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Addenda to the Revised Operations Plan for the Katmai Scientific Drilling Project

A. R. Sattler

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ADDENDA TO THE REVISED OPERATIONS PLAN FOR THE KATMAI SCIENTIFIC DRILLING PROJECT

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Abstract

This document presents additional operations-related information necessary for completion of the Environmental Impact Statement (EIS) being prepared for the proposed Katmai Scientific Drilling Project. It also largely supplements information contained in the Revised Operations Plan for the Katmai Scientific Drilling Project which presented a detailed account of the operation. However, in certain instances, the nature of the EIS required a level of detail greater than what was in the plan. This document thus provides greater detail for reclamation, monitoring, and describing equipment available to mitigate and remediate effects of possible spills. The EIS required information on helicopter and drill site noise levels and a development of alternatives. That information is contained herein. Because of time constraints, additional data on drill rigs, drilling fluid additives, and logging are included here since they could not be included in the Revised Operations Plan. Finally, revised site drawings are contained in this document.

PREFACE AND INTRODUCTION

The Alaska Regional Office of the National Park Service (NPS) is presently evaluating the proposed Katmai Drilling Project in accordance with the Requirements of the National Environmental Policy Act (NEPA). Preparation of an Environmental Impact Statement (EIS) by the third party contractor to the NPS is underway. A Draft Environmental Impact Statement is expected shortly.

The publication of the Katmai Operations Plan (Sattler, 1991) was necessary to initiate the NEPA process. However, since it was published, engineering plans have been refined and the overall operations scenario has been altered. Also, additional changes have been based on reviews by permitting agencies, industry, and consultants, as well as on availability of additional baseline data. The Revised Operations Plan for the Katmai Drilling Project (Sattler and Blankenship, 1992) was required for the writing of the Environmental Impact Statement.

It became apparent that not only supplemental, but additional, information would be needed for the EIS in certain critical areas. That information was prepared and distributed and is compiled in this document. At times the preparation of an EIS for the Katmai Scientific Drilling Project required a level of detail that was greater than that found in the Revised Operations Plan. This included information on reclamation, monitoring, and materials for response to a possible spill. The preparation of the EIS also required information that was not contained in the revised plan, namely noise level data on drill rigs and helicopters.

The Revised Operations Plan was written under extremely tight schedule constraints which were linked to the EIS preparation. Certain information, while highly desirable, could not be included in the plan under the time constraints. This includes additional material on drill rigs, drilling fluid additives, and logging.

All the above material, in fact, was included as addenda to the Revised Operations Plan. These addenda were reviewed internally and sent to the NPS, separately, as soon as they were prepared, to facilitate timely preparation of the EIS. Because of the importance of this proposed project, major inputs to the EIS are herein assembled in a formal document. For this reason, certain correspondence and drawings are also included in this document to incorporate revised and new site and waterline layouts.

Section 1.0 (Addendum I) presents data on candidate drill rigs for use in the Valley of Ten Thousand Smokes. Heliportable, wireline coring (diamond core) rigs will be utilized to accomplish this work rather than the larger oil field rotary rigs. The choice of a specific rig cannot be made until contractual agreements are completed with a drilling contractor.

The development of alternatives is presented in Section 2.0 (Addendum II). The chances of successfully accomplishing all of the scientific goals depend upon the alternative chosen.

Section 3.0 (Addendum III) focuses in detail on the proposed logging and borehole measurements program. Included are wireline logging, water sampling,

and a proposed vertical seismic profiling measurement which uses the drill bit as the energy source.

A detailed reclamation plan is offered in Section 4.0 (Addendum IV). It is the intent of the project to minimize impact including minimizing any long- or short-term surface disruption.

Section 5.0 (Addendum V), Helicopter and Drill Rig Noise Data, discusses measurements of these of these noise sources. Mitigation noise measures are also presented.

Section 6.0 (Addendum VI) presents the best professional projection of what the drilling fluids program will be. It also discusses the characteristics of virtually all drilling fluid additives that may be used in this project as well as suggestions for monitoring these additives. Material Safety Data Sheets for Katmai Drilling Fluid Additives are also included (Appendix A).

A detailed listing of materials that would be available to help remediate a spill is presented in Section 7.0 (Addendum VII). A tutorial discussion of important classes of remediation materials is also given.

The focus of Section 8.0 (Addendum VIII) is the monitoring program which includes the location of monitoring sites and the proposed frequency of sampling. Sampling of both liquid and solid samples is discussed as well as recommendations for further sampling.

Finally, all revised or new site layouts are included in this document under their original submittal correspondence (Appendix B and Appendix C). Much of this work was the result of additional survey data taken in the Valley of Ten Thousand Smokes under permit in July 1992.

The EIS review process could require the submittal of further information for the EIS. Such a situation is anticipated; therefore, preparation of further documentation on Katmai operations is likely.

ACKNOWLEDGMENTS

The author would like to acknowledge Doug Blankenship of RE/SPEC, Inc., for his inputs to addenda concerning the drill rigs, alternatives, logging, and reclamation. Acknowledgments are given to Christina Neal of the U.S. Geological Survey (USGS), Anchorage for organizing the Reclamation Plan and for her direction and assistance in selecting the topics to include in this document. Without the inputs of Terry Keith, USGS, Anchorage, AK, and Menlo Park, CA (and other project scientists), the assembly of a monitoring plan would have been impossible.

Henry Friedman and Coleen Burgh of CH2M Hill are acknowledged for their assistance in assembling information necessary to respond to possible spills. Much work and thought were provided by M-I Drilling Fluid Co. (Robert Lindenberg and Tom Heinz, Bakersfield, CA; Dr. Arthur Leuterman and Paul Scott, Houston, TX; and Bob Haagensen, Anchorage, AK) in assisting the author to provide both a drilling fluids program and ideas how to monitor for these additives in streams and rivers of the Valley of Ten Thousand Smokes. Dr. James C. Dunn, Project Supervisor, Sandia National Laboratories, reviewed all the material and made many valuable suggestions.

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ACRONYMS

ADEC	Alaska Department of Environmental Conservation
CP	Chicago Neumatic
DMW	Diversified Machine Works
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
GPM	gallons per minute
GRDO	Geoscience Research Drilling Office
IT	International Technology Corporation
KS	King Salmon
MSDS	Material Safety Data Sheets
NEPA	National Environmental Policy Act
NPS	National Park Service
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RMAL	Rocky Mountain Analytical Laboratory
TCLP	Toxicity Charcteristic Leaching Procedure
UDR	Universal Drill Rigs Inc.
USGS	U.S. Geological Survey

SECTION 1.0 (ADDENDUM I)

DATA ON DRILL RIGS UNDER CONSIDERATION FOR THE KATMAI SCIENTIFIC DRILLING PROJECT

The choice of drill rigs for the proposed Katmai Scientific Drilling Project depends not only on the specific drilling needs of the project, but upon what the drilling contractor has available to commit for the job. The schedule in the Revised Operations Plan for the Katmai Scientific Drilling Project showed a 1994 fielding date (which, of course, depends on a timely and favorable record of decision). The Geoscience Research Drilling Office (GRDO) at Sandia National Laboratories is, in effect, prohibited from making contractual commitments to a drilling contractor and for drill rigs at this relatively early time.

Often, the connotation of a "drilling rig" evokes visions of oilfield rigs used in hydrocarbon extraction. These rigs are much larger than diamond core rigs rated to the same depth, hence, their footprint is substantially larger. For example, the approximate dimensions and characteristics of a more conventional, but heliportable, rig which could be used at the dome site is compared to typical characteristics of one of the larger diamond core rigs actually under consideration in Table 1-1. It is obvious that the footprint of the diamond core rig is much less conspicuous. The diamond core rig is much more suitable for work in an environmentally sensitive area.

Table 1-1

Drill Rig Comparison*

Characteristic	Conventional Rig	Diamond Core
Mast height	113 ft	73 ft
Substructure height	21 ft	12 ft
Area (substructure with drill on top)	2,000 ft^2	850 ft^2**
Mud system	17,000 gal	3,000 gal
Fuel consumption (rig, pump, and generators)	800 gal/d	300 gal/d
Weight (rig only)	275,000 lb	65,000 lb

*These numbers are approximate, and in some cases estimates, but are accurate enough to show the comparison in magnitude between a heliportable conventional oilfield rig and a diamond core rig.

**The footprint called out for the diamond core drill pad in the operations plan is 1,500 ft^2. The actual area of the substructure on the pad (with drill mounted on the substructure) is less than that.

GRDO can describe in some detail four candidate diamond core drill rigs for the work at the Novarupta Dome Site and two candidate rigs for the work at the ash-flow site. GRDO cannot guarantee that one of the listed rig types will be chosen. Much depends on the contractor selected and what rigs are available at that time. The environmental impact (footprint) of any other rig type chosen, however, will be similar to those listed here. Moreover, any rig chosen for the work at the respective sites listed here, with substructure and drill pad included, will fit within the footprint described in Sections 4.0 and 8.0 of the Revised Operations Plan along with this addendum. A possible exception to this is in total height. If a mast which can handle 60 ft of drill rod (20 3-ft sections) is chosen rather than one which can handle 40 ft of drill rod, then the total height will be about 90 ft rather than the 70-ft height listed in the Revised Operations Plan.

Possible drills considered for the dome site are the J. K. S. Boyles International Inc. B-30H, Universal Drill Rigs (UDR) Inc. 1500, Chicago Neumatic (CP) 50, and the Longyear Company Super Hydro 44 (Hydro 50) Drill.

The B-30H and the UDR 1500 are both newer top drive drill rigs. The B-30H has an 11-ft coring rod feed stroke and the UDR 1500 has a 20-ft stroke. Both of these drills can pull 30 ft of coring rod. The CP 50 and the Hydro 44 are very capable older core drills. Both the CP 50 and the Hydro 50 have a 2-1/2-ft stroke. The CP 50 can pull 60 ft of rods, the Hydro 50 can pull at least 30 ft of rods. The characteristics of drill rigs considered for use are shown in Table 1-2. The values shown for the area and weight includes a skid with the drill itself, drawworks, and mast. Use of a substructure will require some additional area, but this area should fit within the bounds described in the Revised Operations Plan.

Possible drills considered for work at the ash-flow site are the Longyear 38 drill rig and the Diversified Machine Works (DMW) 65 drill rig. The Longyear 38 has a 2-ft stroke, the DMW 65 has a 4- to 5-ft stroke. The Longyear 38 can pull 20 ft of coring rod. The DMW 65 can pull 30 ft of coring rod.

Some illustrations of drill rigs are given. Figure 1-1 shows a J.K.S. Boyles B-30H rig on a substructure. Figure 1-2 shows a Universal Drill Rig 1500 on a substructure. Figure 1-3 shows a Chicago Neumatic 50 Rig. Figure 1-4 shows a heavy duty Longyear Hydro 55 Drill Rig on a substructure, a drill rig similar in size to the one described in Table 1-2.

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Figure 1-1. J. K. S. Boyles B-30H Rig on Substructure

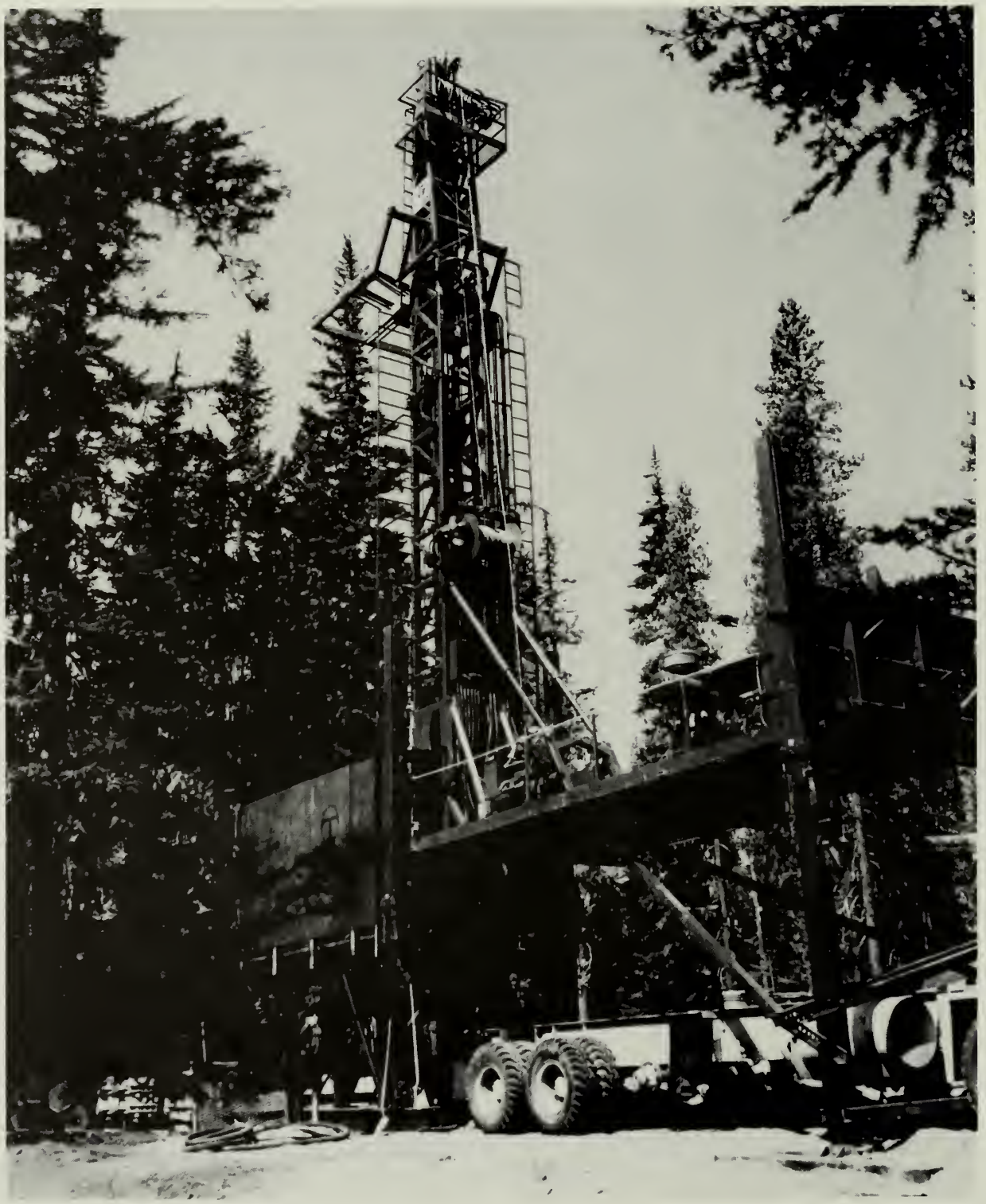

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Figure 1-2. Universal Drill Rig 1500 on Substructure

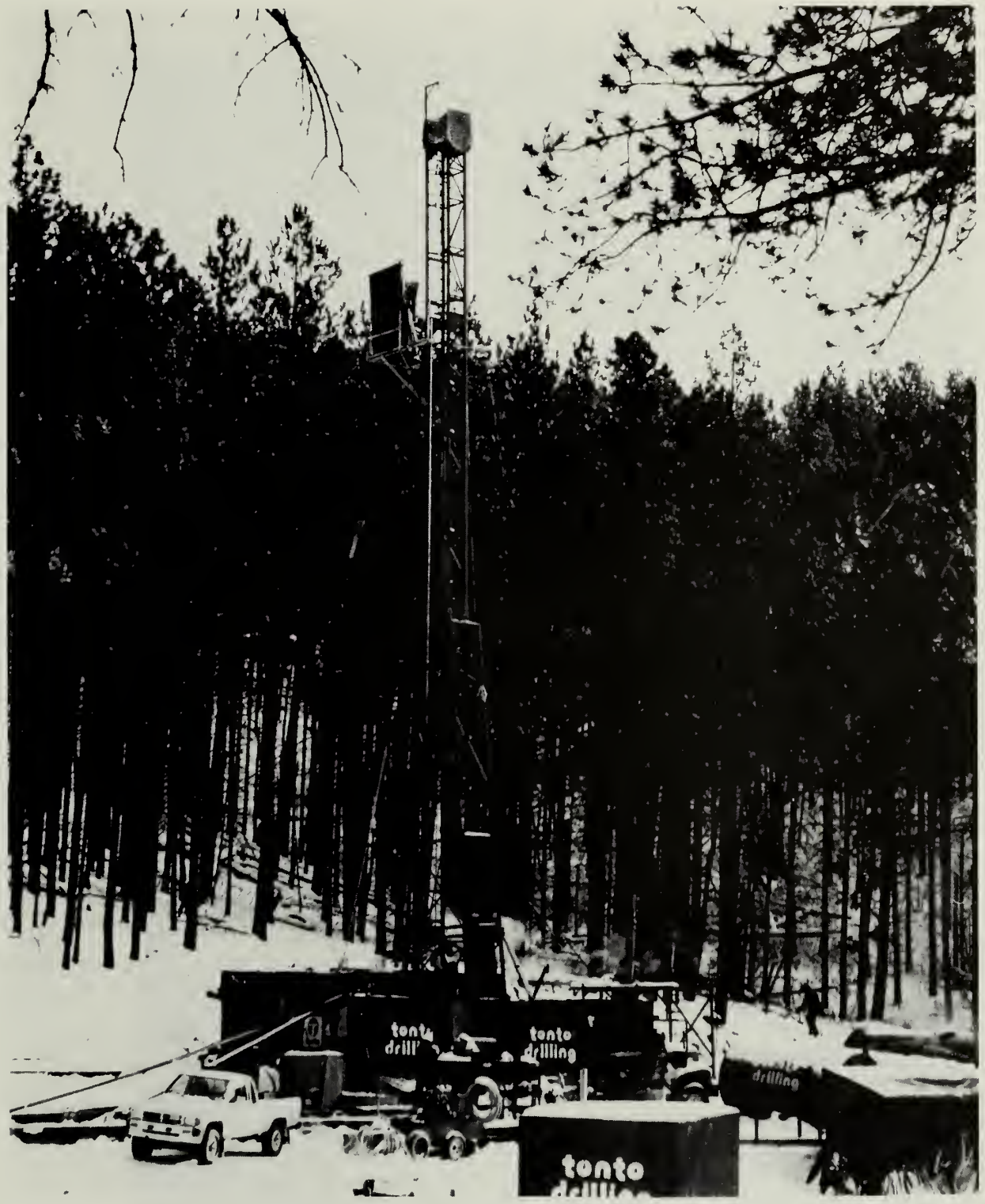

Figure 1-3. Chicago Neumatic 50 Drill Rig

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Figure 1-4. Longyear Hydro 55 Drill Rig on Substructure

Table 1-2

Characteristics of Drill Rigs That Could Be Used for the Katmai Scientific Drilling Project

Rig Type	Length*	Width*	Mast Height (ft)	Lift (lb)	Thrust (lb)	Torque (ft lb)	H Rod Depth (ft)	Power Unit (kw)	Weight approx. (lb)	Mud Pump (gpm) (psi)
				For Dome Site						
JKS Boyles B-30H	22′	11′ 10"	43 33	15,000 30,000**	20,000	5,000	3,500 3,500	138	22,000	30 1000
Universal Drill Rig 1500	52′ 6"	8′ 2"	53	33,000	5,400	5,000	3,940	172	42,900	37 700
Chicago Neumatic 50	43′ 2"	9′ 3"	75	52,500 105,000**	3,500	4,800	7,500	250	65,000	40 1000
Longyear Super Hydro 50	22′	10′	40	21,000	14,000	3,500	3,250	66	21,000	35 1200
Diversified Machine Works 65	17′ 6"	8′	27	21,000	14,000	3,500	800	66	7,500	20 800
Longyear 38	18′	8′	20				1,200	54	8,500	20 1500

*With Substructure, effective working area of rig could be doubled.
**Double line pull.

SECTION 2.0 (ADDENDUM II)

ADVANTAGES AND DISADVANTAGES OF EXTENDED SEASON OPERATIONS

An extended season operation is defined as the establishing of all three wells, or going "as far as you can go" in one season and being able to plug and abandon the well successfully and safely and to conduct the necessary site reclamation. Chances of successful completion of the deviated well at the dome site will be more affected than they will be for either the vertical wells at the dome site or the well at the ash-flow site. Presumably, the vertical well at the dome and the ash-flow well will be completed during the warmer weather. Making any rig retrofits or adjustments between seasons will probably not be possible with this option.

The mobilization for an extended season operation will start in the same manner as described in the (project preferred) alternative two warm season operations, described in Section 8.0 in the Revised Operations Plan for the Katmai Scientific Drilling Project. Equipment will be mobilized and prepared for the first barge of the season into the Bristol Bay area (Figure 2-1). Setup of the site support base at King Salmon will be accelerated and mobilization of equipment will start as rapidly as possible. The object will be to utilize as much of the months of longer daylight hours and moderate temperatures as possible, including late April/early May, in spite of standing snow at the dome drill site. Certain problems related to climate will be encountered at the early and late parts of this extended drilling season.

Concurrent with the camp setup, an enhanced snow removal operation will commence since a few feet of snow will certainly remain on the ground at that time of year. Problems associated with the standing snow during the mobilization are discussed below.

Because of standing snow, meaningful contour maps and photographs necessary for site reclamation can not be generated at the beginning of this operation. These maps and photographs will have to be generated in the previous fall requiring entry into the park by helicopter. This is mentioned in the operations plan. Efficient snow removal will require preestablished references, such as snow poles.

A large freight mobilization helicopter will deliver the camp and snow removal equipment. Snow removal at the dome site will have to be enhanced to keep pace with helicopter transport of equipment. Otherwise, a large amount of costly standby charges for helicopter support will be incurred. Hand-operated snow removal vehicles and blowers for snow removal may have to be utilized temporarily at the dome site and along the water line.

Laying the water line in the snow may require 1 to 2 extra people in this option. Motorized, but hand-operated, snow removal equipment may also be needed for some limited trenching through the snow to lay portions of the line along the ground surface and, more importantly, to make a clearing for the pumping stations. It is assumed that much of the water line could be laid on the snow. (The potential need to anchor the water line into the ground because of prevailing high winds can not be realized.) The portion

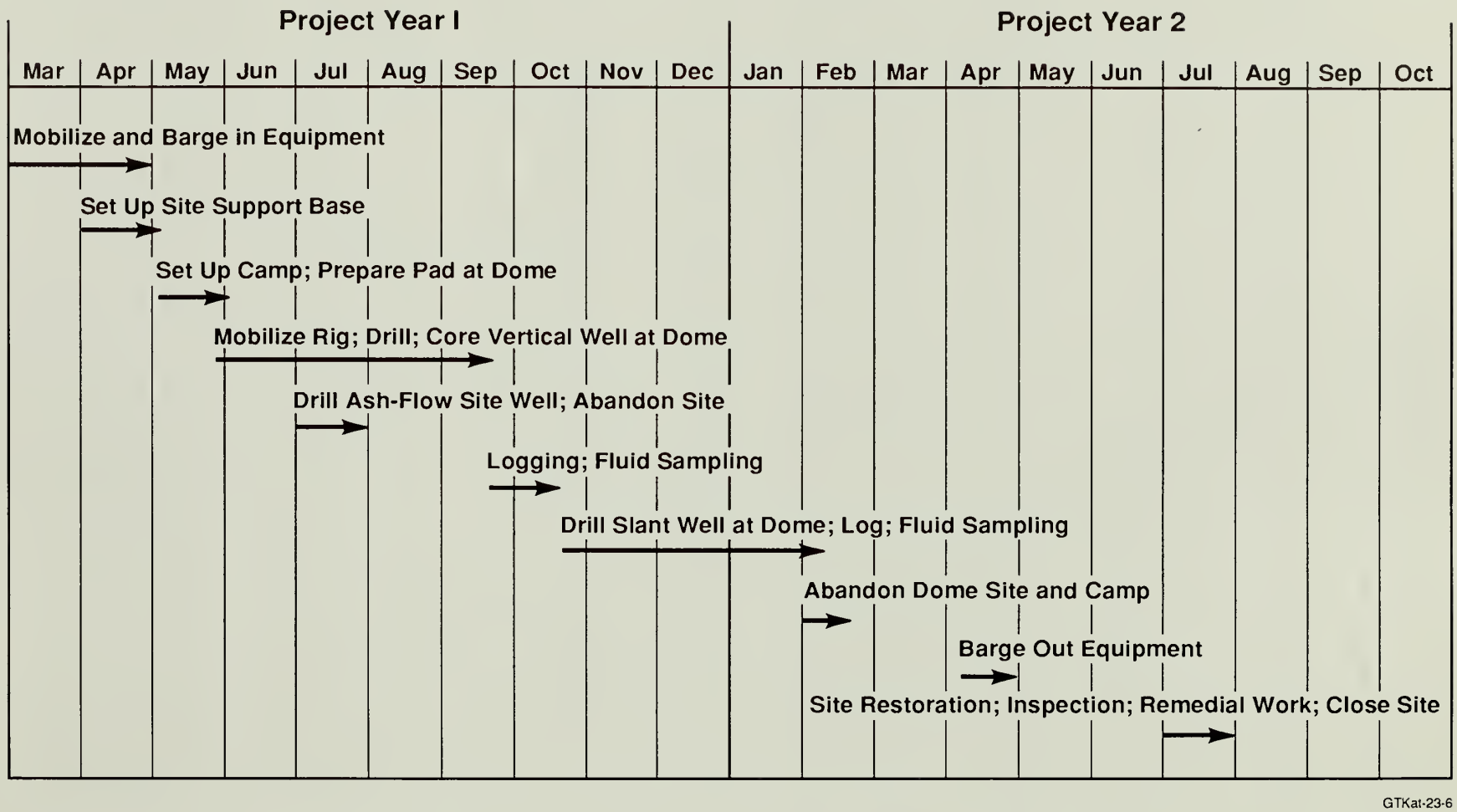

Figure 2-1. Schedule of Operations

of the water line that is laid on the snow will eventually melt its way to the surface. It will be necessary to break through ice in Mageik Lake to obtain water. Maintenance of the water line, more difficult with the snow at first, should become easier as summer approaches but become more difficult again in the late fall.

