, ice, weather, and current. Supervision will start immediately, and documentation must be conducted simultaneously with the other operations.

Spills require prompt attention whether they are on water or on land. Detailed response plans must be prepared for immediate action to be taken wherever and whenever spills occur.

The contingency planning concept involves two types of documents: the response plan and the response plan annex.

The response plan describes in logical and sequential order the what-to-do actions. Some actions are undertaken in all situations. Other actions are contingent and are initiated only under specific circumstances.

The response plan annex explains how-to-do-it for each action specified in the response plan. In addition, the annex provides information on who, where, and how much. It also includes the following information:

a. nature of the action
b. detailed operating instructions
c. constraints
d. technical performance data
e. containment and cleanup equipment requirements and specifications
f. support equipment requirements and specifications
g. manpower and skills required.

The annex is prepared in looseleaf form to allow insertion of information on a particular area of interest and to make it easier to keep the plan current.

Contingency organization

The Alyeska Oil-Spill Task Force is divided into four functional areas: management, advisory, support, and area response. Figure 3 charts the overall organization of the task force. The managerial, advisory, and support areas generally perform staff functions, and the required positions will normally be staffed by Alyeska personnel based in Anchorage, Fairbanks, or Valdez. The area response positions will be staffed by Alyeska operating personnel located at maintenance headquarters, the marine terminal, and pump stations along the pipeline route.

The Alyeska Oil-Spill Task Force, under the direction of the oil-spill coordinator, uses a two-level organization to provide fast and effective initial response and strong follow-up capabilities for all oil spills. The first level of the organization, called the Immediate Response Team [IRT], responds immediately to any spill within its response area, taking preplanned actions depending on actual spill location. The second level, the remainder of the oil-spill task force, including IRTs from other areas, is activated as necessary by the oil-spill coordinator. This mode of organization enables the personnel closest to the spill source (the IRT) to conduct initial con-

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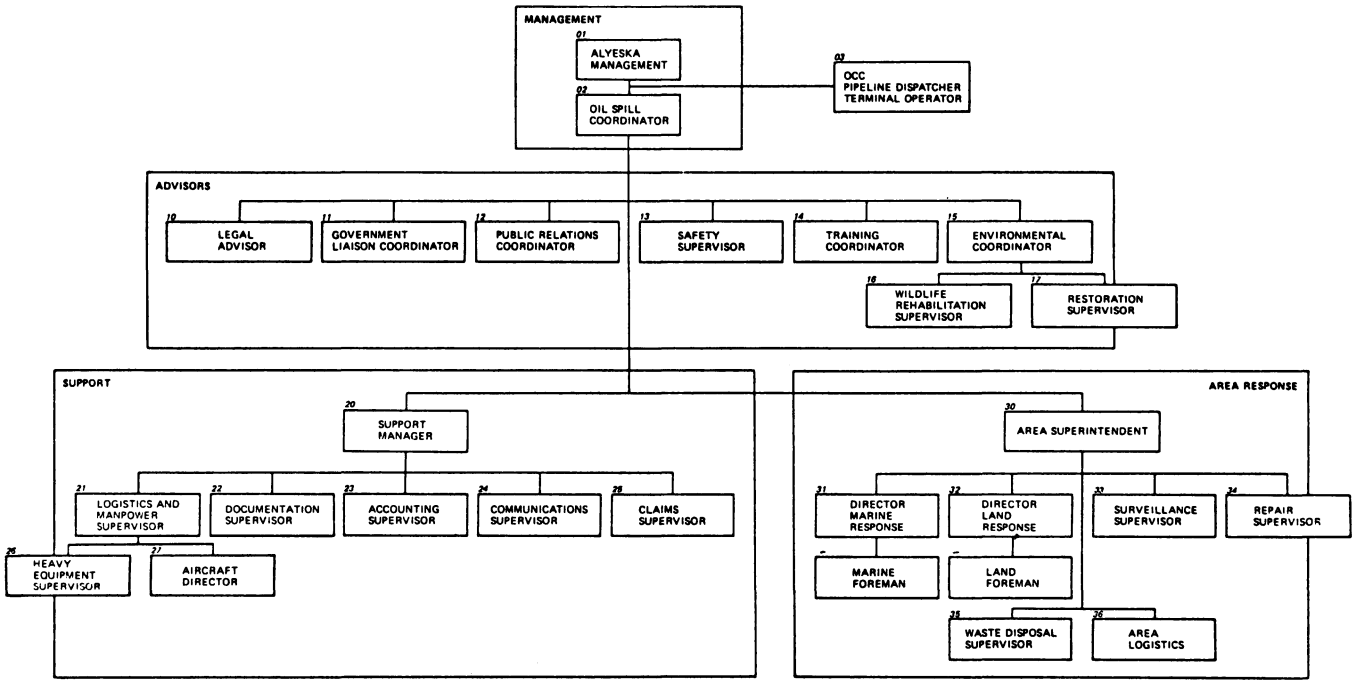

Figure 3. Alyeska Oil-Spill Task Force Organization

tainment, assessment, and cleanup, and allows for the expansion of the team to meet the requirements of any situation.