In late spring a deep freeze, jeopardizing water line operations, is not out of the question, but in the May time frame it is not too likely. Normal plans to heat the water line will probably be adequate this time of the year.

The operations will progress through the summer months in a manner similar to that described in the operations plan. In late October, with the onset of much colder weather, related problems can arise.

Problems resulting in accidents of all types are more likely during the coldest weather months of the year, late November through March. Inclement weather, subfreezing temperatures, and protracted periods of darkness are all conducive to accidents.

Helicopter support will be constrained by the weather. There are protracted winter storm periods, including whiteouts, which will create a dangerous flying situation. Helicopter support will also be constrained by the short daylight window and, coupled with poor weather, may prevent an adequate number of support flights. Flying to the dome site from King Salmon can be difficult compared to other times of the year (see Section 11.0).

In the colder months, upwards of 100 percent more fuel will be necessary to heat water tanks or bladders compared to current fuel use estimates. Water lines can rupture at the drill sites. Response to any onsite or offsite spill or accident will also become tenuous. A switch to Arctic grade diesel fuel will be necessary at the coldest temperatures. The propane fired heaters may have to be replaced with diesel fired heaters to function at the coldest temperatures necessitating 10,000 - 20,000 extra gallons of diesel fuel on site.

It may become difficult to extract water from Mageik Lake through thick ice during the colder months. The lake may be frozen solid; it is unknown. It may be necessary in this case to drill for a water source close to the dome site and the ash-flow site, as well. Water wells were considered earlier in the project, but were rejected because there is no guarantee that usable water will be found in adequate amounts.

Construction of the camp will reflect the colder conditions encountered. Additional material will be needed.

Maintainance of the water line during the cold weather raises certain operational issues

- Cold month operations will require additional heating stations.
- Shelters will be required around the heating stations so the equipment will function properly.

- Water lines buried in snow will be hard to maintain, although the snow will act as an insulator against extremely cold temperatures.

- Maintainance by foot and helicopter may become extremely difficult. A snowmobile will be necessary to facilitate water line maintainance.

- If the water line fails at extremely cold temperatures, it may be extremely difficult to correct the situation.

At extremely cold temperatures, water line failure has significant implications on the ability to guarantee well safety. A heated reserve of water, 80,000-120,000 gallons, is planned at the dome drill site. Whether this will be enough to guarantee well safety in the face of long-term water line failure is unknown. Well plugging and abandonment will be necessary at this time. Helicopter transport of water will be inadequate to assure well safety, will be expensive, and will entail additional intrusion into the park.

A premature site abandonment may necessitate the removal of additional tubular, cement, and additives. (It is assumed that the well at the ash-flow site will be completed in the summer months when the River Lethe is flowing.)

The more difficult operating conditions translate into more time in the park, more equipment, and fuel needed to sustain the operation. The costs of operating in the winter months will rise. It is very likely that there will be a decrease in the rate of progress during these months, compounding costs. (This increase in costs would be exacerbated for an option of the operation taking place exclusively in the colder months.)

Site reclamation in a snow-covered, wintry, environment becomes difficult. Even if the reclamation is attempted, it will be impossible to verify the reclamation by generating contour maps and photography under these conditions. As a result, additional helicopter entry into the park during warmer weather to complete site reclamation will become a necessity (Figure 2-1).

On the other hand, the extended season operation alleviates some important issues. The dome site will only be involved through one tourist season, not two. Tourism, with the attendant visual and audio impacts around the drill sites, will be virtually non-existent for about half or more of the operation. Chances of establishing the vertical well at the dome site and the well at the ash-flow site are largely unaffected by the weather in this option. Obtaining support in King Salmon during the colder months late in the calendar year poses few problems. The problem of site shutdown for the winter or employment of caretakers during the shutdown period no longer exists. No partial demobilization for winter is necessary. The probability of complete failure diminishes with the establishment of the operation during the months of more daylight. It is difficult to predict, but chances of operation of the water line into November and perhaps beyond are fair. When extreme temperatures set in, presumably in late November or December, the water line could fail necessitating well plugging and abandonment. Thus, the weather may terminate the split season operation sometime during the drilling of the deviated hole at the dome site.

In cold weather, the concerns for well safety, without an assured water supply, and the extreme difficulty of conducting adequate site reclamation make this option less attractive than the alternative preferred by the project. The probability of completing the slant well, an extremely important scientific goal, is much lower than in an ordinary warm season operation. This extended season alternative is felt preferable to a wintertime operation, however, because there is a reasonable chance for considerable scientific data. The winter option implies a larger chance of weather-related failure of the operation: intrusion into the park, but no scientific data. Naturally, reservations about well safety and inability to conduct a reasonable site reclamation operation during the colder months of an extended season operation hold for the winter operation. The cost of an extended season operation is raised. (The cost of a full winter operation is raised even more.)

SECTION 2B.0 (ADDENDUM II B)

THE MODIFIED EXTENDED SEASON ALTERNATIVE (SUPPLEMENTAL DESCRIPTION)

2B.1 Comments on a Cold Season Operation

2B.1.1 General Description

Much of this modified extended season alternative, which schedule is shown in Figure 2B-1, is as described in Section 2.0 with the addition of the technical data in the matrices/tables sent to Dames and Moore under a cover letter dated July 27. Differences and additions to Section 2 are:

- The camp is constructed and all dome site preparation, including construction of berms and placing interlocking timbers on the pad, will now be accomplished in the fall prior to drilling, with the drilling itself to commence the following spring. This avoids possibility of excavation in frozen pumice and will reduce unnecessary scoring of the ground by performing excavation in snow. This work will be accomplished in September.

- The pump stations, but not the waterline, will also be emplaced in the fall. Seismic emplacements for the vertical seismic profiling study will be dug. Some of the coring rods may also be brought in to the dome site.

- In mid-April to early May of the following year the main operation commences. The camp is reactivated and snow removal on the site commences. The material for drilling arrives at Naknek on the first barge of the season, is brought to the site support base in King Salmon, and mobilized to the Dome Site immediately. The waterline is laid simultaneously with the set up of the drill site. With the camp and excavation of the drill site already complete, and the pumping stations in place, the drilling can commence sooner.

  Once the drilling of the vertical well at the dome site commences, the drilling sequence with the attendant logging is similar to that described in the Revised Operations Plan. The sequences with the well at the ash-flow site are accomplished in parallel with those of the vertical well at the dome in a manner also similar to that described in the Revised Operations Plan.

- There is no site abandonment or winterization of the equipment at the end of the drilling of the vertical well at the dome site. Instead, after some logging and testing in the vertical well, it is plugged. The operation to establish the deviated well at the dome site begins immediately thereafter.

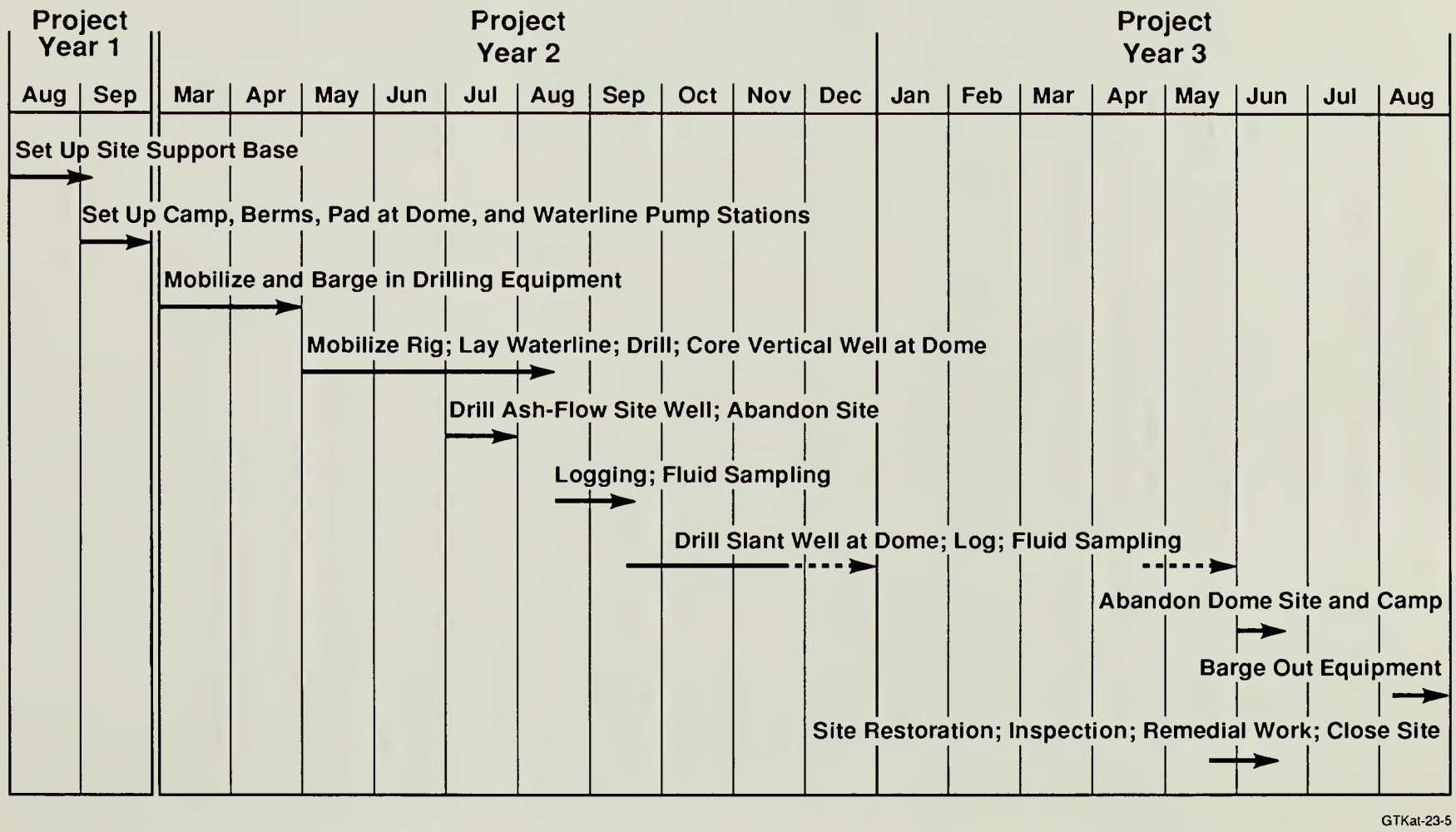

Figure 2B-1. Schedule of Operations

- Around early November, a decision will be made (1) to continue drilling until the waterline freezes and maintain drilling operations using stored water and then cease operations; or (2) to drain the waterline before it freezes and resume operations in late April/early May of the following year. If the waterline can function in late April, there is a short 4 to 5 week window where additional drilling/logging can resume. This choice is reflected in the schedule.

- Demobilization will be started in early June and will be conducted in parallel with site restoration. Both operations are to be completed by June 15.

2B.1.2 Additional Technical Considerations

- At least two track-mounted snow blowers will be necessary for snow removal in addition to the utility vehicle. Numerous snow poles, laid the previous fall after the site preparation, will make snow removal more efficient and necessitate less surface remediation later. Some snow melt equipment may be necessary.

- A series of supplemental helicopter flights are necessary in the fall to set up the camp, excavate the drill site, and construct the drill pad. A series of about 20 mobilization flights by a Vertol will be necessary. These fall operations also will be supported by flights from a camp support helicopter of the types mentioned in the Operations Plan making 1 to 3 flights/day for the 4 to 5 week time period necessary to complete camp/site construction. Otherwise, the use and type of the support helicopter remains as described in the tables. The total mobilization/demobilization flights of the larger freight helicopters for the drilling equipment are approximately 92 and 35, respectively, for the Chinook. If the Vertol is used, these numbers are approximately threefold greater.

- Additional personnel will be required for much of the modified extended season operation. Two extra water men are needed in April, May and after September. A construction crew of 6 people are needed for 1 to 2 weeks to remove snow and perform excavation. (This crew will be needed, temporarily, with any alternative.) The time required will be shorter with the primary alternative where operations will conducted in warm season months.

- The 2 or 3 man cement crew become permanent occupants in the camp when loss of the waterline from freezing becomes possible sometime in October. A certified welder will also be available onsite when the loss of the waterline becomes possible. Thus, the permanent party at the camp will increase by 6 to 8 people during certain time of the year.

- Storage of diesel fuel will be 20,000 to 40,000 gallons greater than the combined storage requirements for both warm seasons from the primary proposal (60,000, and 30,000 gallons, respectively) amounting to storage of up to 130,000 gallons onsite. Water

storage will be increased from the 80,000 to 120,000 gallon storage range to 120,000 to 150,000 gallons.

- Camp construction will reflect the need to protect against colder temperatures. Lines in the utility corridors will be buried or insulated.

- The pump stations must be enclosed and will include survival equipment.

2B.1.3 Environmental Consequences of the Modified Extended Season Alternative Compared With the Primary Proposal

- More people are required onsite.

- Snow removal procedures necessitate more surface remediation as the surface will be scored by such operations. Track-mounted snow blowers are required.

- Snowmobiles may be required for water line maintenance.

- Extra helicopter flights into the park are required.

- The amount of fuel storage onsite is increased.

- The scale of the operation is increased.

- Response to an offsite spill is more tenuous.

- Much of the floor within Novarupta Dome is occupied by the site and storage of snow will be a problem. While the snow will be piled on the floor near the south facing part of the tephra ring which receives more sunlight, semipermanent snow piles may exist for some time after abandonment.

- Delays may necessitate abandonment operations beyond June 15. More important, it is likely that sufficient snow will remain on the ground to necessitate reclamation operations after the June 15 deadline regardless of the time of site abandonment. This could necessitate activity in the dome requiring helicopter flights during the second tourist season.

- Trenching will be necessary to bury some utility lines.

- Monitoring of streams and rivers, cannot be accomplished in parallel with drilling in cold months. The monitoring, of necessity, has to be completed in the warmer months.

2B.1.4 Consequences on Science From Selection of This Alternative

The chances of completing the proposed science package diminish with this option. Progress will diminish during the colder months, and necessity for snow removal will slow the progress of the operation. A potential shutdown (due to lack of water) with a subsequent restart

of the drilling will consume more time. The parts of the science program more effected are:

- Chances for completion of the slant hole at the dome are greatly diminished.

- The general logging and water sampling programs in the open hole must be curtailed from lack of sufficient time.

- A primary scientific goal of the Katmai Scientific Drilling Program is to determine the equilibrium temperature in the vertical hole. This requires a 1 to 2 month period between the drilling of the vertical and slant holes at the dome site in order for temperature equilibrium to be established after drilling the vertical hole. This is not attainable with this option. An equilibrium temperature profile in the slant hole is also not attainable with this option.

2B.1.5 Safety Consequences on the Operation From Selection of the Alternative

- Drilling in a thermal regime becomes a critical safety consideration when the water source is no longer replenishable. As the Operation proceeds into the late fall months, the waterline will probably freeze. How far the well can be advanced with the stored water depends on the day-by-day drilling conditions. An ample water reserve of 60,000 gallons is an absolute necessity for abandonment. Drilling msut stop when the amount of stored water approaches this quantity. If severe loss circulation zones are encountered along with high temperatures, stored water can be depleted rapidly. In such a situation it would be unlikely that well the would be advanced much further. Abandonment would be the prudent course.

- Flight safety margins are reduced in the colder months. Resupply, or delivery of that "specially machined part" essential to the operation, becomes a problem. Weather delays increase.

- Industrial type accidents are more frequent.

- Ability to evacuate ill or injured personnel becomes tenuous.

SECTION 2C.0 (ADDENDUM II C)

AN EXCLUSIVELY COLD SEASON OPERATION

2C.1 Comments on an Exclusively Cold Season Operation

An exclusively "off season" operation through one or two winter seasons is not practical. Most of the comments on environmental consequences, science and safety mentioned in the split season operation apply to a greater degree. There are some important additional comments for this option.

2C.1.1 Environmental Consequences

- Semipermanent installations using Arctic technology are required.
- Because even more personnel, fuel, and flights are necessary than even in the modified extended season alternative, the scale of the operation greatly increases to a degree that is commensurate with oilfield, not mineral, operations. This is a significantly larger scale of operation.
- Waterline operations, even with additional heating stations, become questionable. Alternatively drilling for a water supply at the dome does not guarantee the establishment of an adequate water supply for drilling.
- Fuel requirements are increased greatly over the split season option.

2C.1.2 Consequences on Science

- The chances of appreciable scientific return from the operation are greatly diminished. Water supplies for both drill sites be cannot be assured over much of the duration of the operation.

2C.1.3 Safety Consequences

- Hours of daylight and possibility of whiteouts are critical flight safety factors.

SECTION 3.0 (ADDENDUM III)

LOGGING AND GEOPHYSICAL ACTIVITIES TO ACCOMPANY THE KATMAI SCIENTIFIC DRILLING PROJECT

3.1 Logging and Water Sampling

The logging tools to be run at Katmai are of two classes. The first class will utilize an electrical wireline to transmit power and data between the tool and the surface. Most of the tools listed here are of this variety.

The second class is memory tools, largely under development at this time, but more self-contained in the sense that power is obtained from batteries in the tool package and data are stored in an on-board memory. A spectral gamma tool and a water sampling tool are memory tools under development. The temperature tool, which is an existing memory tool, is being improved; a high precision pressure sensor is being added.

Most of the tools listed below are slim hole tools approximately 2 in. in diameter, although some are larger. The potential use range for the larger diameter tools will be limited to the upper portion of the well where hole diameters are larger. Generally, the tools listed in Table 3-1 whether wireline or memory tools, are capable of measurements at temperatures expected in the Katmai drilling, 200° to 300°C.

It is difficult to predict in 1994 (or later) which of the total spectrum of logging tools will be available for use in the field. However, at this time, the type of logging tool can be called out and clarified at what point in drilling each tool will be deployed. Logging tools will be provided by the U.S. Geological Survey at Denver, the Geoscience Research Drilling Office, and the Geothermal Research Department at Sandia National Laboratories (Lysne, 1992; Paillet and Morin, 1988; Paillet, 1986). The logging tools have high temperature electrical components and some logging tools are dewared. Logging tools planned for use in the Katmai holes are:

- Temperature The temperature tool has a 2-in. diameter and will fit inside the H coring rod. Such tools have been used to 300°C. A 2-in. diameter temperature/pressure tool with downhole memory will be tested late in 1992.

- This will be incorporated in the temperature tool which has an on-board (downhole) memory.

- Well survey tool A number of tools from single shot, downhole survey with magnetometer (open hole), gyroscopic tools (to be run in drill rods) are commercially available. The single shot tool used in a given coring run will be utilized whenever possible, but other tools may be used as needed. Heat shield schemes are employed with these tools, but the deployment of the survey tools at the higher temperatures remains a concern. These tools have diameters in the range of 1 to 2 in. Surveys can be run either in the open hole or in the coring rod.

- Caliper A 2-in. diameter tool. Versions of this tool have been used at high temperatures.

- Natural Gamma A 2-in. diameter probe. It contains a 3/4-in. x 2-in. long sodium iodide crystal.

- Spectral Gamma A 3-in. diameter probe that contains a 1-in. x 4-in. sodium iodide crystal. A 2-in. diameter tool with a sodium iodide crystal and downhole memory is being developed.

- Acoustic Velocity Probe The acoustic velocity tool is a 4-in. diameter probe that consists of three receivers located 4, 6, and 7 ft uphole from a single 15-khz transmitter. The tool is used to obtain an acoustic travel time log and acoustic, full waveform recording. This tool can only be used to the intermediate casing point because of its diameter.

- Televiewer Models are available with 4-in. diameter probes that will work to about 200°C, but can go no further than the intermediate casing hole, approximately 1,350 ft. Slim hole televiewers, 2 in. or less in diameter, are available, but can only go to 125°C. The slim hole televiewer will require a four-conductor cable; the larger tool requires a seven-conductor cable.

- Flow Meter, Spinner This tool will be used to detect aquifers. It can be put in slim holes approximately 2 in. in diameter.

- Downhole Fluid Sampler A memory tool with a pressure sensor. The tool will be approximately 2 in. in diameter.

Tables 3-1, 3-2 and 3-3 list the suite of logs and run times in the drilling stages. Perhaps not all of the tools stated in a given run will be employed; however, the suite of logs should not exceed what is listed in the tables. Temperature and pressure logs will be run not only at fixed times listed in Tables 3-1, 3-2 and 3-3, but whenever opportunity arises. Furthermore, a special logging run can also be made with the well survey tool, flow meter, televiewer, fluid sampler, caliper, or other logs listed above if there is a scientific or operational need and the well conditions are safe. If an open hole is available during the winter shutdown, fluid sampling may be run through perforated coring rods before the slant hole at dome is started. Temperature logs and other logs will be run during the winter shutdown inspection periods, as appropriate.

Table 3-1

Suite of Logs for Vertical Hole at Dome Site

A. At Completion of Reaming for Surface Casing String*

temperature	spectral gamma
pressure	natural gamma
caliper	acoustic log
televiewer	fluid sampler
flow meter	well survey

B. At Completion of Hole for Intermediate Casing String**

temperature	spectral gamma
pressure	natural gamma
caliper	acoustic log
televiewer	fluid sampler
flow meter	well survey

C. At Target Depth or When H Coring Rods Can No Longer Be Used***

temperature	spectral gamma (memory tool)
pressure	natural gamma
flow meter	fluid sampler
caliper	well survey

*If hole conditions dictate immediate running of casing because of sloughing, etc., the temperature log can be run through the coring rods. Temperature and pressure logs will be run whenever opportunity arises.

**If hole conditions dictate immediate running of casing or using the CHD 134 rods as casing as a result of sloughing, etc., the temperature log can be run through the flush joint casing or the CHD 134 coring rods. Temperature and pressure logs will be run whenever opportunity arises.

***If hole conditions dictate keeping the H rods in place, the temperature log can be run through the rods. Flow meter and fluid sampling may be run through the core hole or through perforated coring rods before the vertical hole at dome is abandoned. Temperature and pressure logs will be run whenever opportunity arises.

Table 3-2

Suite of Logs for Deviated Hole at Dome Site

At Target Depth or When H Coring Rods Can No Longer Be Used*	
temperature	spectral gamma (memory tool)
pressure	natural gamma
flow meter	fluid sampler
caliper	well survey
televiewer	

*If hole conditions dictate keeping the H rods in place, the temperature log can be run through the rods. Flow meter and fluid sampling may be run through the corehole or through perforated coring rods before the vertical hole at dome is abandoned. Temperature and pressure logs will be run whenever opportunity arises.

Table 3-3

Suite of Logs for Slant Hole at Ash-Flow Site

At Target Depth or When H Coring Rods Can No Longer Be Used*	
temperature	flow meter
pressure	spectral gamma (memory tool)
caliper	natural gamma
televiewer	water sampler

*Temperature and pressure logs will be run whenever opportunity arises. If hole conditions dictate keeping the H rods in place, the temperature log can be run through the rods.

3.2 Geophysical Activities

Seismic activities often have the connotation of an explosive energy source or of a large energy source such as a vibroseis machine, or mechanical thumper. However, the seismic work proposed in the region of the dome site in conjunction with the Katmai drilling project is ideally suited for an environmentally sensitive area as it utilizes none of these conspicuous energy sources. Rather, it utilizes the drill bit as a downhole energy source impacting the formation during the drilling operation. Seismic energy is recorded by geophones and the resulting seismic data are processed on site.

The drill or core bit will provide a picture of the Novarupta vent structure along the line taken by the bit. A technique of passive seismic recording while drilling can provide a coarse scale image of the vent as a whole. A seismic vent image places the fine scale drill hole section in the context of the large scale vent structure and helps constrain interpretations of the eruption process derived from volume estimates of successive ejecta stages.

The proposed seismic imaging comes from noninvasive, passive listening to the drill bit with an array of geophones deployed on the ground surface at regular intervals around the drill site. As the drill bit meets fresh rock, considerable seismic energy is continuously generated at the point of contact. The continuous seismic signal detected by the surface geophone array is recorded along with a source monitor signal transmitted to the surface through the drill pipe derived from the motion of the rotary drill stem. Subsequent computer processing of the continuous source and ground surface geophone signals generates seismic traces that would occur if the continuous drill bit action were compacted into an instantaneous source signal at the site of the drill bit. The principle of continuous seismic source action, used by the oil and gas industry to profile millions of kilometers of the Earth's crust, has been adapted to the drill-bit-as-source under the trademark of Tomex, a commercial service of Western Atlas International, Inc.

A commercial seismic service, Tomex is ideal for the Katmai project where drilling should not be delayed for independent seismic imaging procedures and where surface seismic sources are not feasible. Tomex operations have been conducted in environmentally sensitive areas to take advantage of the noninvasive nature of passive seismic recording of the drill bit source. The equipment for Tomex monitoring consists of a compact field recording unit mounted in a standard equipment rack plus up to eight geophones and four digital transmission units which can be deployed in a pattern around the drill site. Each digital transmission unit collects data from one or more of the nearby geophones for transmission to the drill site over distances up to 3 km. Four digital transmission units plus geophones may be deployed simultaneously. The geophones require emplacement 1 to 3 ft below the ground surface to ensure good ground-phone coupling and to minimize vibrations generated by wind. Thin cables connect the geophones to the data transmission units, and a thicker cable connects the transmission units to the rig site. No further equipment or ground access is necessary.

The two principal aims of the Tomex survey are to characterize the lateral extent of the Novarupta vent as a function of depth and to locate, if

possible, the third stage eruption conduit to guide the slant hole through the most complete vent section (Figure 3-1). Because drilling has not been conducted at Katmai and because of the potential complexity of the vent rock sequence, the seismic drill-bit-as-source properties and the seismic transmission properties of the Novarupta vent are not presently known. A precise deployment pattern of the Tomex geophones cannot be prescribed in advance of basic knowledge of the source and path qualities of the vent. However, a general geophone deployment strategy, guided by our vent imaging goals, can be clearly stated.

To obtain a large scale vent structure image, eight to sixteen geophones will be deployed on two radial transect lines southwest and northwest of the drill site (see Figure 3-1). The southwest line will begin diametrically opposite the drill rig across the Novarupta dome and proceed as far as signals can be recorded; the northwest line will begin at a similar radius from the rig at a position north of the dome and proceed northwest as far as signals can be recorded. It is hoped that the farthest geophones will record seismic rays passing through the Naknek formation at the vent edges. To obtain an image of the suspected concentric nature of the Novarupta vent structure, eight to sixteen geophones will be deployed and fanned out over a range of azimuths at one or more fixed radii centered on the southwest transect line.

Another transect line to the east and north of the epheramal pond will be used if structural data looks promising or if measurements cannot be made on one of the other lines. This immediate area will be also used if results from the radial measurements look promising.

The radial offsets of the azimuthal fans will be largely guided by the strength of the source signal but cannot be closer than the rim of the Novarupta dome. Each geophone deployment is expected to last one to three days, depending on source signal strengths, drilling time, and weather. The personnel for the Tomex survey will consist of a one- or two-man Tomex crew plus the survey seismologist.

The technique, described above, is employed mainly with oilfield rigs. Because the oilfield operation is generally on a larger scale, a greater amount of energy is generated than will be with a diamond core operation. Thus, this technique will be best employed during the reaming of the surface casing to approximately 450 ft, the drilling through cement after setting of the casing, during the coring with the larger CHD 134 coring rods, and the drilling through cement after cutting the intermediate casing. If the techniques generate useable signals under these conditions, the use of this technique during the coring with the H coring rods may be investigated.

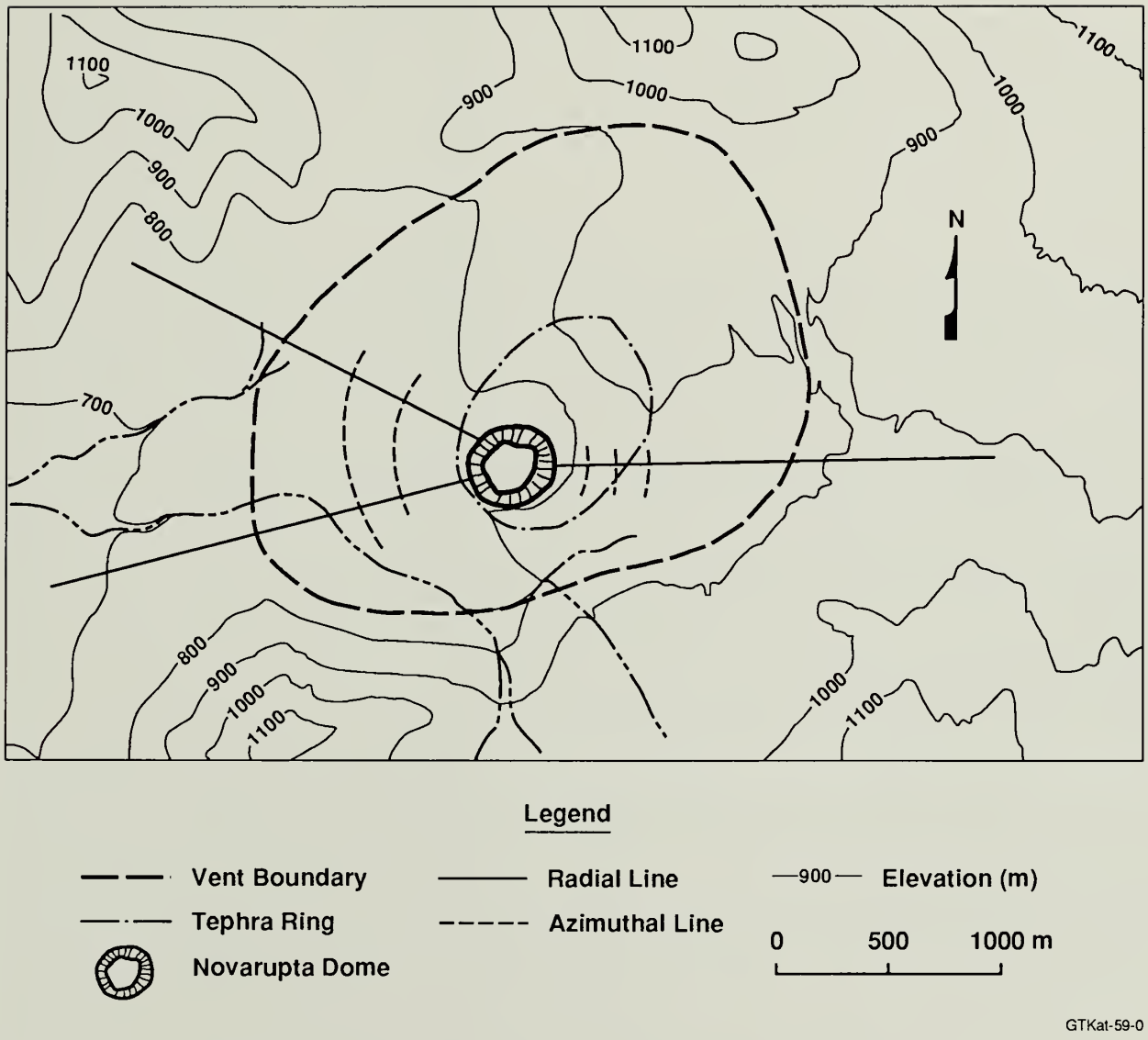

Figure 3-1. Vertical Seismic Profile Lines

SECTION 4.0 (ADDENDUM IV)

RECLAMATION PLAN

4.1 Statement of Intent

It is the intent of this project to minimize short-term impact, and attempt to eliminate long-term surface disruption in all aspects of this operation. The project proposers are committed to performing all necessary actions to restore affected Park areas as closely as possible to preoperation conditions. Adequate funding for core hole abandonment and reclamation operations, detailed below, is part of the operational budget. Funds budgeted for site restoration and reclamation will not be redirected for other purposes.

4.1.1 Anticipated Site Disturbance

- Certain rectangular areas where elements of the drill site are located will need some minor earthwork. Some areas will need to be leveled and a berm will be constructed on the perimeters. This berm will act as an enclosure. Surface material will be stockpiled for later use in reclamation.

  Other rectangular areas will contain one or more catch basins and/or liner material only. A minor rise will be constructed around the perimeter of such areas, if necessary.

  Drill pad elements on other rectangular areas will be secondary containers in themselves. Figures 4-1 and 4-2 and Table 4-1 show the affected areas in the drill pad.

- In the vicinity of the dome camp, leveling of the ground may be necessary to allow construction of camp facilities.

- Footpaths connecting project elements will be restricted to minimize compaction. Compaction and tracking will also occur around the site because of utility vehicle movement and helicopter landing.

- Minor disruption of the surface will occur beneath structures and equipment such as the drill pad (formed of interlocking timbers) and shelters.

- Small sites of excavation may be necessary to bury anchoring materials such as cement footing for guy wires.

4.1.2 Minimization of Site Disturbance During the Operation

- The utility vehicle (grade-all, D3, or D4 models), used on-site for moving equipment and materials, will be confined to the drill and camp sites only. The vehicle can be configured as a forklift, crane, or bulldozer.

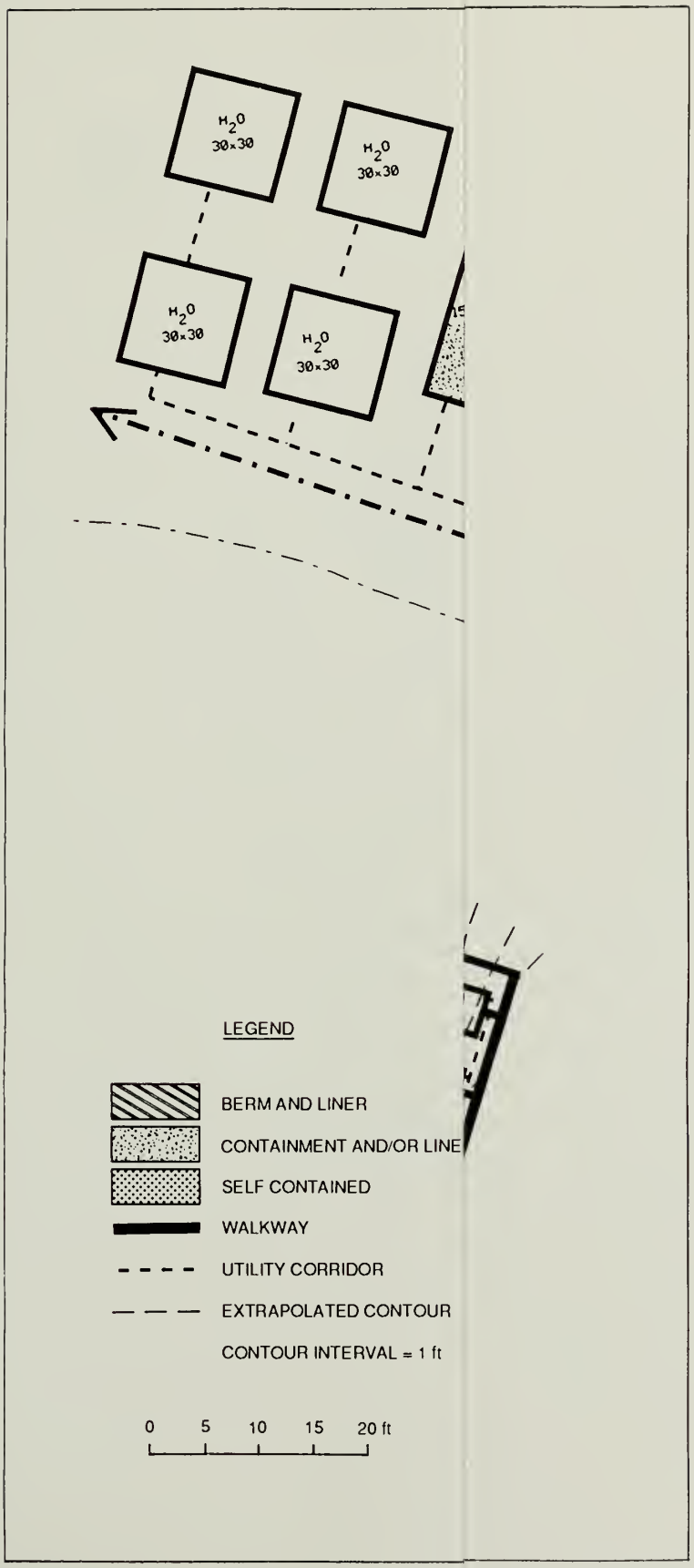

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Figure 4-1.
Proposed Layout of the Dome Drill Site and Supporting Camp

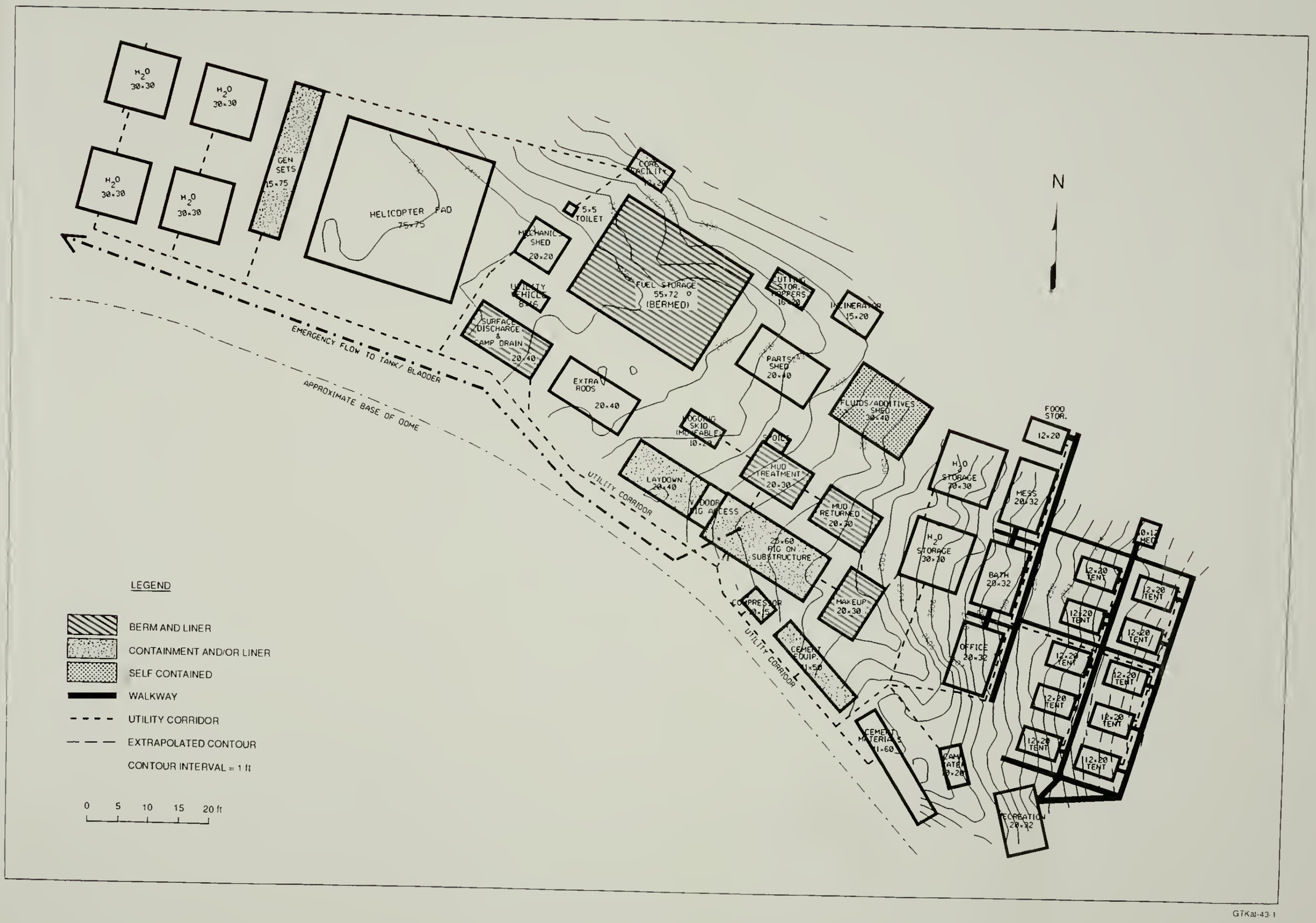

Figure 4-1.
Proposed Layout of the Dome Drill Site and Supporting Camp

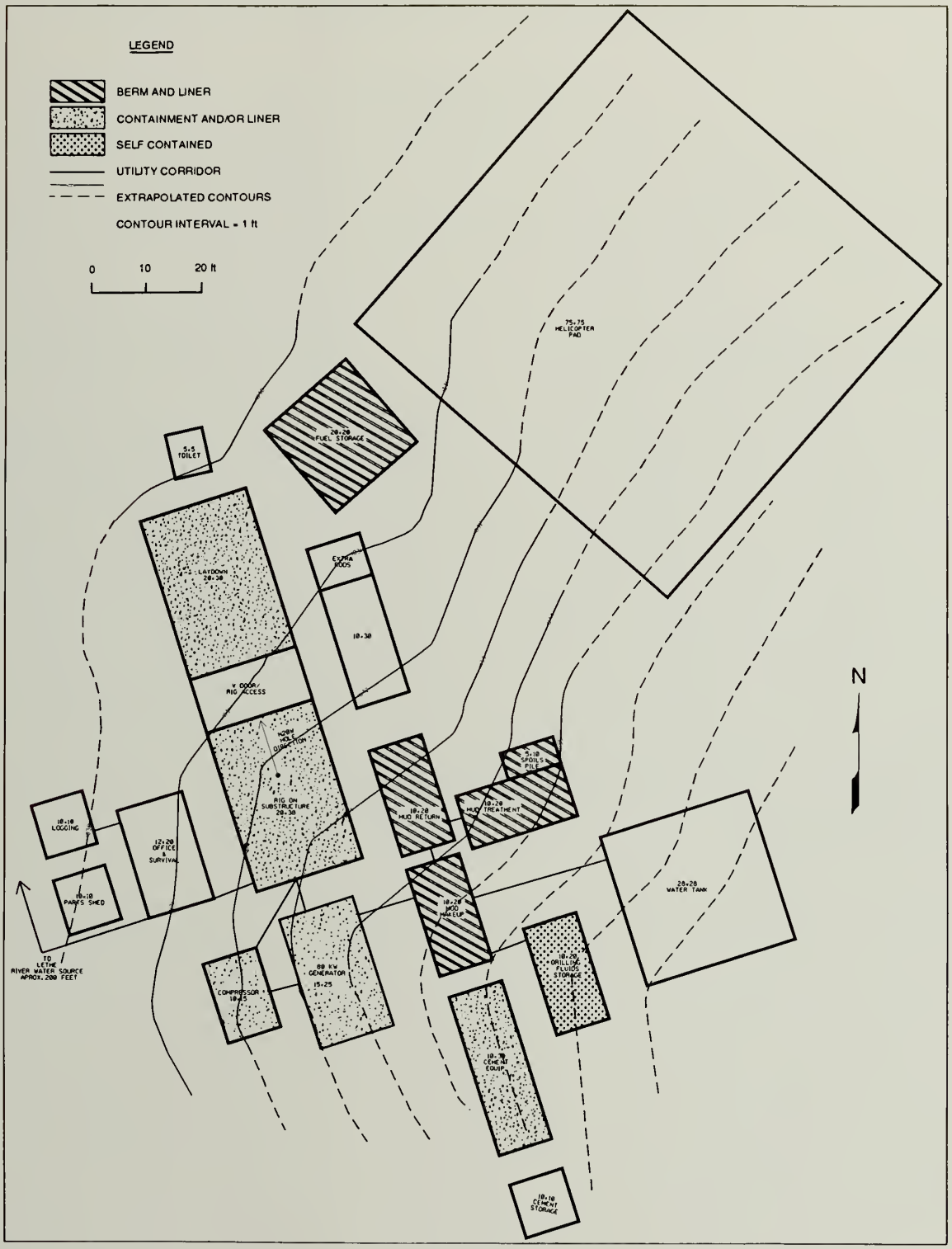

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Figure 4-2. Proposed Layout of the Ash-Flow Site

Table 4-1

Mitigation Measures for Specific Operational Functions

A. Dome Site

Operational Function	Mitigation Measure
Fuel storage	Berm and line
Drilling fluids area (Makeup, treatment, return, spoils pile, cuttings storage)	Berm and line
Surface discharge (leach pit)	Berm and line, where necessary
Rig on substructure	Catch basins and/or liner*
Core lay down	Catch basins and/or liner*
Compressor	Catch basins and/or liner*
Cement equipment	Catch basins and/or liner*
Generator sets	Catch basins and/or liner*
Drilling fluids storage	Self-contained
Pumping and heating stations around water line	Berm and line

*If necessary, there will be a minor rise around catch basins or liners.

Table 4-1

Mitigation Measures for Specific Operational Functions (Concluded)

B. Ash-Flow Site

Operational Function	Mitigation Measure
Fuel storage	Berm and line
Drilling fluids area (Makeup, treatment, return, spoils pile)	Berm and line
Rig on substructure	Catch basins and/or liner*
Core lay down	Catch basins and/or liner*
Compressor	Catch basins and/or liner*
Cement equipment	Catch basins and/or liner*
Generator	Catch basins and/or liner*
Drilling fluids storage	Self-contained

*If necessary, there will be a minor rise around catch basins or liners.

- Access to the camp from the dome drill site will be restricted to a designed pathway; this will minimize the area trammeled by foot traffic and focus reclamation efforts to fewer corridors.

- Any necessary access across vegetated ground or soft soil will be facilitated by elevated decking material.

- Organic liners and geotextile materials will be placed in all bermed areas where fuel will be present. These areas will be inspected for leakage on each shift. Other bermed areas will have liners. The surface drainage pit will have liners around the periphery of the pit.

- Absorbent pads will be put around machinery, valves, and other areas where fuel may seep. Drip pans will be placed under machinery.

- Project personnel will be trained in spill prevention, spill remediation, and handling of hazardous materials. All project personnel will be instructed as to the specific conditions of the operating permit. In all personnel briefings, special emphasis will be made on the importance of sensitivity to the pristine condition of the Park and wilderness values and the necessity to conduct the operation in a manner consistent with National Park Service (NPS) mandates and philosophy. Foot access to the remainder of the Park for recreational purposes will be planned with the NPS prior to the start of the operation.

- Nearby streams, springs, and rivers will be monitored for any contamination from the operation. If contamination from the drilling operation is detected, the operation will cease until the source of the contamination is stopped.

4.1.3 Procedures for Reclamation, Post-Drilling Operation

- To guide the reclamation process, color photographs will be taken from several angles to show the potentially affected area; one-foot contour topographic maps of the drill and camp sites have also been prepared. In cooperation with National Park Service personnel and to assist in evaluating the adequacy of reclamation, this photography and mapping will be completed prior to the operation and will be repeated following site rehabilitation.