Small oil spills can generally be controlled by a few men with the proper equipment, if the response to the spill is quick and effective. Each IRT will be trained and equipped to respond in this manner to all spills. Should the IRT be unable to completely handle any spill, it will take preplanned actions to protect sensitive areas and initiate containment and cleanup, and will notify the oil-spill coordinator that assistance is needed. The oil-spill coordinator will then call upon the resources of the remainder of the oil-spill task force as necessary.

When an oil spill is detected, the pipeline dispatcher terminal operator, located at the Alyeska Operations Control Center (OCC) in Valdez, will be notified to ensure proper communications. The OCC pipeline dispatcher/terminal operator ensures that the area superintendent responsible for the appropriate contingency area has dispatched the IRT to the spill site and then notifies the oil-spill coordinator that a spill has occurred. The oil-spill coordinator will activate additional resources as necessary after consulting with the area superintendent. The flow chart shown in figure 4 illustrates how the contingency response organization functions.

Immediate response organization

The composition of each IRT will vary, depending upon the makeup of the Alyeska staff at each location and the type of action to be used in a specific area. The specific duties and composition of the IRT are defined in each area contingency plan. A supervisor will be directly in charge of the IRTs located within his region of responsibility.

The duties of the IRT may need to be undertaken simultaneously. These include:

a. verifying and locating the leak
b. stopping the leak, if possible
c. taking initial prescribed steps as outlined in each area plan to limit spill volume, contain the spill, and protect sensitive areas
d. providing initial assessment information to the area superintendent and the oil spill coordinator
e. assuming other assigned positions in the oil-spill task force when released from IRT activities by the area superintendent.

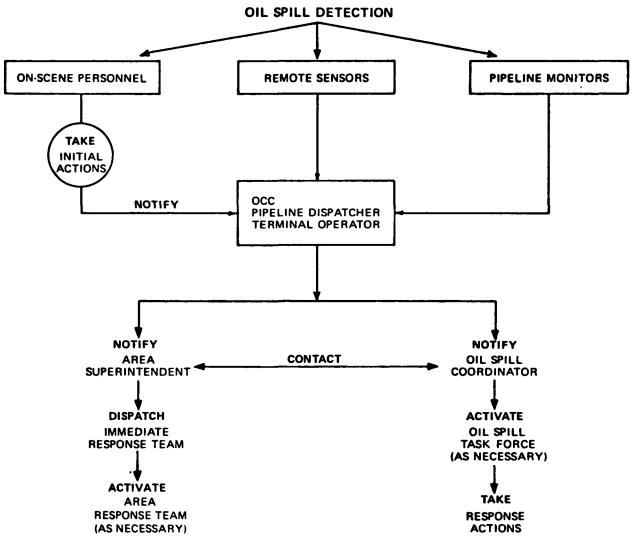

Figure 4. Action flow chart, Contingency Response Organization

The IRT positions are manned 24 hours a day by on-duty personnel at the pump stations, the OCC, and the marine terminal while they are performing normal duties. At maintenance headquarters, these positions are manned by personnel on duty only during normal working hours. However, they are available for callout during off-duty hours. The individuals who will fill these positions are listed in the contingency response plan for each area. Figure 5 gives the callout order for a spill incident.

Immediate response actions

When an oil spill is detected or indicated, the IRT will take preplanned actions at once under the direction of the area superintendent. The primary purpose of immediate response actions is to exclude oil from sensitive areas. The IRT will also locate and verify the leak. These actions will generally precede assessment and containment activities.

All spills or leaks will be detected or indicated in one of three ways:

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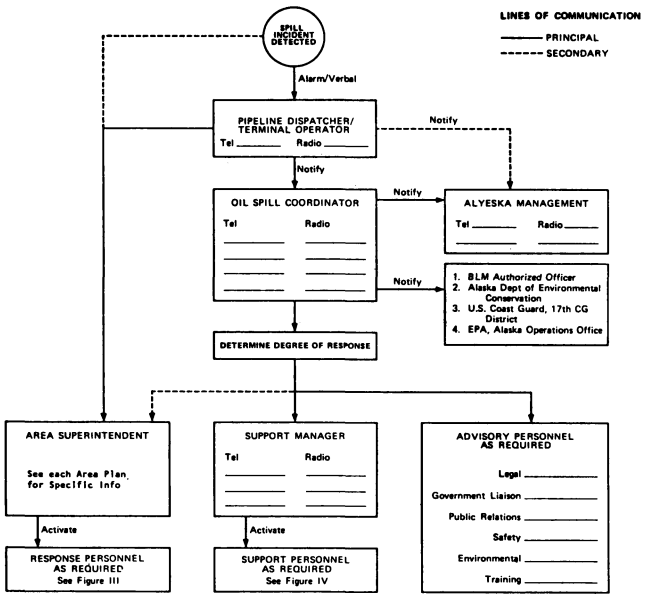