- All structures, equipment, supplies, and other imported articles or debris generated by the operation will be removed from the Park and brought to King Salmon for proper disposal.

- Core holes will be plugged with cement in accordance with NPS and State of Alaska requirements. The pipe will be cut approximately 5 ft below the surface. A cap will be affixed on top of the pipe and the hole will be abandoned.

- The drilling pad will be dismantled and removed. Cement from the guy wire anchors will be removed to a reasonable depth and the surfaces restored with handtools.

- The preoperation surface topography will be restored as closely as possible and clean, stockpiled surface material will be redistributed appropriately. Any large rocks moved during camp or drill site installation will be repositioned to approximately the original pattern, lichen side up. Any natural drainage features disturbed will be reestablished.

- Berms will be leveled and the utility vehicle and any footpaths or other surface disturbance (at either drill site, the camp site, and along the water line) will be regraded.

- Equipment used for these reclamation activities will include: hand tools such as shovels and rakes, a small utility vehicle, and the demobilization helicopter for transport of materials from the Park.

- Reclamation will be conducted by the drilling contractor and camp construction personnel under the supervision of the GRDO site manager; representatives of the National Park Service and the USGS will monitor the reclamation process.

SECTION 5.0 (ADDENDUM V)

HELICOPTER AND DRILL RIG NOISE DATA

5.1 Helicopter Noise Considerations

Helicopter noise is an important concern in considering the proposed Katmai Scientific Drilling Project. Transportation of people and equipment to and from the proposed operational sites will be by helicopter. Section 11 of the Revised Operations Plan provides details of the helicopter work necessary to support the overall operation. This includes helicopter routes, Figure 11-1 in the document. The primary noise mitigation measure for helicopters will be altitude. The helicopter will maintain a 2000-ft altitude above the ground except in the immediate vicinity of King Salmon and two drill sites. On occasion it will be necessary to fly lower than 2000 ft on the basis of flight safety if ceiling problems exist.

Dames and Moore obtained noise data from various sources and have also obtained data from the Fly Neighborly Guide published by the Fly Neighborly Committee of the Helicopter Association International, February 1992. This publication translates technical information on helicopter operations into laymen's terms. Unfortunately, much of the noise information is displayed on different scales; Perceived Noise Level (decibels), Effective Perceived Noise Level used by the Federal Aviation Administration (FAA) for certification (decibels), and the decibel A scale. These scales are not equivalent. For noise discussions in the Katmai Environmental Impact Statement (EIS), it is recommended that the A scale be used. It appears to be the most universally used noise scale, although it is more sensitive to higher frequencies. The sound measurements discussed in this addendum are annotated on the decibel A scale.

On July 10, 1992, helicopter noise measurements were made by the GRDO using a Bell 296-L helicopter at Novarupta Dome in the Valley of Ten Thousand Smokes. This particular helicopter generates noise comparable to some helicopter equipment considered for operations support. The background noise from wind at the Dome that day was 60 to 70 decibels with gusts creating noise approaching 75 decibels. The observer was on the ground. Measurements were made with helicopter approach, flyover and departure at 500 ft and 1000 ft in altitude over the observer. The noise level for a 500-ft helicopter approach, flyover, and departure was from 80 to 85 decibels. At 1000 ft the decibel noise range for the same helicopter flycover procedure was similar. The prevailing winds that day effectively masked the noise except when the helicopter was in sight from within the dome. Due to the effects of the tephra ring and the wind, no noise was heard when the helicopter was out of sight. The effect of the tephra ring as a sound barrier is discussed below.

Figure 5-1 is taken from the Fly Neighborly Guide. This figure gives a generalized noise range, in the decibel A scale, of routine operations for helicopters of all sizes, with the helicopter flying 500-ft above the observer. Side-by-side with this is a portrayal of the ranges of common noise sources, diesel train, truck or bus, automobile, chain saw, and a power

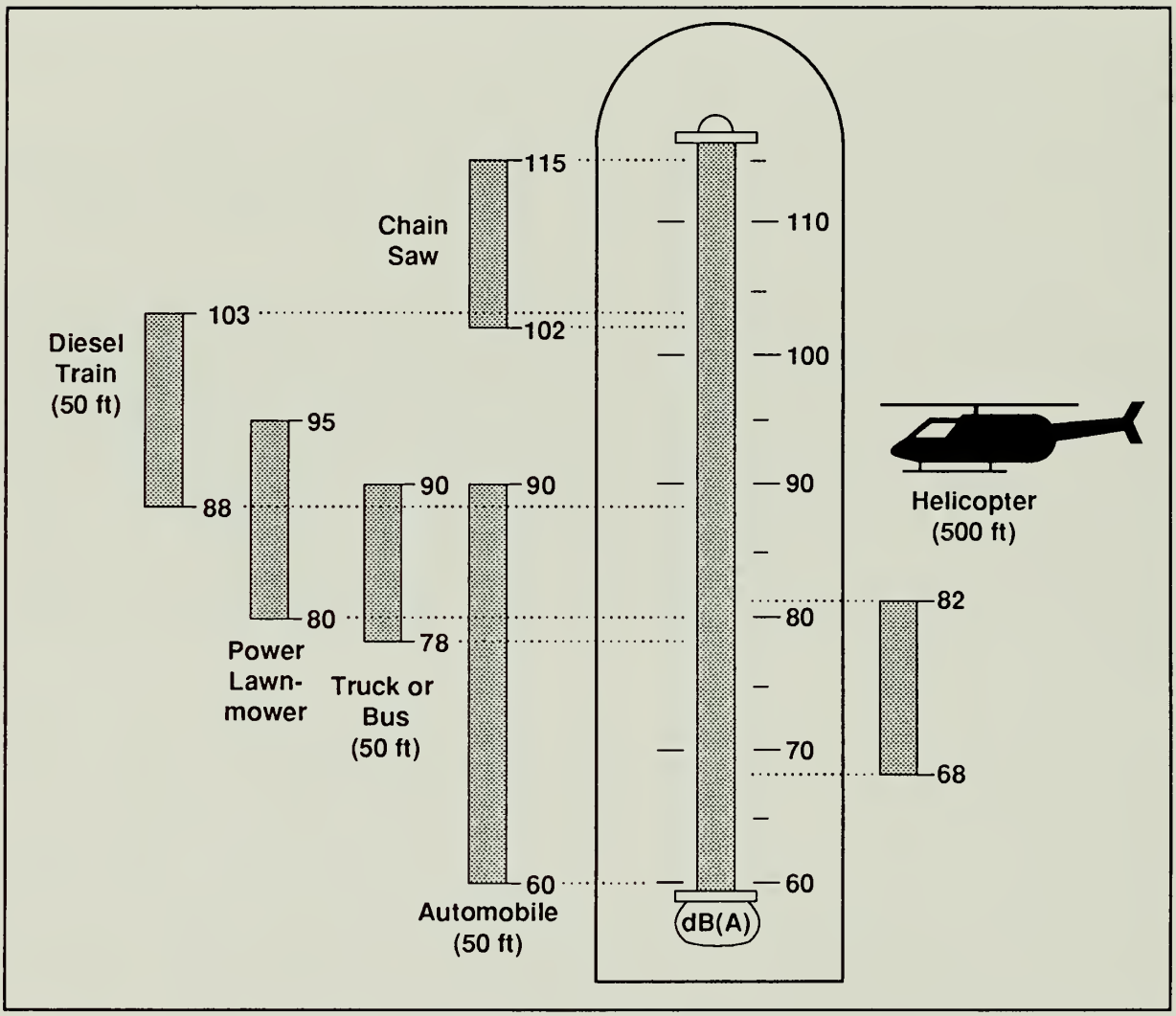

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Figure 5-1. Range of Helicopter Noise and Range of Common Helicopter Noise Sources

lawnmower. Except for the automobile, the apparent noise seems greater for these other common noise sources. Table 5-1, from the same reference, further relates noise levels relative to familiar sounds.

5.2 Noise Levels at and in the Vicinity of Operating Drill Rigs

Noise levels in decibels were measured on a Universal Drill Rig 1500 and a Boyles Brothers Drilling Company BB 2000 Rig. Both rigs were operated by Boyles Brothers Drilling Company for clients in Nevada in September, 1992. The clients of Boyles Brothers Drilling Company gave permission to have these on site measurements made. The Universal Drill Rig 1500 was configured for reaming, hole opening. The Boyles Brothers BB 2000 Rig was configured for diamond coring with about 1000 ft of H rod.

5.2.1 Noise Measurements Using the Universal 1500 Drill Rig as a Noise Source

During the conduct of the sound measurements, the Universal 1500 230 HP motor was running, the drill head was down, and the drill was in high gear. The diesel-powered mud pump was not running for this measurement, but the Detroit 353 motor running the mud pump produced about 100 decibels at a 3-ft distance when it was run. The noise level 3 ft away from the drill motor was slightly over 100 decibels; behind the rig on the side opposite the motor it was 88 to 89 decibels, and at the control panel, 82 decibels (Figure 5-2). The wind was out of the south and estimated to be between 15 to 20 mph. The wind created background noise ranging from 60 to 75 decibels.

Sound measurements were taken at 100 ft increments up to 500 ft away from the drill rig, in both the north and south directions (Figure 5-3). Noise was also measured in a sheltered draw, about 6 ft deep, at 575 ft to the south of the rig. These data are shown in Table 5-2.

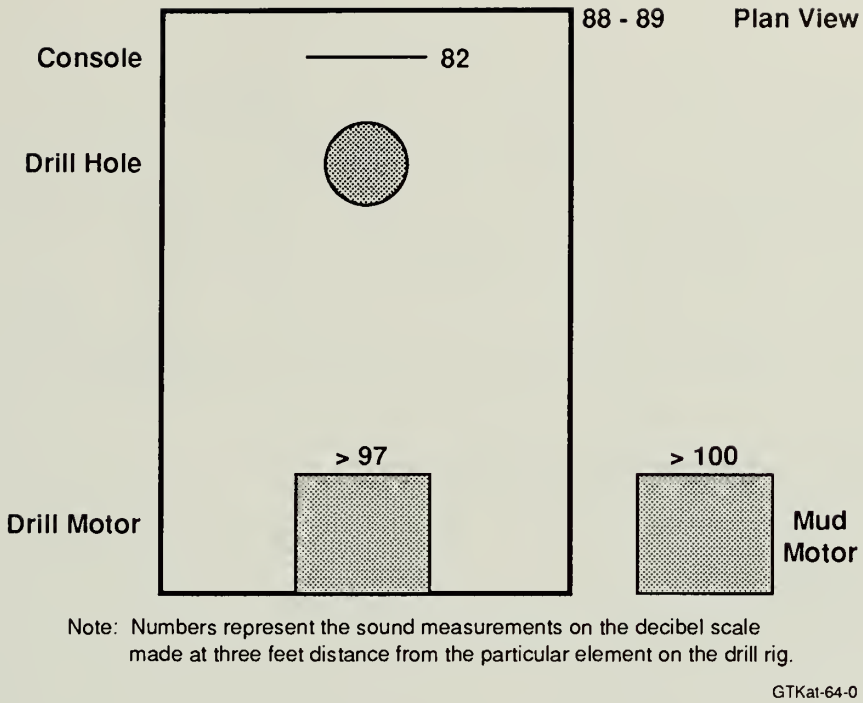
The noise attenuates considerably as one moves away from the drill rig. At 500 ft from the drill rig, drill rig and wind noise both appear to be in the 60-decibel range, down from about 100 decibels. Moreover, at distances greater than 300 ft much of the measured noise seemed to come from the wind. (This would often be the case in the Valley of Ten Thousand Smokes; the wind sound would predominate at distances of a few hundred feet from a concentrated noise source.) In the sheltered draw at 575 ft to the south of the rig, noise from the wind as well as the rig appear to be muted. In the draw a considerable amount of earth shields the listener from direct sound paths from the drill rig. (At Novarupta Dome, the tephra ring and the dome itself should provide similar sound shielding of a proposed drill site, at least for potential listeners outside of that geological feature. This is demonstrated more directly in the sound measurements described below.)

The large diesel motors driving the Universal 1500 Drill Rig, as well as the motors running the mud pump, appear to be the primary noise sources at any distances from the drill rig. A small Honda WB 369 pump produced 105 decibels right at motor, but this unit is much smaller than the motors running the drill and the mud pump and it did not produce substantial noise at a distance (relative to the two aforementioned motors).

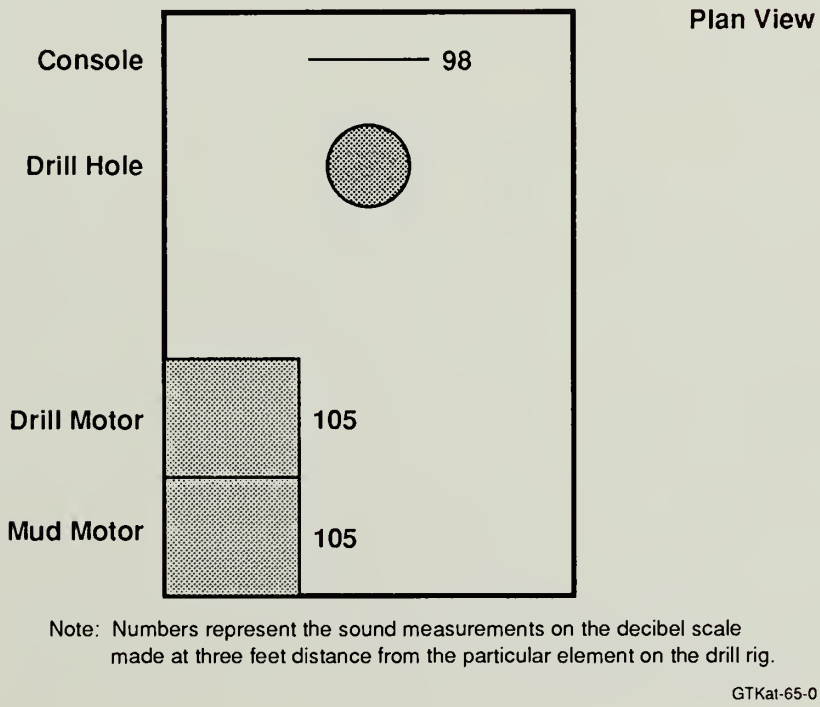
Table 5-1. Illustrates Noises Relative to Familiar Sounds

dB(A)	Overall Level	Community (Outdoor)	Home or Industry (Indoor)	Human Judgment of Loudness
130	Uncomfortably loud	Military jet aircraft takeoff from aircraft carrier at 50 ft (130)		
120			Oxygen torch(121)	120 dB(A) 32 times as loud
110	Very loud	Turbofan aircraft at takeoff power at 200 ft (118)	Riveting machine (110) Rock-and-roll band (108-114)	110 dB(A) 16 times as loud
100		Jet flyover at 1000 ft (103)		100 dB(A) 8 times as loud
90		Power mower (95) Motorcycle at 25 ft (90)	Newspaper press (97)	90 dB(A) 4 times as loud
80	Moderately loud	Car wash at 20 ft (89) Diesel truck at 40 mph at 50 ft (84) High urban ambient sound (80)	Food blender (88) Milling machine (85) Garbage disposal (80)	80 dB(A) twice as loud
70		Passenger car at 65 mph at 25 ft (77)	Livingroom music (76) TV audio, vacuum cleaner (70)	**REFERENCE NOISES** 70 dB(A)
60		Air conditioning unit at 100 ft (60)	Electric typewriter at 10 ft (64) Dishwasher (rinse) at 10 ft (60) Conversation (60)	60 dB(A) 1/2 as loud
50	Quiet	Large transformers at 100 ft (50)		50 dB(A) 1/4 as loud
40		Bird calls (44) Lower limit of urban ambient sound (40)		40 dB(A) 1/8 as loud
10	Just audible	dB(A) scale interrupted		
0	Threshold of hearing			

*Noise range of helicopter operations with helicopter 500 ft above observer, 08-82 dB(A).

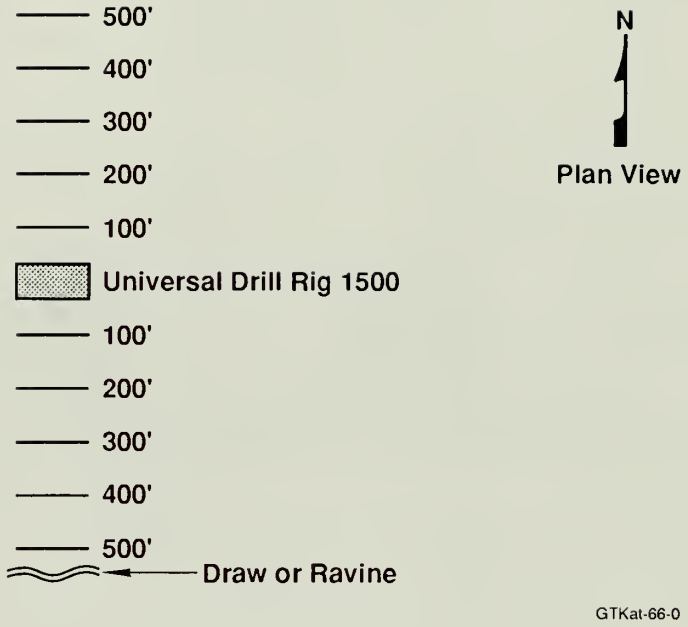


(a) Universal Drill Rig 1500

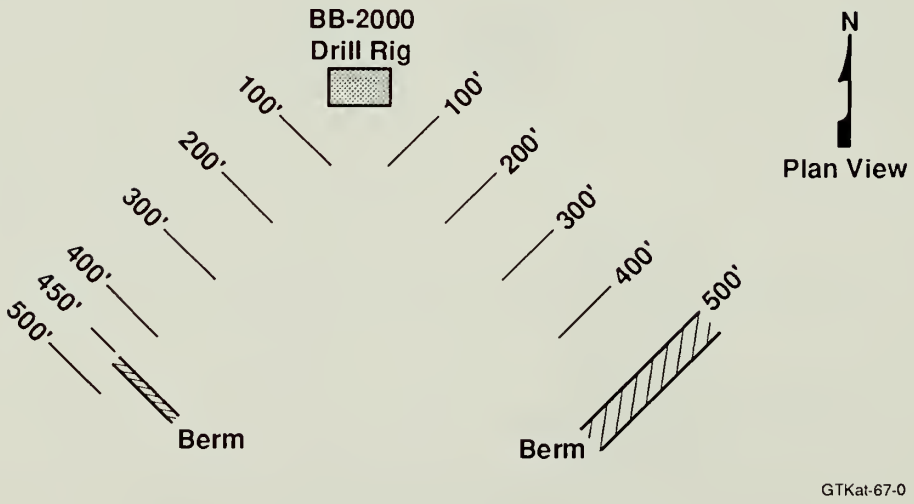


(b) Boyles Brothers Drilling Company BB 2000 Drill Rig

Figure 5-2. Rig Schematics



(a) Universal Drill Rig 1500



(b) Boyles Brothers Drilling Company BB 2000 Drill Rig

Figure 5-3. Noise Measurement Schematics

Table 5-2

Noise Measurements Using the Universal Drill Rig 1500
As a Noise Source

Distance From Rig (ft)	Distance North	Distance South	Comments
	Sound Level db (A)		
3	~100	88-89	Measurements close to motor (north) Measurements just away from console (south)
100	76	76-77	
200	74-75	66-70	
300	66	63-65	
400	63-64	58-65	
500	57	63-65	
575	45-55	--	In sheltered draw

5.2.2 Noise Measurements Using the BB 2000 Drill Rig as a Noise Source

The BB 2000 Drill Rig 220 hp motor was running, along with the diesel-powered mud pump, during the conduct of the noise measurements. The noise 3 ft from the side-by-side motor and mud pump, respectively, was 105 decibels (Figure 5-2). The noise on the opposite side of the rig away from both motors was 105 decibels. The background noise without the wind was 40 to 45 decibels. The background noise with the wind, estimated at 15 to 20 mph from the south became as high as 73 to 74 decibels. Later, the wind became so strong that noise measurements, as those tabulated below, were meaningless except within 100 to 200 ft of the rig. (This will certainly have analogues at the proposed valley drill sites.) The rod spin in the hole added substantially to the noise level at the console and to the overall noise level in the vicinity of the rig, but the relatively large diesel motor noises seemed to predominate (to the naked ear) at distances over 300 ft from the rig.

Sound measurements were measured at 100 ft increments up to 500 ft away from the drill rig in the southwest and southeast directions (Figure 5-3). Measurements in other directions were impossible at large distances from the Rig due to the unique topography of the site. There was an escarpment or dirt barrier about 10 ft thick at eye level, about 450 ft just alongside the

measurement line to the southwest. Measurements were made behind this escarpment just off the line of measurement extending from the rig in the southwest direction. There was no wind when measurements were taken in the southwest direction. At 500 ft to the southeast there was a 25-ft-thick escarpment (an analogue of the tephra ring). The wind had come up when measurements were made in the southeast direction. These data are shown in Table 5-3.

Table 5-3

Noise Measurements Using the BB 2000 Drill Rig
As a Noise Source

Distance From Rig (ft)	Distance: Southwest	Distance: Southeast	Comments
	Sound Level db (A)		
3	105		Measurements just off motors (north end)
		98	Measurements at console (south end)
100	78	77-78	
200	72-73	74-76	
300	68-69	65-71	
400	63-64	57-65	
450	52-54	--	Behind berm just off SW axis
500	57-58	55-61	Just in front of 25 ft berm in SE direction

The noise attenuates considerably as one moves away from the drill rig. The noise level at 500 ft was in the 60-decibel range, down from over 100 decibels. The dirt barrier or escarpment in the southwest direction at 450 ft was fairly effective in attenuation noise as the unshielded noise 50 ft further from the drill rig was substantially larger. (Again, the tephra ring and the dome should be an effective large-scale analogue to this situation since it is least an order of magnitude thicker.) The effect of the wind and the berm at 500 ft, acting as a sound reflector, appears slight in this case. Again the diesel motors driving the drill and mud pumps seem to be the primary noise sources at distances greater than 200 ft (at least to the naked ear).

5.3 Discussion

These noise measurements above shed light on the necessity of noise mitigation measures. Because the tephra ring encloses the primary drill site at Novarupta Dome, and the dome itself offers shielding against the side where the tephra ring is less extensive, no noise mitigation measures are planned there on the basis of wilderness values. The tephra ring and the dome should damp the noise of the drilling operation for people at any distance outside the ring. (The project is working with the State of Alaska Department of Labor to assure the safety and health of the camp and drill site occupants, which may require noise consideration and monitoring of CO_2, NO_x as well as for H_2S).

The Universal 1500 Drill Rig and the BB 2000 Drill Rig, with their mud motors, are candidates for the drilling operation at the dome. The drill and mud motors outside the tephra ring at the ash-flow site will have power ratios two- to three-fold smaller than those used in the dome. The motors driving the waterline pumps also have an energy rating about 1/10 of that of smaller than the machinery inside the dome. However, in order to mitigate the effects of sound in these rather flat areas, where little if any noise shielding is to be expected from topography, engines will be equipped with mufflers in order to help preserve wilderness values. If necessary, these motors will be enclosed to further mute the sound.

SECTION 6.0 (ADDENDUM VI)

DRILLING FLUIDS PROGRAM

6.1 Toxicity Limitations

This section provides a fairly detailed description of the drilling fluids program to be used in the proposed Katmai Scientific Drilling Project. The material contained in this section supersedes the drilling fluids additive portions of Table 8-3 in the Revised Operations Plan.

It must be pointed out that the drilling conditions to be encountered are unknown, and they are expected to be difficult. Problems associated with lost circulation and high temperatures are to be expected. Because of these problems and the fact that the actual fielding of the proposed project is well over a year away, it is impossible and impractical to specify each particular drilling fluid additive and the amounts of drilling fluid additives to be used.

What is provided, however, is the best professional estimate from the project personnel and their consultants (MI Drilling Fluids Co., including their Environmental Affairs personnel, and personnel from other major and independent drilling fluids and environmental companies) of what drilling fluid additives may be used, in what well, and at what temperature range (Table 6-1A). Also provided are estimates of lower and upper bounds of the quantities of each additive to be used, Table 6-1A. These drilling fluid additives are listed generically and by trade name. (Trade names are necessary to cross reference with the Material Safety Data Sheets (MSDSs) which are enclosed in Appendix A to this section.)

Again, while a precise listing of all drilling fluid additives to be used cannot be promised under the circumstances listed above, a serious attempt has been made to list *all possible* alternative additives, at least generically, that could be used. Table 6-2 describes these additives, the use of each, and, where appropriate, its interaction with the formation. Other additives may be used but they will meet the self-imposed standards for the project described below.

Almost all the materials listed in Tables 6-1 and 6-2 meet Environmental Protection Agency (EPA) toxicity limitations given in the Federal Register, Vol. 50, No. 165, August 26, 1985, pp 34631-36. The limitations listed in this regulation are a self-imposed standard for the proposed Katmai Scientific Drilling Project. These limitations refer to a 96-hour aquatic toxicity test of a drilling fluid additive on Mysidopsis Bahia shrimp. These are regulations for drilling off the continental shelf, but the limitations on toxicity are universally understood within the United States (U.S.), and as such provide an environmental adherence standard for this project. Any drilling fluid additive utilized will meet or exceed these toxicity limitations in the concentrations to be employed. Substitutions of a product from certain other vendors will not jeopardize these self-imposed standards.

This is corroborated in part by F.V. Jones, W. Bettge, A.J. Leuterman, and R. Garrison, "Drilling Fluids Firms Respond to EPA Toxicity Concerns," *Oil and Gas Journal*, November 24, 1986, and A.J. Leuterman, F.V. Jones, G. Wayne Bettge, and C.S. Stark, "New Drilling Fluid Additive Toxicity Data Developed," *Offshore*, July 1989, pp 31-37. These references show that similar products between the major drilling fluid vendors meet these toxicity limitations. This is not surprising since all the major drilling fluid companies are environmentally conscious and have competent environmental groups.

The minimum drilling fluid additive estimates, listed in Table 6-1, are for an ideal situation with no lost circulation whatsoever, a situation rarely attainable in realistic drilling conditions in volcanic rock. (Drilling fluid makeup could add 20 to 40 percent more to the additives and the water listed in the minimum estimates.) The maximum drilling fluid estimates listed in Table 6-1 are for the situation where lost circulation is a continuous problem, a situation which is more likely to occur. The amounts of drilling fluid additives used in actual Katmai drilling conditions should be somewhere between the 2 set of values estimated and listed in Table 6-1. In certain situations the maximum estimates may be exceeded. If lost circulation is protracted it is unlikely that the desired concentration of the drilling fluid additions can be maintained. Bioassay information on the drilling fluid additives used has not been included in this section, but this information is available and much of this information is to be found in the references above.

Although a drilling fluids program has been outlined for the ash-flow site, other drilling fluid options may be utilized because of the proximity of the site to the River Lethe. These options are:

- Drill with water only,
- Limit the drilling fluid additives to water and clays, and
- Air drill the hole, muting the compressor noise.

These options are discussed Section 8.5.1.2 of the Revised Operation Plan.

6.2 Monitoring of Nearby Streams and Rivers for Evidence of Drilling Fluids

Monitoring of drilling fluid additives will consist of a visual inspection of water samples, routine water analysis (the major geochemical ions, pH, conductivity, total suspended solids content), testing for common substances, such as SIO_2 and Fe, Clean Water Act ions such as As, Pb, etc., and testing for other appropriate substances. Certain tests will be keyed or emphasized, sort of a preliminary monitoring diagnostic, to see if the drilling fluid additives will be detected at all; certain substances, which are detected easily in the laboratory, are abundant in the drilling fluid but not abundant in the streams and rivers.

Caustic soda or soda ash will be used as a drilling fluid additive for pH control at lower temperatures. These substances are abundant in sodium, whereas the streams and rivers contain up to two orders of magnitude less sodium. A substance containing soybean oil which is not present in the streams and rivers will be used for lubrication at intermediate to high temperatures. The proposed lubericant contains phosphate ions. These ions should occur naturally in very small amounts if at all. Detection of these easily detectable substances, to a few parts per million, as well careful measurement of the pH will give an indication whether drilling fluid additives are present at all. The pH of the drilling fluids may be in the 9-11 range. The pH in the streams and rivers in the valley is around 5-7. The pH tests will be run but there may be natural buffering in the formations or the waters of the valley. Further tests can be run to verify preliminary tests. Other substances in the drilling fluids can be keyed for special diagnostic tests. Approximate concentration of these substances are:

Substance or Test	Abundance in Drilling Fluid ppm	Abundance Naturally ppm	Temperature Range
Na*	~1,500	$\lesssim$ 30	Low temperature, intermediate temperature
pH	9-11	~5.5	Low temperature, intermediate temperature
Soybean oil	~2,000	---	High temperature
Phosphorous ester salt (CONQOR 404)	~800	**	

*Free sodium is present in most polymers listed and may be a valid indicator at all temperatures.

**Baseline to be established--thought to be very low. Initial analyses of Knife Creek and other samples show no phosphate ions within 0.05 ppm detection limits.

Table 6-1A
(Vertical Well at Dome)

Proposed Katmai Drilling Fluids Program and
Estimate of Amounts of Drilling Fluid Additives Needed

ADDITIVE GENERIC NAME (TRADE NAME)	EST. AMOUNTS MIN	MAX	COMMENTS
(0-100 ft, through loose pumice and setting of conductor pipe)			
Bentonite Clay (M-1 GEL)	6 bags[a]	103 bags	
Anionic acrylamide acrylate polymer (POLYPLUS)	2 bags	41 bags	
Sodium Hydroxide (CAUSTIC SODA)	2 bags	21 bags	May use soda ash
Fresh water	100 barrels	2000 barrels	
(100 ft-450 ft, through surface casing)			
Sodium polyacrylate copolymer (SP-101)	11 bags	144 bags	
Anionic acrylamide acrylate polymer (POLYPLUS)	11 bags	144 bags	
Glycerine type material (LUBE 167)	3 drums	78 bags	
Sodium Hydroxide (CAUSTIC SODA)	6 bags	72 bags	May use soda ash
Fresh Water	482 barrels	7200 barrels	

[a]1 bag = 50 pounds additive except for Bentonite = 100 pounds

Table 6-1A
(Vertical Well at Dome)

Proposed Katmai Drilling Fluids Program and
Estimate of Amounts of Drilling Fluid Additives Needed (Concluded)

ADDITIVE GENERIC NAME (TRADE NAME)	EST. AMOUNTS MIN	MAX	COMMENTS
(450 ft-1250 ft through intermediate casing)			
Anionic acrylamide acrylate polymer (POLYPLUS)	9 bags	144 bags	
Sodium polyacrylate copolymer (SP-101)	9 bags	144 bags	
Sodium hydroxide (caustic soda)	5 bags	72 bag	
Glycerine type material (LUBE 167)	5 drums	78 drums	
Fresh water	381 barrels	7200 barrels	
(1250 ft-4000 ft)			
Anionic acrylamide acrylate polymer (POLYPLUS)	12 bags[a]	352 bags	
Polyacrylate copolymer (SP-101)	12 bags	352 bags	
Sodium hydroxide (caustic soda)	6 bags	176 bags	
Glycerine type material (LUBE 167)	6 drum[b]	197 drums	
Phosphorous ester salt (CONQOR 404)	1 drum	4 drums	
Fresh water	535 barrels	1760 barrels	

[a]1 bag = 50 pounds additive except for Bentonite = 100 pounds
[b]1 drum = 55 gallons additive

Table 6-1B
(Deviated Well at Dome)

Proposed Katmai Drilling Fluids Program and
Estimate of Amounts of Drilling Fluid Additives Needed

ADDITIVE GENERIC NAME (TRADE NAME)	EST. AMOUNTS MIN	MAX	COMMENT
	(kickoff point-3300 ft)		
Anionic acrylamide acrylate polymer (POLYPLUS)	12 bags[a]	352 bags	
Polyacrylate copolymer (SP-101)	12 bags	352 bags	
Sodium hydroxide (caustic soda)	7 bags	176 bags	
Glycerine type material (LUBE 167)	7 drums[b]	192 drums	
Phosphorous ester salt (CONQOR 404)	1 drums	4 drums	
Fresh water	600 barrels	17,600 barrels	

[a]1 bag = 50 pounds additive except for Bentonite = 100 pounds
[b]1 drum = 55 gallons additive

Table 6-1C
(Slant Well at Ash-Flow Site)

Proposed Katmai Drilling Fluids Program and
Estimate of Amounts of Drilling Fluid Additives Needed

ADDITIVE GENERIC NAME (TRADE NAME)	EST. AMOUNTS MIN	MAX	COMMENTS
(0-60 ft including setting of conductor pipe)			
Anionic acrylamide acrylate polymer (POLYPLUS)	2 bags[a]	32 bags	
Bentonite Clay (M-1 GEL)	5 bags	96 bags	
Sodium hydroxide (caustic soda)	1 bags	16 bags	
Fresh water	96 barrels	1600 barrels	
(60-230 ft to casing point)			
Anionic acrylamide acrylate polymer (POLYPLUS)	2 bags	64 bags	
Polyacrylate copolymer (SP-101)	2 bag	64 bags	
Sodium hydroxide (caustic soda)	1 bag	32 bags	
Glycerine type material (LUBE 167)	1 drum[b]	35 drums	
Fresh water	67 barrels	3200 barrels	

[a]1 bag = 50 pounds additive except for Bentonite = 100 pounds
[b]1 drum = 55 gallons additive

Table 6-1C
(Slant Well at Ash-Flow Site)

Proposed Katmai Drilling Fluids Program and
Estimate of Amounts of Drilling Fluid Additives Needed (Concluded)

ADDITIVE GENERIC NAME (TRADE NAME)	EST. AMOUNTS MIN	MAX	COMMENTS
	(230 ft-660 ft)		
Anionic acrylamide acrylate polymer (POLYPLUS)	2 bags[a]	64 bags	
Polyacrylate copolymer (SP-101)	2 bags	64 bags	
Sodium hydroxide (caustic soda)	1 bag	32 bags	
Glycerine type material (LUBE 167)	1 drum[b]	35 drums	
Fresh water	74 barrels	3200 barrels	

[a]1 bag = 50 pounds additive except for Bentonite = 100 pounds
[b]1 drum = 55 gallons additive

Table 6-2

Description of All Candidate Drilling Fluid Additives
Envisioned to Date for the Katmai Scientific Drilling Project

ADDITIVE NAME GENERIC NAME (TRADE NAME)	USE OF PARTICULAR ADDITIVE	INTERACTION WITH FORMATION
(Low temperature application, <80°C)		
Bentonite Clay (M-1 GEL)	Achieve viscosity, lubricate bit, reduce fluid loss.	Forms filtercake
Cellulose (POLYPAC)	Achieve viscosity, lubricate bit, reduce fluid loss, inhibit swelling of clays.	Forms filtercake
(Intermediate-high temperatures, >80°C)		
Anionic acrylamide acrylate polymer (POLYPLUS)	Provide viscosity, lubricate bit, fluid loss control, shale stabilization	Forms filtercake
Sodium polyacrylate copolymer (SP-101)	Fluid loss, thinner	Forms filtercake
Oxidized lignite (TANNATHIN)	Thinner, fluid loss control	Forms filtercake
Polyacrolyte polymer (TACKLE)	Thinner	Forms filtercake
Glycerine type material (LUBE 167)	Lubricant, torque trimmer	
Complex stearate emulsion (TORKease)	Lubricant, torque trimmer	

Table 6-2

Description of All Candidate Drilling Fluid Additives
Envisioned to Date for the Katmai Scientific Drilling Project (Continued)

ADDITIVE NAME GENERIC NAME (TRADE NAME)	USE OF PARTICULAR ADDITIVE	INTERACTION WITH FORMATION
	(Very high temperatures, T >225°C)	
Acrylamide acrylate polymer, polyfunctional sulfonated teropolymer (EMI-164)	Provide viscosity, lubricate bit, fluid loss control shale stabilization, high temperature polymer	Forms filtercake
Modified acrylic polymer (ALCOMER 242)	Provide viscosity, lubricate bit, fluid loss control, high temp polymer	Forms filtercake
Tera polymer of anionic polyacrylamide, acrylate and sulfonate group (MINTHERM)	Provide viscosity lubricate bit high temperature polymer	Forms filtercake
Synthetic magnesium silicate (THERMA-VIS)	High temperature viscosifier, lubricate bit	
Acrylic copolymer (ALCOMER 75L)	High temperature fluid loss, thinner	Forms filtercake
Phenel-formaldehyde polymer solution polymer solution (THERMEX)	High temperature thinner and fluid loss control	Forms filtercake
Sulfono-acrylamide co-polymer (THERMA-CHECK)	High temperature fluid loss control	Forms filtercake
Anionic polymer of sulfonated acrylate (THERMA-THIN)	High temperature thinner	Forms filtercake

Table 6-2

Description of All Candidate Drilling Fluid Additives
Envisioned to Date for the Katmai Scientific Drilling Project (Concluded)

ADDITIVE NAME GENERIC NAME (TRADE NAME)	USE OF PARTICULAR ADDITIVE	INTERACTION WITH FORMATION
	Special Applications	
Sodium hydroxide (caustic soda)	pH control	
Sodium carbonate (soda ash)	Remove calcium from drilling fluid, e.g., drilling thorough cement, pH control.	
Potassium chloride	Inhibit swelling of clays	Inhibit swelling of clays
Zinc oxide (SULF-X)	Hydrogen sulfide scavenger, reduces danger of hydrogen, embrittlement of tubulars	
Barium sulfate (barite, MI BAR)	Weighting material	Inert, insoluble
Phosphorous ester salt (CONQOR 404)	Corrosion inhibitor	
Copolymer of sodium acrylate and acrylamide (ALCOMER 120)	Shale stabilizer, lubricate bit, reduce friction	

SECTION 7.0 (ADDENDUM VII)

DISCUSSION AND LISTING OF SPILL RESPONSE MATERIALS

This section provides information on the spill response materials which are to be kept on hand for a response to a spill or an accident involving sensitive materials. Response to an oil spill is discussed and detailed in Section 10 and Appendix D of the Revised Operations Plan.

It is impossible and impractical to provide an exact listing, with quantities, of spill response materials for the proposed project. What is provided, however, is the best professional estimate by project personnel and their consultants of what material should be stored in case of a spill or accident. Ch2M Hill provided the generic needs for spill response based on their extensive experience. An operating spill response contractor provided a generic detailed listing of the major materials needed for a response. The Geoscience Research Drilling Office at Sandia reviewed each list and overlaid the needs of the project onto these lists.

Table 7-1 contains an annotation and a detailed description of the major materials needed for a spill response. Table 7-2 contains a more detailed listing of these materials. This list will be revised on a continuing basis.

Most of the material listed on Table 7-2 would be kept in readiness, in palletized form, at King Salmon site support base. In this form, the material is available for helicopter transport to an accident site, should an accident occur. Much of the material stored at King Salmon would be for a response to a downed helicopter over water. The bodies of water are closer to King Salmon than the drill sites. On the other hand, many of the emergency fuel storage tanks would be stored mainly at the drill sites as most of the fuel storage is at the dome drill site.

There are daily commercial and air freight flights between Anchorage and King Salmon. In addition, many spill response contractors have additional storage depots at locations closer to the site than Anchorage. Thus, timely resupply or supplementing the material listed in Table 7-2, will, in all probability, be rather simple.

Some material, such as skimmers, funnels, and pumps would be available at both drill sites as well as the support base. Certain expendable materials such as absorbent pads and rolls, in addition to being stored for emergency response, would be used on a day-by-day basis at both drill sites. Such materials would have to be restocked by the project on a frequent basis.

Most of the materials listed in Table 7-2, with the exception of booms, pads, and response over water items, are common to drill site operations. Materials listed in Table 7-2 common to a drilling operation include funnels, rope of various sizes, jerry cans, extension cords, air and pump hoses for almost any application, slings, pulleys, various pumps, jacks, hand tools as picks, shovels and rakes, fire extinguisher, flashlights, tool boxes, electric heaters, water coolers, slick suits, hard hats, first aid kits, eyewash station, respirators, and empty drums. (Quantities of some certain larger

items available from the drill site such as empty drums and fire extinguishers, eyewash stations, and first aid kits are already reflected in Table 7-2.) Thus, many additional common spill response items would be available, in quantity, from the normal complement of materials of the proposed a drilling operation. Furthermore, additional emergency services could be procured through an established local contractor maintaining a site support base for the project.

Table 7-1

Discussion and Annotation of Major Equipment Needs

Storage Capacity - To offload a leaking storage bladder with ability to hold largest tank volume in storage - tanks, bladders, drums.

Some Earthmoving Equipment - To create additional berms or trenches to contain spills if necessary. However, the fuel storage containers will be in a containment area with secondary berms and be capable of containing contents of the largest tanks. The need and availability of such a utility vehicle (a grade-all or wide track, low pressure D3 or D4 caterpillar tractor) has been discussed in the Revised Operations Plan.

Liner Material - This would be used inside bermed areas or trenches to create an impermeable liner for the storage of the fuel prior to removal of the fuel. Polyethelene and geotextile materials have been called out in the Revised Operations Plan. Other liners could be used on occasion.

Skimmer, Pump, and Hoses - The same skimmer that would be available to remove a floating fuel product from water could be used within a trench or bermed-in area to remove pure product. A small portable skimmer would be connected to a diaphragm pump and would pump product into a storage container. A typical mobile skimmer can pump from around 5 to over 60 gallons per minute (GPM). A skimmer would be available at each drill site and one would be available at the site support base for other responses.

Storage Container (to collect fuel) - The storage container to be used to collect the fuel pumped off of water needs to have a bleeder valve near the bottom to drain out water collected with the oil. Depending on the disposal options available for the water, the water may need to go through a separation phase prior to discharge. Typical storage containers include 55-gallon drums and 200 to 500 gallon tanks, and 2400 gallon fast tanks for use on site or wherever needed.

Sorbents - Typical sorbents include pads of 18 in. square and 36 in. square (usually 100 per package), mats that roll out to form sorbent sheets, booms in 10 ft lengths with connectors on either end for lengthening, and pillows. Sorbent pads are most useful for small leaks, drips, and for use within a confined area such as a sump. The sorbent rolls can be used within a diked area to form an inner berm, or to corral larger quantities of oil for removal with a skimmer. Sorbents are more successful with lighter fuels. Flammability of sorbents after absorbing fuel products, such as jet fuel and gasoline, will be considered before actual use. Some types of sorbents are static-resistant. Sorbents can also sometimes be wrung out and reused. A mobile wringer, much like a clothes wringer, set over a 55-gallon drum can be used to wring out sorbents for re-use. Absorbent pads and rolls would be used on a daily basis at the drill sites. Other pads and rolls would be kept in reserve at the site support base for other responses.

Table 7-1

Discussion and Annotation of Major Equipment Needs (Concluded)

Storage Containers (for used sorbents) - To contain used sorbents for disposal; often 55-gallon drums.

Harbor Booms - For collecting oil in calm waters and containing oil for skimming, and for exclusion booming in calm waters to protect sensitive resources. Typical harbor booms are 12 in. to 24 in. above the water surface and have curtains below the water surface (draft) of 18 in. to over 36 in. The harbor booms come in a variety of shapes and sizes.

Ropes and Anchors - To be available for securing ends of the harbor boom if it is used in a stream or river.

Hand Tools - Rakes, shovels, buckets. Used for gathering both oil-contaminated soil and debris, and also for directing and gathering sorbent on water.

Fire Suppressant Material - For spills from aircraft; the primary concern will be fire danger, and response to an aircraft spill will include fire foam or whatever suppressant material is used by fire-fighting personnel. Fire suppressant material will be available at the drilling locations and at the support base at King Salmon. The recommended type of foam suppressant for potential spills of jet fuel, gasoline, and diesel will be included. In most cases, an oil spill from a downed aircraft in water is difficult to respond to; the priorities are danger to human life and again the fire threat. Jet fuel from an aircraft evaporates so rapidly that a response to contain and clean up jet fuel is usually not successful.

Waste Containers - In anticipation of using sorbents to clean up small spills and routine leaks and drips from operating equipment, waste containers need to be available for collecting and storing oily debris and sorbents prior to disposal. Oily debris and sorbents for disposal that cannot be burned in the on site incinerator will be taken to an approved disposal site.

Table 7-2

List of Response Equipment for Spill Cleanup

Quantity	Units	Item	Comments
12	75 ft	Collapsible containment booms	
6	50 ft	Collapsible containment booms	
4	50 ft	Mini collapsible containment booms	
	1400 ft	Total containment boom	
1	16 ft	Inflatable Zodiac	Other boats would be available in emergencies--probably through the King Salmon (KS) site support base contractor.
1	15 hp	Outboard motor	
4		Floats	
2		Oars	
1		Anchor	
1	10-gal	Gas tank outboard	
1		Air foot pump	
1		Pulley for boom or rope mop	
12		Life jackets	
3		Ringers	
6	#3	Wash tubs	
3		Funnels	
3	Medium	Funnels	
5+	2400 gal	Fast tanks	Sufficient tanks to off-load largest fuel container
50	55-gal	Empty drums	25 at dome site, 25 at the KS support base

Table 7-2

List of Response Equipment for Spill Cleanup (Continued)

Quantity	Units	Item	Comments
5	100-500 gal	Portable tanks	Drill sites, KS support base
1	100 ft	Rope, 3/4 in. dia.	
1	150 ft	Rope, 1/2 in. dia.	
2	5-gal	Jerry cans	
1	150 ft	Extension cord	
2	100 ft	Extension cords	
2	Box	Air hoses, assorted	
2	3 ft	Slings	
4	6 ft	Slings	
8	Bundles	10-ft sectioned sorbent boom (8 in. to 40 ft to bundle)	
8	Bundles	10-ft sectioned sorbent boom (4 in. to 40 ft to bundle)	
15	Bundles	18 in. by 18 in. absorbent pads (3/16 in.)	Drill sites, KS support base
12	Bundles	36 in. by 150 in. absorbent rolls (3/8 in.)	Drill sites, KS support base
12		Other pads, rolls and booms of various sizes	
8		Beach anchors	
1		Come-along	
3		Skim-pacs	Drill sites, KS support base
6	20 ft	Suction hoses for pump and connections	
6	50 ft	Discharge hoses for pump/ connections	

Table 7-2

List of Response Equipment for Spill Cleanup (Continued)

Quantity	Units	Item	Comments
1		Trash pump	
1		Generator	
1	Bucket	Miscellaneous fittings	
1	5 hp	Compressor	
2	Small	Electric winches	
1		Vac-U-Max pump	
6	2 in.	Hose floats (clamp type)	
1		Circular saw, portable	
1		Disc grinder	
2		Wood ripper blades	
1	1/2 hp	Electric pump	
1		Handyman jack	
6		Shovels, square point	
6		Shovels, round point	
6		Brass picks	
6		Beach shovels	
7		Rakes	
6		Pitch forks	
40		ABC fire extinguishers	Drill sites, camp, KS support base
8	Large	Flashlights	
2		Tool boxes (with assorted hose clamps)	
3		Electric heaters	

Table 7-2

List of Response Equipment for Spill Cleanup (Concluded)

Quantity	Units	Item	Comments
2	8-gal	Water coolers	
2	10-gal	Water coolers	
2		Water jugs	
12	pair	Rubber boots	
12	pair	Rubber gloves	
12		Hard hats	
12		Protective goggles	
12		Slicker suits	Various sizes
24	1/2 face	Respirators w/filters	
4		First aid kits	Drill sites, camp, KS support base
4		Eyewash stations	Drill sites, camp, KS support base

SECTION 8.0 (ADDENDUM VIII)

THE MONITORING AND SAMPLING PROGRAM FOR THE KATMAI SCIENTIFIC DRILLING PROJECT

8.1 Introduction

This section further describes a plan for monitoring and sampling the water and solid samples in the Valley of Ten Thousand Smokes. The Revised Operations Plan for the Katmai Scientific Drilling Project presented a detailed plan for geochemical monitoring of the streams and rivers of the valley. This section supplements the discussions presented there, and further integrates the relevant material in the above document into the monitoring plan.