Figure 5. Callout order

1. The pipeline monitoring equipment will indicate potential leaks between pump stations; no oil has been observed.
2. Oil is reported visible on ground or water; no leak from the pipeline is verified or indicated.
3. Oil is reported leaking from a known location on the pipeline.

The immediate response actions to be taken for each of these types of detection will vary depending upon the specific contingency area. The intention of the actions is to discover the leak and begin exclusion procedures immediately. The IRT will initiate these actions regardless of the season or ground conditions. However, the area superintendent may make necessary modifications, especially to ensure the safety of personnel.

The following plan is an example of immediate response actions for one of the contingency areas.

Immediate response actions—Haggard-Sourdough Creek area

The Haggard-Sourdough Creek contingency area, bounded by pipeline stations 3450+00 on the north and 3162+07 on the south, is shown in figure 6. It contains 5.4 miles of pipeline which parallels the Richardson Highway throughout the area. Drainage patterns in the area divide the pipeline into six segments. Drainage from the pipeline in the northernmost segment is southerly toward Haggard Creek, which crosses the pipeline at station 3394+49. The next line segment drains eastward from the pipeline to Haggard Creek, while the third line segment drains westward toward a small pond which empties into Haggard Creek. Drainage in the fourth line segment flows westerly through small ponds and creeks to the Gulkana River. The two southern line segments drain from the pipeline south and easterly to Haggard Creek which joins Sourdough Creek near the southern end of the area. Sourdough Creek then joins the Gulkana River about 8 miles to the south near the community of Sourdough.

If an oil spill is detected in the Haggard-Sourdough Creek contingency area, the IRT will take immediate action under the direction of the area superintendent to prevent a spill from reaching the Gulkana River. The initial action, whether the leak location is known or not known, is to deploy boom across Sourdough Creek at Sourdough (Richardson Highway Bridge, MP 147.7) upstream from its confluence with the Gulkana River. Fifty feet of boom should be taken to the site, although 20 to 25 feet may be adequate. If the leak location on the pipeline is known, the appropriate containment

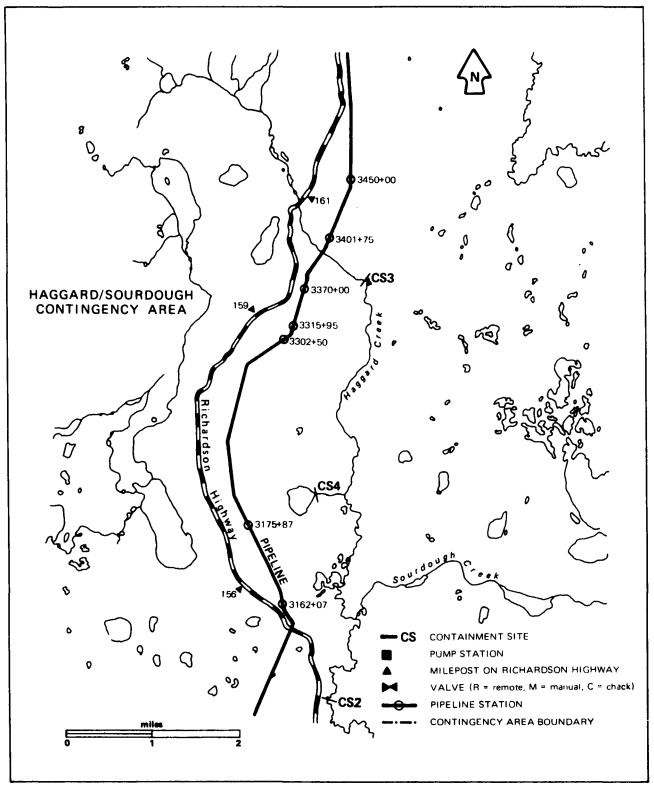

Figure 6. Area map

instructions should be followed. Figure 7 diagrams the actions to be followed when the pipeline leak location is known.

If any oil is found on the ground or water, but the pipeline leak location is not known, the actions diagrammed in figure 8 should be taken. Different responses are required depending on the spill's location in relation to the Richardson Highway. If oil is found south of Richardson Highway MP 158.8, boom should be deployed at containment sites 1 and 2. If oil is found north of 158.8, boom should be deployed at containment sites 1 and 3. Fifty feet of boom should be taken to each site, but it may not be necessary to deploy all of the boom.