The material from the Revised Operations Plan and other addenda relevant to the monitoring plan is to be found in:

Section 5.3--Geochemistry and Hydrology

Section 5.3.1--Element Analysis of Typical Rock Samples From the 1912 Eruption

Section 5.3.2--Hydrology

Section 8.5.2--Monitoring of the Streams and Springs in the Valley

Appendix C--Considerations of Water Quality and RCRA data for the Water and Rock Samples From the Valley of Ten Thousand Smokes

C1--Possible Influence of Drilling on the Salt Content of Water From the Valley of Ten Thousand Smokes, Katmai National Park

C2--TCLP Analysis of Volcanic Samples from the Valley of Ten Thousand Smokes

C3--Analysis of the Water Samples from the Valley of Ten Thousand Smokes (Under EPA Clean Water Act Protocol)

Addendum VI--Drilling Fluids Program

The format of this section largely follows the suggested outline of Christina Neal of the United States Geological Survey, Anchorage Alaska. This outline is contained in a facsimile transmission from C. Neal to A. R. Sattler et al., June 27, 1992. However, considerable additional information has been overlaid onto the original outline. The original outline was derived as a result of discussions with the National Park Service and Dames and Moore. New information is provided on the sampling sites, techniques, and specifics for the actual geochemical monitoring, information on the quality of the existing baseline data, and recommendations for future sampling.

Key elements of the Revised Operations Plan are repeated in this section to accomplish a better integration of that data with the new information.

This section, however, does not repeat all data listed in the above sections of the Revised Operations Plan.

8.2 Water Sampling Sites for the Katmai Scientific Drilling Project

The proposed monitoring sites are shown in Figure 8-1. These sites have been prioritized and are discussed in terms of the possible hydrological paths. (Repeated from the Revised Operations Plan and listed in Table 8-1.) These hydrological paths have been postulated by Terry Keith of the USGS, Anchorage, Alaska. They are based on more than ten years of study by Keith and other project scientists of the waters and geology of the Valley of Ten Thousand Smokes. An account of much of this work is to be found in Keith et al., 1992[1] and in Fierstein and Hildreth, 1992.[2] Other supporting references are to be found in Section 5.3 of the Revised Operations Plan. Keith's water sampling data throughout the valley provide a decade or more of baseline geochemical data on the streams and rivers of the valley and this is included in Sections 5.3 and 5.4 of the Revised Operations Plan.

The detailed discussion of the sampling sites selected for geochemical monitoring is found in Table 8-2. The numbers on the sites in Table 2 correspond with those locations shown in Figure 8-1.

8.3 Procedures and Sampling Intervals

8.3.1 Water Samples From Streams, Rivers, and Springs

Water sampling of streams, rivers, and springs in the valley is to be accomplished in order to ensure that material from drilling, particularly drilling fluids and solids, does not enter the streams, rivers and springs. A list of what is to be sampled is repeated from the Revised Operations Plan and is shown in Table 8-3.

Sample collection for geochemical water analysis will be done by foot, walking down the valley from the drill sites, or by helicopter. Sample collection will be possible only during the months of the warm season. As mentioned, there are more than ten years of data from the streams, rivers, and springs from the valley. More recent sample collection has included samples from the sources of drilling water, Mageik Lake, the River Lethe, and snow melt from the dome. This data is included in the Revised Operations Plan, Appendix C3. During drilling operations geochemical water analysis would also include fresh and returned drilling fluids (Table 8-3).

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[1]Keith, T. E. C., Thompson, J. M., Hutchinson, R. A. and White, L. D., 1992. "Geochemistry of Waters in the Valley of Ten Thousand Smokes Region, Alaska," *Journal of Volcanology Geothermal Research*, 49:209-231.

[2]Fierstein, J., and Hildreth, W., 1992. "The Plinian Eruptions of 1912 at Novarupta, Katmai National Park, Alaska," Bulletin Volcanology, Vol. 54 (in press).

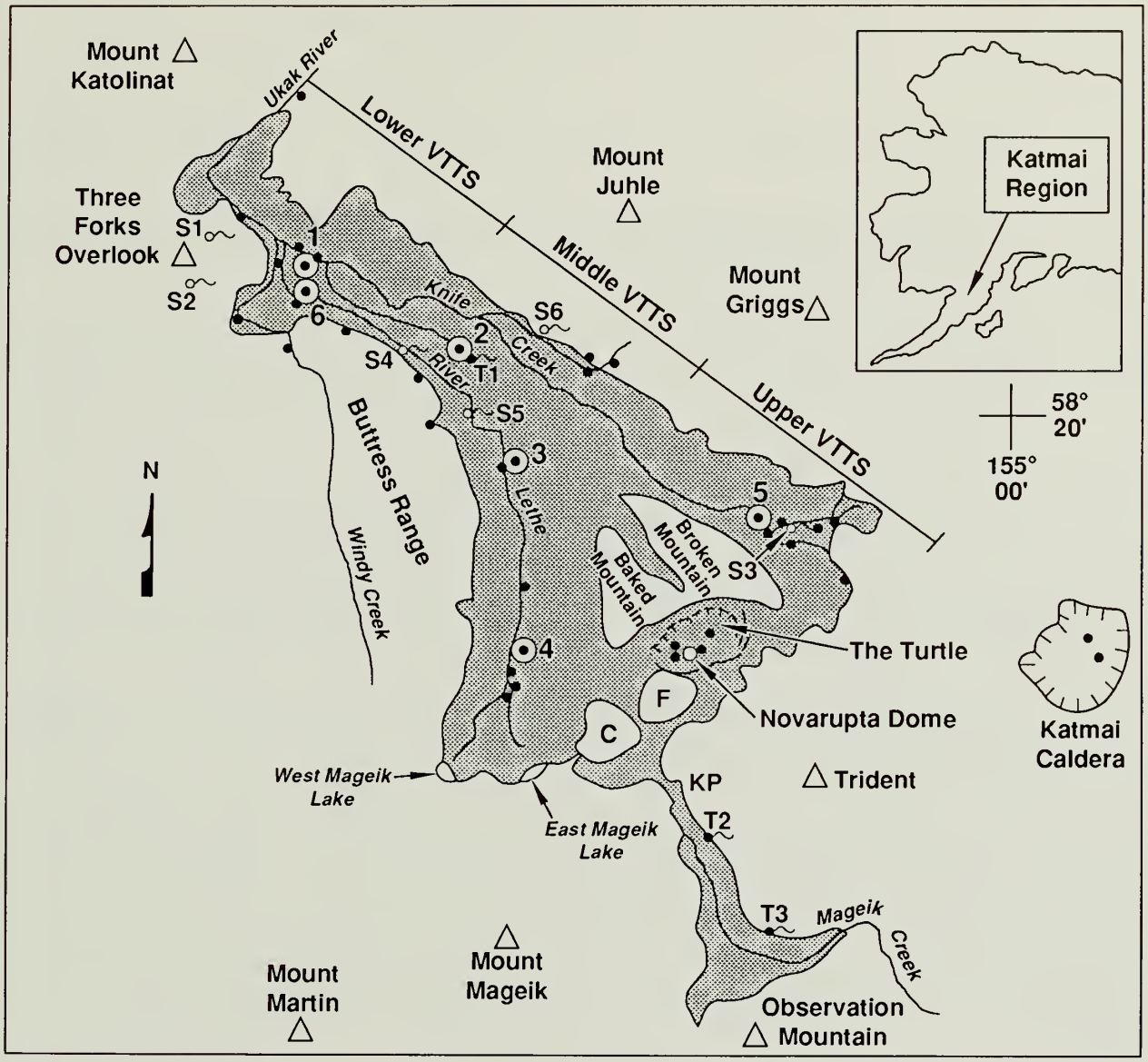


Figure 8-1. Proposed Monitoring Locations (Prioritization Shown Alongside Site)

Table 8-1

Possible Hydrological Drainage Paths at the Proposed Drill Sites

- Possible Drainage Paths--Possible drainage paths of fluids from the dome drill site at Novarupta Dome are the following:

  - The water drains from or near the top of the Naknek siltstone into numerous fresh water springs in lower Knife Creek at the contact with overlying ash-flow tuff.

  - The water drains into either the upper Knife Creek or River Lethe systems from within the airfall/ash-flow deposits from 1912 and perhaps along the contact of these deposits and the Naknek siltstone. Seeps in the ash-flow sheet are observed along Knife Creek and may exist along the River Lethe.

  - At certain depths in the vent, the water at the vent drill site percolates into the hydrothermal system rather than the fresh water systems because the Naknek siltstone was breached by the eruption.

- Possible Drainage Paths for the Area Encompassing the Ash-Flow Drill Site--Drainage paths near the River Lethe are the following:

  - The water drains directly into the river through fractures in welded layers of the ash-flow and at the contact between these deposits from 1912 and the Naknek siltstone.

  - The water drains into the midvalley fresh water springs through the ash-flow deposits from 1912, and along the contacts of these deposits with the Naknek siltstone.

Table 8-2

Proposed Streams and Rivers Sampling Sites
in the Valley of Ten Thousand Smokes (Prioritized)

Priority 1 Sites:

1. Knife Creek at Three Forks--*This is probably the most important monitoring site for waters draining the Valley of Ten Thousand Smokes (VTTS).* This site near the distal end of the ash-flow sheet has been sampled several times since 1979 and has a good geochemical database for many constituents. Most importantly, Knife Creek is on Naknek formation bedrock at this location and any contaminants that might potentially leak through the ash-flow sheet (vertically and horizontally) onto the Naknek bedrock would be focused toward this location.

2. Midvalley thermal springs (rope may be needed)--Although relatively shallow in the ash-flow sheet, these are the only known accessible thermal springs in the VTTS. The middle VTTS location of the springs, as well as their constant chemical composition over the several years they have been sampled, makes this location a high priority site for sampling for possible drilling contaminants. The naturally produced higher ion content of these waters, however, will make monitoring for certain ions more difficult.

Priority 1 Only During Drilling at Ash-Flow Site, Otherwise Priority 2:

3. River Lethe at ford--Monitoring at this site could be significant for shallow contamination, especially while drilling at the ash-flow site several miles upstream from the ford. Any waters, and drilling contaminants, from the dome site would not likely emerge at this site. Several geochemical data sets exist for water at this site. The water here flows only during summer and is interpreted to be shallow runoff. It would be possible to detect shallow drilling contaminants at this site but any contaminants from deeper drilling in the ash-flow site would probably not emerge here, but would percolate down valley through the ash-flow sheet at deeper levels until emerging at the base of the sheet.

Priority 2 Sites:

4. Upper River Lethe above drill site--This site was suggested for the possibility of detecting contaminants from drilling at the dome site. Subsurface waters from the vent region are likely to drain in a westerly to northwesterly direction toward the River Lethe at unknown depths in the subsurface. Previously analyzed samples of upper River Lethe waters show chemically very dilute water, thus indicating flow of any hydrothermal water from the vent region within the ash-flow sheet is deeper than the River Lethe channel. Monitoring this site might be useful for shallow drilling.

Table 8-2

Proposed Streams and Rivers Sampling Sites
in the Valley of Ten Thousand Smokes (Prioritized) (Concluded)

Priority 2 Sites: (Concluded)

5. Upper Knife Creek seep--This site is at the contact of 1912 fallout over the sintered top of the ash-flow sheet. Sandia has sampled this site but there is only a limited chemical data base. The water at this site is interpreted to flow on or near the surface from Glaciers 1 and 2, percolating into the air fall/ash-flow tuff, and water emerging at the head of Knife Creek. Monitoring at this sight might indicate any shallow water percolating from the vent region and, thus, any possible drilling contaminants from shallow levels. However, it is highly unlikely that any of the shallow water in the vent region would emerge at a shallow level at this location. Any shallow water in the vent region most likely goes into deeper fractures in the vent region and emerges deep within the Knife Creek (and/or River Lethe) system.

6. Lower River Lethe upstream from Three Forks (need rope--sample collection is dangerous procedure)--This site has also been sampled several times since 1979 and has a good geochemical data base. Although the site is not on bedrock, it must be very close because glacial morraine is exposed beneath the ash-flow sheet just *upstream* from the site. Therefore, this site may pick up any contaminants that might flow through the southwest edge of the ash-flow sheet. Possible contaminants from deeper parts of drilling at both the dome and ash-flow sites are more likely to percolate in the subsurface along a path leading to the Knife Creek monitoring site (1) above. Because of this, this site will be deleted from consideration.

Table 8-3

List of Sample Analyses

From Drilling Operations
Fresh drilling fluid
Returned drilling fluid
Cuttings and drilling sludge
From Streams, Rivers, and Springs
Waters of the Knife Creek and the River Lethe
Various springs and seeps in the Valley of Ten Thousand Smokes

Streams and rivers of Priority 1 and 2 sites will be monitored every two weeks for the first month of drilling and monthly thereafter during the first drilling season. If no trace of drilling is found during the first year, the streams and rivers will be monitored every eight weeks during the second warm season. Sufficient funds will be reserved for a two- to three-year monitoring programs following the operation. If no evidence of drilling fluids has been seen, such monitoring will be limited to priority 1 sites. Samples will be taken once during post operation years. Analysis will probably be conducted in Anchorage or Fairbanks, with more cursory analysis to be considered on site.

If there are severe lost circulation problems at shallow depths, nearby terrain will be examined to make certain that surface emergence of drilling fluids (a spring) has not occurred. If such a spring is created, drilling techniques will be altered.

Measurements will be performed before drilling commences and upon activation of the camp to further establish a baseline in the streams springs and water source. In addition, careful water measurements have been performed at over 30 stations in the valley (Section 5.3, Appendix C3) (Keith et al., 1992).

If drilling fluids are found in the streams, rivers or springs of the valley by monitoring or by other means, the drilling will be stopped. The problem will be corrected before drilling continues.

Monitoring for drilling fluid additives will consist of a visual inspection of water samples, routine water analysis (the major geochemical ions, pH, conductivity, total suspended solids content), testing for common substances, such as SIO_2 and Fe, and testing for other appropriate substances. Backgrounds are being established for clean water act substances. Water samples will be tested for these substances as appropriate. Certain tests will be keyed or emphasized, sort of a preliminary monitoring diagnostic, to see if the drilling fluid additives will be detected at all; the tests will

key on certain substances, which are detected easily in the laboratory, are abundant in the drilling fluid but are not abundant in the streams and rivers.

Caustic soda or soda ash will be used as a drilling fluid additive for pH control at lower temperatures. These substances are abundant in sodium, whereas the streams and rivers contain up to two orders of magnitude less sodium. A substance containing soybean oil will be used for lubrication at intermediate to high temperatures, which is not present in the streams and rivers. The proposed lubricant contains phosphate ions which should occur naturally in very small amounts if at all. Locating these easily detectable substances, to a few parts per million, as well careful measurement of the pH will give an indication whether drilling fluid additives are present at all. The pH of the drilling fluids may be in the 9 to 11 range. The pH in the streams and rivers in the valley is around 5 to 7. Further tests can be run to verify the preliminary tests. Other substances in the drilling fluids can be keyed for special diagnostic tests. Approximate concentration of these substances are shown in Table 8-4.

Table 8-4

Approximate Concentrations of Substances in Drilling Fluid That Can be Used as Preliminary (Key) Indicators in Monitoring

Substance or Test	Abundance in Drilling Fluid ppm	Abundance Naturally ppm	Temperature Range
Na*	~1,500	$\leq$ 30	low temperature, intermediate temperature
pH	9-11	~5.5	low temperature, intermediate temperature, high temperature
Soybean oil	~2,000	---	high temperature
Phosphorous ester salt	~800	**	high temperature

*Free sodium goes into solution when many polymers listed here are used. This sodium may be a valid indicator at all temperatures.

**Baseline being established--thought to be very low. Initial analyses of Knife Creek and other samples show no phosphate ions within 0.05 ppm detection limits.

8.3.2 Solid Samples and Samples of Returned Drilling Fluids

Originally there was some concern that there could be Resource Conservation and Recovery Act (RCRA)-regulated chemical elements in the returned drilling solids (cuttings and core). This is because there are concentrations of a number of RCRA elements in volcanic rock and in particular in the samples of the rocks from the Valley of Ten Thousand Smokes (Section 5.3.1 of the Revised Operations Plan.) However EPA-approved Toxicity Characteristic Leaching Procedure (TCLP) analysis of many of the samples of volcanic rock from the valley (including fumaroles where concentrations of many of these RCRA-sensitive elements are concentrated) showed no traces of these elements in the leachate. (The exception to this is that small amounts of barium were found in a couple of leachate samples, but the amounts were about two orders of magnitude below the regulatory limits.) *Thus, RCRA Subtitle C hazardous waste concerns will probably not be an issue for Katmai core, cuttings, or other samples brought up from drilling and coring.*

In order to have knowledge of the contents of the cuttings, however, measurement of the total concentrations of RCRA elements and other appropriate substances every 500 ft in all wells drilled is proposed. Actual TCLP tests would be run only if the total concentrations showed a theoretical possibility that concentrations of these elements in the leachate might exceed statutory amounts. *However, there is a statutory exclusion for drilling solids, scientific (core) samples and liquids, including drilling fluids and produced waters, under the RCRA subtitle C program.)* These wastes are appropriately regulated under subtitle D.

Fresh and returned drilling fluids will also be monitored. A detailed chemical analysis will be available for each drilling fluid additive before it is used.

Returned drilling fluids will be analyzed every 500 ft the same way the fresh water samples from streams and rivers are analyzed. Because of the possibility of hydrothermal waters entering the drilling fluid stream, these samples will be analyzed for Clean Water Act elements also, as appropriate. Analyses will also be conducted on key constituents of the drilling fluids such as those mentioned above. Fresh drilling fluids will be analyzed when major changes are made in the drilling fluid additives.

8.4 Comments on Data Quality and on Analytical Laboratories

The USGS Water Laboratory at Menlo Park, California, performed the majority of the work on the baseline data. The USGS Water Laboratories are recognized in the industry for quality and they have their own Quality Control (QC) Procedures which can be made available for inspection.

Later measurements (1991-1992) were conducted on both solid and liquid samples in the valley and were performed under EPA protocol by Enseco/Rocky Mountain Analytical Laboratory (RMAL) in Arvada, Colorado. These data are then reviewed by International Technology (IT) Corporation, in Albuquerque, New Mexico, under contract to Sandia National Laboratories. IT then issued overall reports on the recent analyses of liquid and solid samples from the valley. These IT reports were issued under Project No. 301181.13.01 on July 30, 1991; September 16, 1991; October 3, 1991; and February 13, 1992. Dates

of sample preparation and analyses, analytical method references, and respective geochemical reporting limits are provided in these analytical reports. Included in these reports are results of concurrently analyzed laboratory QC data. All RMAL data, especially the QC data, are reviewed by IT. The original reports are available on request. All the IT/RMAL and USGS data reports are summarized in the Revised Operations Plan, Section 5.3.2 (USGS data) and Appendixes C2, and C3 (IT/RMAL data). Other IT/RMAL reports on samples from the valley are pending.

It is premature to say which laboratories will provide analytical support for the project. The drilling fluids company will certainly provide significant analytical support. (All major drilling fluids companies have capable analytical laboratories.) An established laboratory in the private sector (recommended by the NPS), and an established laboratory in the Federal sector have been consulted.

8.5 Recommendations for Sampling in 1993 and Later

Additional analyses of the hydrothermal water sources on the south side of the Katmai pass and the upwelling in the Katmai Caldera are needed. The analyses are needed to learn what sensitive elements noted in the Clean Water Act might be brought to the surface from the hydrothermal waters encountered by drilling. It would also be advisable to obtain additional baseline data from the proposed monitoring locations as well as from the proposed sources of drilling water. This sampling and analysis should be accomplished before drilling.

8.6 Consultations With Permitting Agencies Other Than the NPS

The NPS, as land manager, has the ultimate authority over the project. It follows that the primary review of the proposed monitoring program would be from experts within the NPS. Other permitting agencies are also being consulted on the monitoring and sampling program as the NEPA process proceeds. These include the U.S. EPA Region 10 Seattle, Washington (Water Permits and Compliance, Compliance, RCRA, NEPA) and Anchorage, Alaska (Water Quality, RCRA) and the Alaska Department of Environmental Conservation (ADEC), Division of Environmental Quality. Formal permitting related to the monitoring program at this time (in addition to the NPS) is required by the State of Alaska for liquid and solid drilling wastes. All agencies above desire to be kept informed about the project, with formal permits being filed where necessary.

9.0 REFERENCES

Fierstein, J. and W. Hildreth, 1992. "The Plinian Eruptions of 1912 at Novarupta, Katmai National Park, Alaska, *Bulletin of Volcanology*, vol. 54 (in press).

Helicopter Association International, 1992. *Fly Neighborly Guide*, Fly Neighborly Committee.

Jones, F. V. et al., 1986. "Drilling Fluids Firms Respond to EPA Toxicity Concerns," *Oil and Gas Journal*.

Keith, T.E.C. et al., 1992. "Geochemistry of Waters in the Valley of Ten Thousand Smokes Region, Alaska," *Journal of Volcanology Geothermal Research*, 49:209-231.

Leuterman, A. J. et al., 1989. "New Drilling Fluid Additive Toxicity Data Developed," *Offshore*, 31-37.

Lysne, P., 1992. "Downhole Memory Logging Tools," *Geothermal Review*, X, U.S. Department of Energy, Conservation and Renewable Energy/Geothermal Division, San Francisco.

Paillet, F. L. and R. H. Morin, 1998. "Analysis of Geophysical Well Logs Obtained in the State 2-14 Borehole, Salton Sea Geothermal Area, California," *Journal of Geophysical Research*, 93:12, 981-984.

Paillet, F. L., 1986. "Preliminary Report on Geophysical Well Logging Activity on the Salton Sea Scientific Drilling Project, Imperial Valley, California," U.S. Geological Survey, Open File Report, 86-544.

Sattler, A. R. and D. A. Blankenship, 1992. "Revised Operations Plan for the Katmai Scientific Drilling Project," SAND92-0850, Sandia National Laboratories, Albuquerque, NM.

U. S. Environmental Protection Agency, 1985. *Federal Register*, vol. 50, no. 165, U. S. Government Printing Office, Washington, D.C.

APPENDIX A

MATERIAL SAFETY DATA SHEETS FOR KATMAI DRILLING FLUID ADDITIVES

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company
P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	M-I GEL

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Bentonite	CHEMICAL FORMULA	Natural clay
MANUFACTURER	M-I Drilling Fluids Company	CAS NUMBER	1302-78-9
PACKAGE QUANTITY	45.4 kg (100 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Viscosifier
FREIGHT DESCRIPTION	Drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Silica, crystalline quartz, respirable dust [14808-60-7]	2-15	0.1 mg/m3 (1)	0.1 mg/m3 (2)	NIOSH TWA: 0.1 mg/m3 (3)
Silica, crystalline cristobalite, respirable dust [14464-46-1]	2-12	0.05 mg/m3 (1)	0.05 mg/m3 (2)	NIOSH TWA: 0.05 mg/m3 (3)
Silica, crystalline tridymite, respirable dust [15468-32-3]	< 1.5	0.05 mg/m3 (1)	0.05 mg/m3 (2)	NIOSH TWA: 0.05 mg/m3 (3)
Gypsum, respirable dust [13397-24-5]	1	5 mg/m3 (1)	10 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	N.D.	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	N.D.	SOLUBILITY IN WATER @ 20°C	Insoluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	769-833 kg/m3 (48-52 lb/ft3)	ODOR & COLOR	Odorless, gray to tan color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)	N.D.										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.A.	U.E.L.	N.A.	AUTO IGNITION TEMPERATURE	N.A.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Essentially none. This material is not combustible.
EXTINGUISHING MEDIA	This material is compatible with all media that may be needed to extinguish nearby burning materials.
SPECIAL FIRE FIGHTING PROCEDURES	High-efficiency particulate respirator or self-contained breathing apparatus must be worn if this material is raised as a dust into the air.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None determined.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Lungs, liver				CARCINOGENICITY				
						NTP	No	IARC	Yes	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Inhalation may result in distress in breathing, coughing, and irritation of the upper respiratory system.(4) Skin and eye contact may cause mechanical irritation.
CHRONIC EFFECTS OF EXPOSURE	Crystalline silica is known to cause fibrosis, silicosis, and liver effects.(4) Limited evidence shows that the inhalation of crystalline silica does cause cancer in humans.(5)
TOXICITY DATA	International Agency for Research on Cancer (IARC) Probable Carcinogen: overall evaluation is 2A; limited human data, sufficient animal data.(5) Oral: Mouse TDLo: 12000 g/kg/28 Wks-C; Tumorigen. Intravenous: Ra

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID		
	EYES	Flush with water for at least 15 minutes and seek medical attention if irritation persists.
	SKIN	Wash thoroughly with soap and water. Launder clothes before reuse.
	INGESTION	Drink water. If large amounts have been ingested or if illness develops, seek medical attention immediately.
	INHALATION	Remove to fresh air. Seek medical attention if breathing becomes difficult.
OTHER INSTRUCTIONS		Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. Persons seeking medical attention should carry a copy of this msds to the physician.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Wear a high-efficiency particulate respirator approved by NIOSH/MSHA.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Cover all exposed skin with clothing and gloves.
EYES	Wear chemical safety goggles.
OTHER PROTECTIVE EQUIPMENT	Wear self-contained breathing apparatus if the proper respirator is not available when concentrations are above the PEL.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! This material contains crystalline silica that is a carcinogen. See the msds for proper protective equipment.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in a dry area and keep dust to a minimum. Wear the proper respirator when this dust is airborne.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear protective equipment stated in Section VIII of this msds. Contain spill and minimize dust. Re-sack or place in a suitable container.
WASTE DISPOSAL METHOD	Consult your local authorities for the proper procedures for disposing of bentonite, a naturally-occurring clay.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC X	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

FDA: Safe designation 21 CFR 582.1155

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	(See n.o.s. description)	HAZARD CLASS	Not regulated
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (bentonite clay)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.D.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.D.
	CARGO AIRCRAFT	N.D.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Drilling fluid additive, n.o.s. (bentonite clay)			UN NO.	N.A.
HAZARD CLASS	Not regulated	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.D.	PACKAGING (SEE SECTION) N.D.		
	CARGO AIRCRAFT	N.D.	PACKAGING (SEE SECTION) N.D.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Drilling fluid additive, n.o.s. (bentonite clay)			UN NO.	N.A.
HAZARD CLASS	Not regulated	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Oil well drilling fluid additive				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

(3) NIOSH Pocket Guide to Chemical Hazards; National Institute for Occupational Safety and Health: Cincinnati, 1990.

(4) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

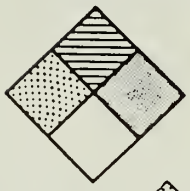
(5) Silica and Some Silicates; IARC Monographs on the Evaluation of the Carcinogenic Risk of to Humans; World Health Organization, 1987; Vol. 42.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H. Perkins
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 27 June 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfuno 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

MI-630

2871M Litho in U S A

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	POLYPAC

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Cellulose	CHEMICAL FORMULA	Variable
MANUFACTURER	M-I Drilling Fluids/Comm. Prod.	CAS NUMBER	9004-57-3
PACKAGE QUANTITY	22.7 kg (50 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Fluid loss reducer
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Cellulose, respirable dust [9004-32-4]	100	5 mg/m3 (1)	10 mg/m3 (2)	See Section XI.

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	329 F
pH (1% Soln.)	6.5-8.0	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	1.5-1.6	SOLUBILITY IN WATER @ 20°C	Freely soluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	548 kg/m3 (34.2 lb/ft3)	ODOR & COLOR	Odorless, white color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	Biodegradable. When heated to decomposition, product emits toxic Na2O fumes.
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)	None										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Combustion may produce carbon monoxide and/or carbon dioxide. When heated to decomposition, toxic fumes of Na2O are emitted.
EXTINGUISHING MEDIA	Alcohol or all purpose type foam. Use CO2 or dry chemical for small fires.
SPECIAL FIRE FIGHTING PROCEDURES	Do not direct a solid stream of water of foam into burning molten material. Use self-contained breathing apparatus and protective clothing.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Avoid dispersion of dust in the air to reduce potential for dust ignition/explosions. Dust is easily ignited.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Eye, skin, upper respiratory system			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Dusts may be irritating to the eyes. Skin contact may cause mechanical irritation. Inhalation of dusts may create distress in breathing and coughing.
CHRONIC EFFECTS OF EXPOSURE	No chronic effects have been reported
TOXICITY DATA	Mildly toxic by ingestion. An experimental neoplastigen. Experimental reproductive effects. Oral: Rat LD50: 27000 mg/kg; Guinea pig LD50: 16000 mg/kg (3)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes. Seek medical attention if irritation persists.
SKIN	Wash thoroughly with soap and water. Launder clothes before reuse.
INGESTION	No emergency care is anticipated.
INHALATION	Remove to fresh air. Seek medical attention immediately if breathing becomes difficult.
OTHER INSTRUCTIONS	Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA respirator designed for protection against pneumoconiosis-producing dusts.
VENTILATION	Special, local ventilation is recommended in areas where containers are opened and discharged, to minimize dusting.
SKIN	Wear cotton or rubber gloves.
EYES	Wear chemical safety goggles.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing. Provide an eye bath and safety shower for emergencies.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! Irritant. May cause irritation to eyes, skin and upper respiratory system.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Keep dust to a minimum. Keep away from open flame.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Sweep up dry powder spills. Product will absorb moisture and become slippery. Cover liquid solutions with absorbent, sweep up, collect and dispose of according to local, state and federal regulations.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to state or local regulations dealing with nonhazardous chemical waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

FDA: Feed additive 21 CFR 573.420; Food contact surface component 21 CFR 175.300(b)(3); Safe designation 21CFR 182.90; Synthetic food additive 21 CFR 172.868. Sodium carboxymethyl cellulose is a CAA 911 Potential Human Health Hazard.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	(See n.o.s. description)	HAZARD CLASS	Not regulated
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (sodium carboxymethyl cellulose)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.D.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.D.
	CARGO AIRCRAFT	N.D.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Drilling fluid additive, n.o.s. (Sodium carboxymethyl cellulose)			UN NO.	N.A.
HAZARD CLASS	Not regulated	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.D.		PACKAGING (SEE SECTION)	N.D.
	CARGO AIRCRAFT	N.D.		PACKAGING (SEE SECTION)	N.D.

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Drilling fluid additive, n.o.s. (Sodium carboxymethyl cellulose)			UN NO.	N.A.
HAZARD CLASS	Not regulated	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Oil well drilling fluid additive, (sodium carboxymethyl cellulose)				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

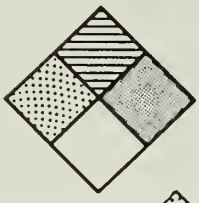
(3) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H Pushing
Manager, Environmental Services (713) 561-1507	Date Prepared: Revised: May 5, 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel the possible hazard in use of water. The violence of the reaction ith water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	POLY-PLUS DRY

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Acrylamide acrylate polymer	CHEMICAL FORMULA	Proprietary
MANUFACTURER	M-I Drilling Fluids Company	CAS NUMBER	Multiple
PACKAGE QUANTITY	2.5 kg (5.5 lbs)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Stabilizer
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Particulates not otherwise classified (PNOC), total dust	N.D.	15 mg/m3 (1)	10 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	7.9	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	N.A.	SOLUBILITY IN WATER @ 20°C	Soluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	781.7 kg/m3 (48.8 lb/ft3)	ODOR & COLOR	Musty odor, white color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	X
	OTHER (Specify)	None										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon and nitrogen.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals. Use water to cool fire-exposed containers.
SPECIAL FIRE FIGHTING PROCEDURES	Self contained breathing apparatus may be required.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Use of direct spray may suspend and disperse dusts creating combustion hazard. Use water fog.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Eye, skin, respiratory system			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	May cause mechanical irritation to eyes and skin. Inhalation may cause distress in breathing, coughing and discomfort.
CHRONIC EFFECTS OF EXPOSURE	None noted.
TOXICITY DATA	None reported.

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute.
INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS	Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA particulate respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton gloves.
EYES	Wear chemical safety goggles or glasses with sideguards. Insure proper fit for best protection.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! This product is an eye, skin and respiratory irritant. See the msds for proper protective equipment.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Keep away from heat, sparks and flame. Wear respiratory protection when handling.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment (Section VIII). Contain the spill. Recycle or rebag and sell if possible. Sweep waste into a suitable container. Keep out of sewers and waterways.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to applicable state and local regulations dealing with nonhazardous materials.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE
None					

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	See n.o.s. description	HAZARD CLASS	Not restricted
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (acrylamide/acrylate polymer)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	N.A.	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	N.A.	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	N.A.	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Oil well drilling fluid additive (acrylamide acrylate polymer)				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

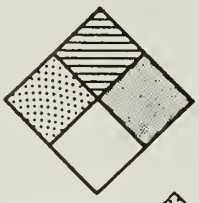
(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H Perkins
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 9 July 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company
P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	SP-101

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Sodium polyacrylate	CHEMICAL FORMULA	(C3H4O2).xNa
MANUFACTURER	M-I Drilling Fluids Commercial Products	CAS NUMBER	9003-04-7
PACKAGE QUANTITY	22.7 kg (50 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Fluid loss reducer
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Particulates not otherwise classified (PNOC), total dust	100	15 mg/m3 (1)	10 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	7.0	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	N.D.	SOLUBILITY IN WATER @ 20°C	Soluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Flakes	FLASH POINT (method used)	N.A.
BULK DENSITY	392.5 kg/m3 (24.5 lb/ft3)	ODOR & COLOR	Odorless, off-white to cream

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)	None.										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals, water. Product will burn in contact with flames, but self-extinguishes when ignition source is removed.
SPECIAL FIRE FIGHTING PROCEDURES	Self-contained breathing apparatus and protective clothing may be required when extinguishing fires involving this material.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Dust may be explosive if mixed with air in critical proportions and in the presence of a source of ignition. Do not use high-pressure water stream.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION		INGESTION	
	TARGET ORGAN	eyes, skin			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	This product is an eye irritant. Extensive or repeated exposure may mechanically irritate skin.
CHRONIC EFFECTS OF EXPOSURE	None reported.
TOXICITY DATA	Eye-Rabbit: 2 mg (moderate irritation).(3)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute.
INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS	Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Wear a particulate respirator approved by NIOSH/MSHA.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton or rubber gloves.
EYES	Wear chemical safety goggles or glasses with sideguards. Insure proper fit for best protection.
OTHER PROTECTIVE EQUIPMENT	An eye wash should be available nearby when using this product.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! This product is an eye irritant and may irritate skin. Wear proper protective equipment stated in the msds.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in cool, dry area. Keep dust to a minimum. Keep away from fire and heat.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment (Section VIII). Contain the spill. Rebag and sell or recycle if possible. Sweep waste into a suitable container. Keep out of sewers and waterways. Slippery when wet.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose of according to state and local regulations dealing with nonhazardous chemical waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

None.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	See n.o.s. description	HAZARD CLASS	Not restricted
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (sodium polyacrylate)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	N.A.	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.a.	PACKAGING (SEE SECTION) N.a.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	See description below			UN NO.	N.A.
HAZARD CLASS	Not restricted	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Drilling fluid additive, n.o.s. (polyacrylate)				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

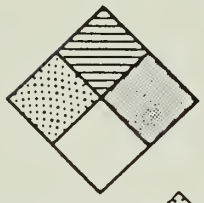
(3) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James B. Pushing
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 28 June 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions ›lids that burn rapidly, and any material that ignites spontaneously .ι normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel ʰe possible hazard in use of water. The violence of the reaction .ı water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	TANNATHIN

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Lignite (leonardite)	CHEMICAL FORMULA	Humic
MANUFACTURER	M-I Drilling Fluids Company	CAS NUMBER	1415-93-6
PACKAGE QUANTITY	22.7 kg (50 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Dispersant
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Lignite (coal dust)	100	2.0 mg/m3 (1)	2.0 mg/m3 (2)	
Silica, crystalline quartz, respirable fraction [14808-60-7]	<5	0.1 mg/m3 (1)	0.1 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	4.5	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	1.6-1.8	SOLUBILITY IN WATER @ 20°C	Insoluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	641 kg/m3 (40 lb/ft3)	ODOR & COLOR	Earthy odor, black color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT	X	ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)	N.D.										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	446

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals, water safe to use.
SPECIAL FIRE FIGHTING PROCEDURES	Self-contained breathing apparatus may be required for suspended dusts.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Treat as a flammable dust in the finely divided state.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Eyes, upper respiratory system			CARCINOGENICITY					
					NTP	No	IARC	Yes	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Inhalation of dust may cause mild upper respiratory irritation. May cause mild eye and mechanical skin irritation.
CHRONIC EFFECTS OF EXPOSURE	Crystalline silica is known to cause fibrosis, silicosis and liver effects.(3) There is limited evidence that indicates crystalline silica causes human cancer.(4)
TOXICITY DATA	The International Agency for Research on Cancer has given crystalline silica an overall evaluation of 2B: Probable Carcinogen; limited human data, sufficient animal evidence.(4)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash thoroughly with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute. Induce vomiting if irritation persists.
INHALATION	Remove to fresh air. If breathing becomes difficult seek medical attention.
OTHER INSTRUCTIONS	Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. Persons seeking medical attention should carry a copy of this msds to the physician.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Wear a high-efficiency particulate respirator approved by NIOSH/MSHA.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton gloves.
EYES	Wear chemical safety goggles or glasses with sideguards. Insure proper fit for best protection.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! This product contains crystalline silica, a suspected carcinogen. Wear proper protective equipment.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Keep dust to a minimum. Keep away from fire and heat.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

TANNATHIN, p. 2

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment (Section VIII). Contain the spill. Rebag and sell if possible or recycle. Sweep waste into a suitable container. Keep out of sewers and waterways.
WASTE DISPOSAL METHOD	Tannathin may contain low levels of leachable chrome. RCRA standards for chrome may be exceeded. Contact Environmental Services prior to disposal. Dispose of according to local, state and federal regulations.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC X	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

None.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	See n.o.s description	HAZARD CLASS	Not restricted
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (lignite)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Drilling fluid additive, n.o.s. (lignite)			UN NO.	N.A.
HAZARD CLASS	Not restricted	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Drilling fluid additive, n.o.s. (lignite)			UN NO.	N.A.
HAZARD CLASS	Not restricted	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Oil well drilling fluid additive (lignite)				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

(3) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

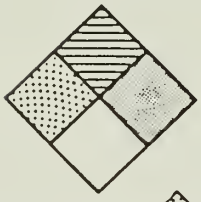
(4) Silica and Some Silicates; IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans; World Health Organization, 1987; Vol. 42.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H. Perkins
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 28 June 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions lids that burn rapidly, and any material that ignites spontaneously . normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel 'he possible hazard in use of water. The violence of the reaction ı water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	TACKLE

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Polymer	CHEMICAL FORMULA	Proprietary
MANUFACTURER	M-I Drilling Fluids Company	CAS NUMBER	Multiple
PACKAGE QUANTITY	19, 208 L (5, 55 g)	UNIT OF ISSUE	L (gal)
USE	Drilling fluid additive	APPLICATION	Deflocculant
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Steel drum meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
No hazardous ingredients				

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.D.	MELTING POINT	N.A.
pH (1% Soln.)	N.D.	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	1.2-1.3	SOLUBILITY IN WATER @ 20°C	Soluble
VAPOR DENSITY (air=1)	N.D.	EVAPORATION RATE (BUTYL ACETATE=1)	N.D.
PHYSICAL APPEARANCE	Liquid	FLASH POINT (method used)	>99 C (>212 F) (PMCC)
BULK DENSITY	N.D.	ODOR & COLOR	Slight odor, brown color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes
PRODUCT DECOMPOSES?	No
PRODUCT POLYMERIZES?	No

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	X
	OTHER (Specify)											

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals, water used to cool containers.
SPECIAL FIRE FIGHTING PROCEDURES	Self-contained breathing apparatus may be required when extinguishing fires.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None reported.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Eyes, skin, respiratory system.			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	This product may irritate eyes, skin and mucous membranes. Repeated or prolonged inhalation may irritate upper respiratory system.
CHRONIC EFFECTS OF EXPOSURE	Prolonged inhalation may lead to pneumonitis.
TOXICITY DATA	None reported for product blend.

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash thoroughly with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water or milk to dilute. Do not induce vomiting. Seek medical attention.
INHALATION	Remove to fresh air. If breathing becomes difficult seek medical attention.
OTHER INSTRUCTIONS	Good measures of personal hygiene should be observed when using this product. Sensitive individuals should avoid further contact. Persons seeking medical attention should carry a copy of this msds to the physician.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Wear an organic vapor respirator approved by NIOSH/MSHA.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton or rubber gloves.
EYES	Wear chemical safety goggles or glasses with sideguard. Insure proper fit for best protection.
OTHER PROTECTIVE EQUIPMENT	None required.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Caution! Product may be harmful if inhaled over prolonged period or swallowed. Can cause eye and skin irritation.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in a dry area. Keep well ventilated. Keep away from oxidizers, heat or open flames.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

TACKLE, p. 2

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment (Section VIII). Contain the spill. Redrum and sell or recycle if possible. Add absorbent material and sweep waste into a suitable container. Keep out of sewers and waterways.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose of according to local or state regulations dealing with nonhazardous chemical waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

None.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	See n.o.s. description	HAZARD CLASS	Not restricted
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (polymer blend)		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Drilling fluid additive, n.o.s. (polymer blend)			UN NO.	N.A.
HAZARD CLASS	Not restricted	FLASH POINT	>212 °F	>90 °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Drilling fluid additive, n.o.s. (polymer blend)			UN NO.	N.A.
HAZARD CLASS	Not restricted	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	>212 °F	>90 °C	
DESCRIPTION	Oil well drilling fluid additive (polymer blend)				

XIII. ADDITIONAL INFORMATION

None.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by:
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 28 June 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

TACKLE, p. 3

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET

NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions ·lids that burn rapidly, and any material that ignites spontaneously . normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel ·he possible hazard in use of water. The violence of the reaction ı water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

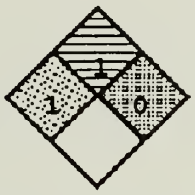
SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company
P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	LUBE-167



Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Lube-167	CHEMICAL FORMULA	Proprietary
MANUFACTURER	M-I Drilling Fluids	CAS NUMBER	Multiple
PACKAGE QUANTITY	55 gallons	UNIT OF ISSUE	gallon
USE	Drilling Fluid Compound	APPLICATION	Lubricant
FREIGHT DESCRIPTION	Oil well drilling mud compound.		
CONTAINER SPECIFICATIONS	Steel drum meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Glycol ethers generic	37.2	Not established	Not established	313 chemicals

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	8.93	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	0.965	SOLUBILITY IN WATER @ 20°C	Dispersible
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	liquid	FLASH POINT (method used)	240 F (PMCC)
BULK DENSITY	8.93	ODOR & COLOR	Mild/honey

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	X
	OTHER (Specify)											

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals.
SPECIAL FIRE FIGHTING PROCEDURES	Self contained breathing apparatus may be required.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None required.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION	X	INHALATION	X	INGESTION	
	TARGET ORGAN	Eye, skin, respiratory system			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Severe eye and skin irritation possible. Inhalation of vapors may cause upper respiratory irritation.
CHRONIC EFFECTS OF EXPOSURE	Over exposure may cause corneal injury which may result in permanent impairment of vision. May cause gastro-intestinal irritation or ulceration.
TOXICITY DATA	None reported for blend.

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute. Do not induce vomiting. Seek medical attention.
INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS	Good measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear rubber gloves.
EYES	Wear chemical goggles or safety glasses.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! May cause severe eye, skin and upper respiratory irritation.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry cool area. Keep container closed.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

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X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Contain spill. Recycle or redrum if possible. Add absorbent material. Sweep into waste container. Keep out of sewer and waterway.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to applicable state and local regulation dealing with nonhazardous materials.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC X	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	Not restricted	HAZARD CLASS	Nonhazardous
IDENTIFICATION NO.	None		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	N.A.		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	N.A.	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	N.A.				

XIII. ADDITIONAL INFORMATION

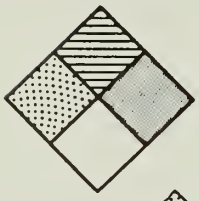
References:
None.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by:
Manager, Environmental Services (713) 561-1507	Date Prepared: Revised: Sept. 1990

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

LUBE-167, p. 3

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	EMI-164

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Acrylamide-acrylate polymer	CHEMICAL FORMULA	Proprietary
MANUFACTURER	M-I Drilling Fluids/Comm. Chemical	CAS NUMBER	Multiple
PACKAGE QUANTITY	50 pounds	UNIT OF ISSUE	pound
USE	Drilling Fluid Compound	APPLICATION	Stabilizer
FREIGHT DESCRIPTION	Oil well drilling mud compound.		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
No hazardous ingredients				

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	N.A.
pH (1% Soln.)	N.A.	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	N.A.	SOLUBILITY IN WATER @ 20°C	Insoluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	45 #/ft3	ODOR & COLOR	Odorless/white

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)											

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon and nitrogen.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals.
SPECIAL FIRE FIGHTING PROCEDURES	Self contained breathing apparatus may be required.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None noted.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT		SKIN CONTACT		SKIN ABSORPTION		INHALATION		INGESTION	
	TARGET ORGAN	Eye, skin, respiratory system			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	May cause eye and skin irritation.
CHRONIC EFFECTS OF EXPOSURE	None noted.
TOXICITY DATA	No toxicity studies have been conducted.

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute.
INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS	Ordinary measures of personl hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton gloves.
EYES	Wear chemical goggles or safety glasses.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning for nuisance dust adequate.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

EMI-164, p. 2

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Contain spill. Recycle or redrum if possible. Add absorbent material. Sweep into waste container. Keep out of sewer and waterway.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to applicable state and local regulations dealing with nonhazardous materials.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	Not restricted	HAZARD CLASS	Nonhazardous
IDENTIFICATION NO.	None		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	N.A.		

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) N.A.

MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.
	CARGO AIRCRAFT	N.A.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	N.A.	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	N.A.				

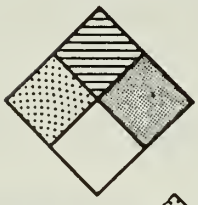
XIII. ADDITIONAL INFORMATION

References:
None.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by:
Manager, Environmental Services (713) 561-1507	Date Prepared: Revised: Oct. 1990

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

TORKease

MATERIAL SAFETY DATA SHEET

TORKease is a product from DSC Incorporated, 4600 Greenville Avenue, Dallas, Texas 75206-5038, Phone (214) 369-4244, FAX (214) 369-3864.

EPA Registration Number for this non-hazardous, non-toxic, biodegradable mud additive product is 11281490. Applicable SARA Title III subsections: None established.

NO HAZARDOUS INGREDIENTS: TORKease is an emulsion of complex stearates. All components of TORKease are well below the DeMinimis Allowable which EPA has established as non-toxic and non-hazardous.

SPECIAL HAZARD DESIGNATIONS

Health	Minimal	Reactivity	Minimal
Flammability	Minimal	Protective Equipment	Minimal

("Minimal" is the lowest designation permitted under present rules.)
Shipped as: Class 55 - Potassium Stearate soak.

PHYSICAL DATA

Appearance:
(a) Light blue gelantinous liquid emulsion
(b) Dry white granules (as concentrate)

Specific Gravity (Water = 1.0):	.95
Freezing Point (Gel)*:	32°
Melting Point:	125°
Thermal Stability:	600° +
pH:	9.3 - 9.5

Solubility: Slightly soluble in fresh water. Insoluble in salt water.

*Product is not harmed by freezing, but granulated concentrate is recommended for use in areas of prolonged low tempteratures.

HEALTH HAZARD DATA

Effects of Exposure: None
Leak or Spill Procedure: Flush with water.
Waste Disposal: No special precautions required.
Inhalation: Avoid prolonged exposure in poorly ventilated areas.
Skin or Eye Contact: Avoid. May irritate eyes.
Protective Handling Equipment: None
Special Precautions: Use normal caution.
Delayed Effects: None established.

Toxic Data: None established for humans. Approved by EPA under LC_{50} tests.

EMERGENCY AND FIRST AID DATA

- Inhalation Reaction:
  Remove subject to fresh air. Obtain medical attention.
- Skin and Eye Contact:
  Wash affected skin with soap and water. Wash eyes with large amounts of clear water for 15 minutes and seek medical attention.
- Ingestion:
  Product may be harmful if swallowed. Dilute immediately by drinking at least two glasses of water and seek medical attention.