Contingency plan development

The development of the Alyeska pipeline system oil-spill contingency plan requires a very close coordination of efforts between Alyeska Pipeline Service Company and Woodward-Envicon, Inc. Pipeline operating and design parameters were essential to the development of the plan. The plan development affected both design and operations in spill prevention, spill detection, location of access roads, location of line valves, location of permanent containment facilities, and oil-spill response equipment and material.

Woodward-Envicon, Inc., developed the content, arrangement, format, and formulated procedures for containment, exclusion, and cleanup based on current state-of-the-art oil-spill technology. This also involved the selection of equipment and materials required and the design of a training program to implement the plans.

The plan calls for thorough training of personnel to assure successful implementation of the contingency plans. Training programs will ensure that all personnel assigned to the oil spill task force are thoroughly familiar with their duties and with the operation of oil-spill contingency equipment.

The Alyeska Pipeline Service Company expects to develop a computerized support system. The system will be used to provide word processing of the contingency plan to keep the text up-to-date and real-time capability of retrieving immediate response actions for all levels of the contingency plan.

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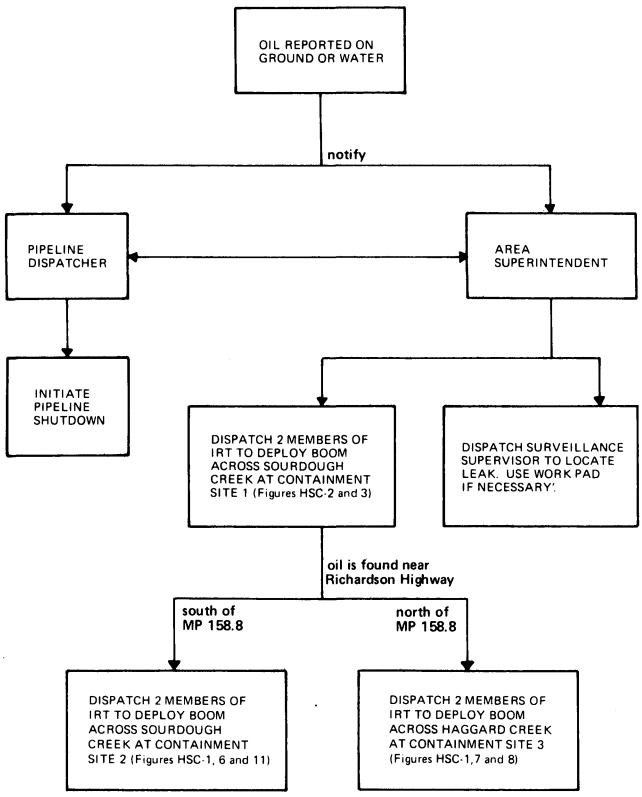

Figure 7. Immediate response actions—leak and location known.

As stated previously, Alyeska's oil-spill contingency plan will be the most thorough and comprehensive plan of this nature yet developed. It will have passed a review by the appropriate regulatory agencies, both federal and state, governing the construction and

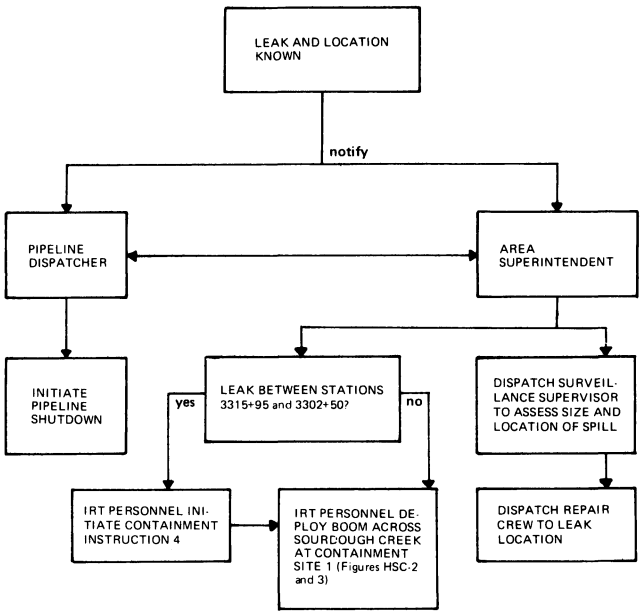

Figure 8. Immediate response actions—oil reported on ground or water.

operation of the Trans-Alaska Pipeline System. Throughout its development and implementation, the plan will be updated to reflect the current state-of-the-art in oil-spill technology and to reflect information gained through the training program and pipeline operations.

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