Revised: September 1, 1992

ALLIED COLLOIDS INC

P.O. BOX 820
SUFFOLK, VA 23439-0820
(804) 934-3700

24-HOUR EMERGENCY CONTACT
CHEMTREC: 800/424-9300

Material Safety Data Sheet

SECTION I - IDENTIFICATION

PRODUCT: **ALCOMER® 242**

ISSUE/REV DATE: 6-Jul-92

CHEMICAL FAMILY: Modified acrylic polymer.

DESCRIPTION: White, free flowing powder or micro-bead, with little or no odor.

HMIS RATING (NPCA)

H	0
F	1
R	0
P	*

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	CAS No	LIMIT(S) IN AIR PPM	LIMIT(S) IN AIR mg/m³	REMARKS
This product is not hazardous as defined in 29CFR1910.1200				

SECTION III - PHYSICAL PROPERTIES

BOILING POINT: NA

SPECIFIC GRAVITY: NA

VAPOR DENSITY (air=1): NA

pH: NA

VOLATILES (% by volume): ND

VAPOR PRESSURE (mmHg): NA

EVAPORATION RATE (ether=1): NA

SOLUBILITY IN WATER: Soluble.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
Carbon dioxide, dry chemical or foam.

FLASH POINT: NA

LEL: NA

UEL: NA

SPECIAL FIRE FIGHTING PROCEDURES
No special procedures. However, wetted product presents a slip hazard. Pedestrian and vehicular traffic must proceed with caution where wet product may exist.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Dust can result in an explosive mixture in air. Minimize dusting; avoid ignition sources. Reaction with acids may liberate highly flammable carbon disulfide & diethylamine.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

INCOMPATIBILITY: Strong oxidants.

Avoid temperature extremes or ignition sources.

ALCOMER IS A TRADEMARK OF ALLIED COLLOIDS INC

Allied Colloids Inc

Material Safety Data Sheet

SECTION VI - HEALTH HAZARD DATA

NATURE OF PRINCIPAL HAZARD(S): NA (not a health hazard as defined by OSHA)

TARGET ORGAN(S): NA

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE:
Eye contact may produce slight irritation and/or redness.
Inhaled dust may cause some respiratory irritation.

CARCINOGENICITY:
Not listed as a carcinogen by IARC, NTP, OSHA or ACGIH

EXPOSURE LIMITS (as particulates not otherwise regulated):
The OSHA 8-hour TWA for total dust is 15 mg/cu-meter (5 mg/cu-meter for the respirable fraction). The ACGIH TLV-TWA is 10 mg/cu-meter.

SAFETY PRECAUTIONS:
Do not get in eyes, on skin, on clothing.
Wash thoroughly after handling.
Avoid prolonged or repeated inhalation of dust.
Avoid prolonged or repeated skin contact.
Caution - slip hazard - see Sections IV and/or VII.

FIRST AID:

EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION: Do not give an emetic unless directed by a physician. Never give anything by mouth to an unconscious person.

SKIN CONTACT: Remove contaminated clothing and launder before reuse. Wash effected area with soap and water.

INHALATION: Remove to fresh air.

SECTION VII - ENVIRONMENTAL DATA

SPILL OR LEAK PROCEDURES

Product becomes slippery and difficult to handle when wet; spills are best handled while still dry. Sweep up and collect dry product. Absorb wet product with vermiculite or other inert material. Then water wash area to waste treatment to eliminate slip hazard.

WASTE DISPOSAL METHOD

Disposal must be arranged in accordance with local, state and federal regulations. This material, when unadulterated, is not a RCRA regulated hazardous waste. However, local disposal regulations will often apply. Care must be taken to prevent environmental contamination from the disposal of material, residues and containers.

SECTION VIII - PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION	Use NIOSH approved dust respirator as required to control exposure. Follow ANSI Z88.2.		
PROTECTIVE GLOVES	Impervious gloves are optional.	EYE PROTECTION.	Goggles (ANSI Z87.1 std; safety glasses alone do not protect from dust).
VENTILATION	Provide mechanical ventilation to prevent dust concentrations, and to reduce potential exposure.		
OTHER EQUIPMENT	Provide eyewash station(s). Select additional protective equipment (eg apron, face shield, etc.), depending on conditions of use.		

SECTION IX - REGULATORY INFORMATION

SHIPPING INFORMATION

PROPER SHIPPING NAME NOT A DOT/IMO HAZARDOUS MATERIAL

ID NUMBER NA RQ NA DOT EMERGENCY GUIDE (ERG) # 31

HAZARD CLASS or DIVISION NA PACKING GROUP -

TSCA COMPONENTS APPEAR ON THE TSCA INVENTORY

SARA PRODUCT HAZARD CATEGORIES (Sec 311) PRODUCT NOT SUBJECT TO REPORTING

The following components are defined as toxic chemicals subject to reporting requirements of SARA Section 313 and of 40 CFR 372:

No components are 313 Toxic Chemicals

STATE LABELLING INFORMATION

CA PROP 65 NOT KNOWN TO CONTAIN A REGULATED ITEM

SECTION X - ADDITIONAL INFORMATION

NA=Not Applicable; ND=Not Determined or No Data

Keep containers closed and properly labelled.
Do not reuse containers before contents are completely removed, and the container is properly cleaned and reconditioned. (Refer also to Section VII)

Good personal hygiene practices can reduce potential exposure. Wash with soap and water following any contact with this product, as well as before breaks and meals. Shower and change clothing at end of work shift. If clothing becomes contaminated, remove and launder or dry-clean before reuse.

The information and recommendations contained herein are, to the best of Allied Colloids Inc's knowledge and belief, accurate and reliable as of the last revision date. This document is offered in good faith. The information relates to the specific material designated, and may not be valid for such material used in combination with any other materials, or in any process, or in a manner other than for which it is intended.

Allied Colloids Inc does not warrant or guarantee accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information, nor do we offer warranty against patent infringement.

ALLIED COLLOIDS INC

2301 WILROY ROAD, P.O. BOX 820
SUFFOLK, VA 23439-0820
(804) 538-3700

24-HOUR EMERGENCY CONTACT
CHEMTREC 800/424-9300

SECTION I - IDENTIFICATION

PRODUCT: **DP9-3124B**

ISSUE/REV DATE 23-Jul-92

CHEMICAL FAMILY: Modified acrylamide polymer dispersed in mineral oil.

DESCRIPTION: White or off-white liquid. Slight, mild odor.

HMIS RATING (NPCA)

H 1
F 1
R 0
P *

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	CAS No.	LIMIT(S) IN AIR PPM	LIMIT(S) IN AIR mg/m³	REMARKS
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE	64742-53-6	T 400	T 1600	OSHA limit (naphtha)
ETHOXYLATED ALCOHOLS; NC REG #99783600-5001		ND	ND	

T = TWA-8, C = CEILING, S = STEL-15min
NTP and/or IARC in remarks indicates possible or probable human carcinogen

SECTION III - PHYSICAL PROPERTIES

BOILING POINT ~ 300 C

SPECIFIC GRAVITY: 1.1

VAPOR DENSITY (air=1) ND

pH NA

VOLATILES (% by volume): ND

VAPOR PRESSURE (mmHg): <1 @ 20C

EVAPORATION RATE (ether=1): <1

SOLUBILITY IN WATER: Low or moderate; self dispersing.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
Carbon dioxide, dry chemical, foam or water spray.

FLASH POINT: > 100 C
LEL: ND
UEL: ND

SPECIAL FIRE FIGHTING PROCEDURES
Firefighters should wear normal protective equipment. SCBA is recommended for confined areas. Cool exposed drums or tanks with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Wetted product presents an extreme slip hazard. Pedestrian and vehicular traffic must proceed with caution where even a small amount of wet product may exist.

SECTION V - REACTIVITY DATA

STABILITY: STABLE

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

INCOMPATIBILITY: Strong oxidants.

Avoid temperature extremes or ignition sources.

Material Safety Data Sheet

Allied Colloids Inc

Material Safety Data Sheet

SECTION VI - HEALTH HAZARD DATA

NATURE OF PRINCIPAL HAZARD(S): Eye and skin irritant.

TARGET ORGAN(S): Eyes, skin

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE:
Contact with the eye may produce irritation and/or redness. Prolonged or repeated skin contact tends to remove skin oils, possibly leading to dry skin, irritation and/or dermatitis. Vapors may irritate eyes and respiratory tract, and result in headache or dizziness.

CARCINOGENICITY:
Not listed as a carcinogen by IARC, NTP, OSHA or ACGIH

EXPOSURE LIMITS:
None established for product. Refer to Section II for limits, if any, appropriate for hazardous ingredients.

SAFETY PRECAUTIONS:
Do not get in eyes, on skin, on clothing.
Wash thoroughly after handling.
Avoid prolonged or repeated skin contact.
Caution slip hazard - see Sections IV and/or VII.

FIRST AID:

EYE CONTACT:	Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.
INGESTION:	Consult a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing and launder before reuse. Wash effected area with soap and water.
INHALATION:	Remove to fresh air. If symptoms persist, consult a physician.

SECTION VII - ENVIRONMENTAL DATA

SPILL OR LEAK PROCEDURES

Remove all ignition sources. Dike area to control runoff, and collect spill in appropriate container(s). Use an inert absorbant such as vermiculite to collect residual liquid. Then water wash area to waste treatment to eliminate slip hazard.

WASTE DISPOSAL METHOD

Disposal must be arranged in accordance with local, state and federal regulations. This material, when unadulterated, is not a RCRA regulated hazardous waste. However, local disposal regulations will often apply. Care must be taken to prevent environmental contamination from the disposal of material, residues and containers.

SECTION VIII - PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION	Use NIOSH approved respirator for organic vapor and/or mist, as required to control exposure.		
PROTECTIVE GLOVES	Chemical resistant gloves.	EYE PROTECTION	Chemical goggles. Wear a face shield over goggles for added protection.
VENTILATION	Recommended general ventilation rate of, as a minimum, 10 air changes per hour.		
OTHER EQUIPMENT	Provide eyewash station(s). Select additional protective equipment (eg apron, face shield, etc.), depending on conditions of use.		

SECTION IX - REGULATORY INFORMATION

SHIPPING INFORMATION

PROPER SHIPPING NAME NOT A DOT/IMO HAZARDOUS MATERIAL

ID NUMBER NA RQ NA DOT EMERGENCY GUIDE (ERG) # 31

HAZARD CLASS or DIVISION NA PACKING GROUP -

TSCA COMPONENTS APPEAR ON THE TSCA INVENTORY

SARA PRODUCT HAZARD CATEGORIES (Sec 311) ACUTE HEALTH HAZARD

The following components are defined as toxic chemicals subject to reporting requirements of SARA Section 313 and of 40 CFR 372

No components are 313 Toxic Chemicals

STATE LABELLING INFORMATION

NJ RTK LABEL - COMPONENTS INCLUDE	CAS or ID #
POLYMER; NJ TRADE SECRET REG #99783600-	5047
HYDROTREATED LIGHT NAPHTHENIC DISTILLATE	64742 53-6
ETHOXYLATED ALCOHOLS; NJ REG #99783600-	5001
SORBITAN MONOOLEATE	1338-43 8
POLYMER; NJ TRADE SECRET REG #99783600-	5000

CA PROP 65 CALL FOR ADDITIONAL INFORMATION

SECTION X - ADDITIONAL INFORMATION

NA=Not Applicable; ND=Not Determined or No Data

Avoid high temperatures and open systems to minimize vapor release and exposures.

Keep containers closed and properly labelled.
Do not reuse containers before contents are completely removed, and the container is properly cleaned and reconditioned. (Refer also to Section VII)

Good personal hygiene practices can reduce potential exposure. Wash with soap and water following any contact with this product, as well as before breaks and meals. Shower and change clothing at end of work shift. If clothing becomes contaminated, remove and launder or dry-clean before reuse.

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Allied Colloids Inc

Material Safety Data Sheet

Allied Colloids

ALCOMER 242 HTHP FLUID LOSS ADDITIVE

ALCOMER 242 is a high temperature fluid loss additive specifically designed to improve the fluid loss of water based drilling fluids. ALCOMER 242 is stable to temperatures in excess of 400°F. ALCOMER 242 exhibits excellent tolerance to calcium and magnesium ions and is effective in salt concentrations up to saturation.

PRODUCT DESCRIPTION

Alcomer 242 is an anionic, water soluble, medium molecular weight copolymer. The product is supplied in a unique, dust-free microbead form which exhibits excellent handling characteristics and rapid solubility.

TYPICAL PROPERTIES

Appearance:	White, free flowing microbeads
Ionic Character:	Anionic
Activity:	100% (less moisture content)
Bulk Density:	50 lbs./cu.ft.
Particle Size:	95% < 1 mm
pH of 1% Soln. In DI Water @ 25°C	7.0 - 8.0

PERFORMANCE DATA

Typical performance of ALCOMER 242 in:

a. 13.5 ppg gypsum/seawater based mud system

Bentonite	10	ppb
Caustic Soda	2.5	ppb
ALCOMER 74L	2	ppb
Causticized Lignite	10	ppb
Barite	250	ppb
Drilled Solids	40	ppb
Gypsum	4.5	ppb

(See results overleaf.)

b. A similar gypsum/seawater mud system saturated with sodium chloride. (See results overleaf.)

PACKAGING AND STORAGE

ALCOMER 242 is supplied in 50 lb. net, polyethylene bags, packed 30 to a shrink-wrapped, palletized crate. When stored in a cool, dry area, ALCOMER 242 has a shelf life of several years.

HEALTH AND SAFETY

Product Handling:

ALCOMER 242 exhibits a low order of toxicity, and therefore requires no special handling precautions. Additional information on handling can be found on the **Material Safety Data Sheet**, available upon request.

Polymer Spills:

All spills should be cleaned up immediately. Dry polymer should be left dry and swept up immediately. If the polymer becomes wet, an absorbent material should be applied to the spill, then swept up and discarded.

NOTICE

The information in this leaflet is believed to be accurate and is intended for general guidance in the use of our products; it should not be construed as a guarantee of their suitability for a particular application.

Allied Colloids Inc. offers no warranties either expressed or implied, nor is freedom from any patent owned by Allied Colloids or others implied, neither is liability accepted for errors or omissions in the information. Typical properties of products are given for guidance only and do not necessarily represent manufacturing specifications. In order to facilitate product improvement, Allied Colloids Inc. reserves the right to change product specifications without notice.

OSD1047/ACI-R1/3-91

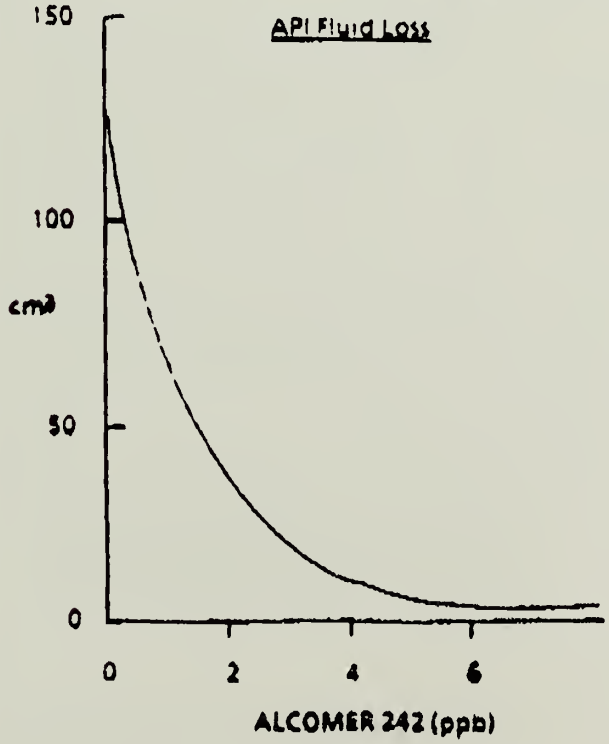
Allied Colloids Inc • P O Box 820 • 2301 Wilroy Road • Suffolk, VA 23434 • Phone (804) 934-3700 • Telex 671 8501 • FAX (804) 934-3989

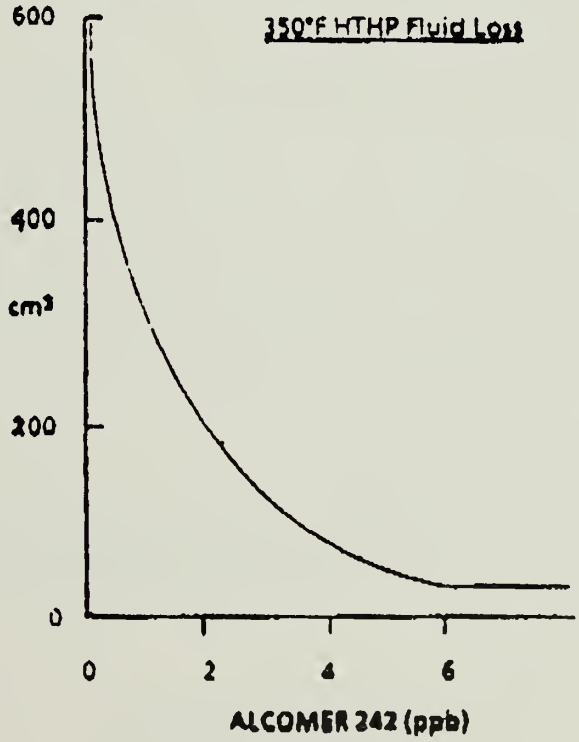
			ALCOMER 242 (ppb)				
			—	2.0	4.0	6.0	8.0
Hot rolled 16 hours @ 150°F	PV (cP)		17	28	39	62	63
	YP (lb/100 ft²)		7	10	18	21	28
	AV (cP)		20.5	33	48	72.5	77
	Gels (lb/100 ft²)		7/24	3/14	3/13	3/11	3/9
Hot rolled 16 hours @ 400°F	PV (cP)		9	16	26	35	47
	YP (lb/100 ft²)		47	25	16	14	14
	AV (cP)		32.5	28.5	34	42	54
	Gels (lb/100 ft²)		38/52	16/40	3/18	2/9	1/3
	Fluid loss (ml)	API	63	32	18	11.5	8
		350 °F HTHP	300	165	100	74	56

b). Saturated salt mud

A mud similar to the gypsum/seawater mud system in (a) was saturated with sodium chloride and hot rolled for 16 hours at 400°F.

Saturated-Salt Mud System: Hot-rolled 16 hours at 400°F





Baroid Environmental, Safety and Transportation Data Sheet

THERMA-VIS™

I. PRODUCT IDENTIFICATION

SUPPLIER BAROID DRILLING FLUIDS, INC.	**REGULAR TELEPHONE NUMBER** 713/987-5900 **EMERGENCY TELEPHONE NO.** 713/987-4000
ADDRESS P.O. BOX 1675 HOUSTON, TX 77251	
TRADE NAME THERMA-VIS	
GENERIC DESCRIPTION SYNETHIC MAGNESIUM SILICATE	

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	HAZARD DATA
SILICA 14808-60-7	2-6	LOW CONCENTRATIONS OF
		CRYSTALLINE SILICA (SiO2)
		IN THE FORM OF QUARTZ,
		CRISTOBALITE AND TRIDYMITE
		MAY BE PRESENT.

III. PHYSICAL DATA

BOILING POINT (Deg F) ND	**MELTING POINT** ND	**FREEZING POINT** ND
SPECIFIC GRAVITY (H2O = 1) 2.5	**VAPOR PRESSURE (mm Hg)** NA	
VAPOR DENSITY (AIR = 1) NA	**SOLUBILITY IN WATER, % BY WT.** SOLUBLE	
% VOLATILES BY VOLUME 6% WATER	**EVAPORATION RATE(BUTYL ACETATE = 1)** NA	
APPEARANCE AND ODOR WHITE POWDER, NO ODOR	**DENSITY @ 20 Deg C (Uncompacted)** 62.4 LB/FT	
pH 1% 8-9		

NA = Not Applicable ND = Not Determined

All information recommendations and suggestions herein concerning our product are based on tests and data believed to be reliable, however, it is the user's responsibility to determine the safety, toxicity, and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by Baroid Corporation as to the effects of such use, the results to be obtained, or the safety and toxicity of the product nor does Baroid Corporation assume any liability arising from the use, by others, of the product referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations

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Baroid Drilling Fluids, Inc.
P.O. Box 1675, Houston, Texas 77251

IV. FIRE AND EXPLOSION DATA

FLASHPOINT: NONE
EXTINGUISHING MEDIA: USE MEDIA APPLICABLE TO SURROUNDING MATERIAL.
SPECIAL FIRE FIGHTING PROCEDURES: WEAR FULL PROTECTIVE EQUIPMENT INCLUDING SELF-CONTAINED BREATHING APPARATUS.
UNUSUAL FIRE AND EXPLOSION HAZARDS: NONE

V. HEALTH HAZARD INFORMATION

CARCINOGENICITY - SEE ROUTES OF EXPOSURE AND EFFECTS

ACUTE ORAL LD50	ACUTE DERMAL LD50	AQUATIC TOXICITY LC50
ND	ND	ND

ROUTES OF EXPOSURE AND EFFECTS

THIS PRODUCT CONTAINS FREE CRYSTALLINE SILICA WHICH ACCORDING TO THE IARC HAS EXHIBITED LIMITED EVIDENCE OF CARCINOGENICITY IN HUMANS. PROLONGED INHALATION OF THE POWDER MAY RESULT IN SILICOSIS, A NONCANCEROUS LUNG DISEASE. OSHA FINAL LIMITS TWA = 0.1 mg/m3
EYES: IRRITANT SKIN: POTENTIAL IRRITANT INHALATION: IRRITATION TO LUNGS, NOSE, AND THROAT; PROLONGED INHALATION MAY CAUSE LUNG INJURY OR DISEASE.

EMERGENCY AND FIRST AID PROCEDURES

EYES: FLUSH EYES WITH LARGE AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
WASH AREAS OF CONTACT WITH SOAP AND WATER.

VI. REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

THIS PRODUCT IS STABLE UNDER NORMAL CONDITIONS

INCOMPATIBILITY

NONE DOCUMENTED

HAZARDOUS DECOMPOSITION PRODUCTS

NONE

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

WILL NOT OCCUR

VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NORMAL HOUSEKEEPING. SWEEP UP MATERIAL AND HOLD FOR DISPOSAL.

NEUTRALIZING CHEMICALS

NA

WASTE DISPOSAL METHOD

DISPOSE OF IN ACCORDANCE WITH ALL LOCAL, STATE AND AND FEDERAL REGULATIONS.

VIII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

MECHANICAL, GENERAL ROOM VENTILATION. USE LOCAL VENTILATION TO MAINTAIN TLV (SEE SECTION V)

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

USE A NIOSH APPROVED MECHANICAL FILTER RESPIRATOR FOR NON-TOXIC DUSTS.

EYE

GOGGLES

GLOVES

WORK GLOVES

OTHER CLOTHING AND EQUIPMENT

APRON, EYEWASH STATION

XI. REGULATORY INFORMATION

STATUS ON SUBSTANCE LISTS

Comprehensive Environmental Response, Compensation and Liability Act of 1980, (CERCLA) requires notification of the National Response Center of release of quantities of Hazardous Substances equal to or greater than the reportable quantities (RQs) in 40 CFR 302.4.

Components present in this product which may require notification are:

Chemical	CAS Number
NONE	

Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires emergency planning based on Threshold Planning Quantities (TPQs) and release reporting based on RQs.
Components present in this product at a level which could require reporting under the statute are:

NONE

SARA requires the submission of annual reports of toxic chemicals that appear in 40 CFR 372 (for SARA 313). This information must be included in all MSDS that are copied and distributed for this material.
Components present in this product at a level which could require reporting under the statute are:

NONE

Toxic Substances Control Act (TSCA)
The ingredients of this product are on the TSCA inventory.

XII. STATE RIGHT TO KNOW

QUARTZ IS ON CANADIAN WHMIS (WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM) INGREDIENT DISCLOSURE LIST, MASSACHUSETTS SUBSTANCE LIST, NEW JERSEY RIGHT TO KNOW HAZARDOUS SUBSTANCE LIST AND PENNSYLVANIA HAZARDOUS SUBSTANCE LIST.

Prepared by:
Environmental Services

DATE:
March,1992

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

AVOID PROLONGED INHALATION:
RECOMMENDED LABELING:
FRONT PANEL: CAUTION SEE BACK FOR CAUTION BEFORE USE.
BACK PANEL: CAUTION THIS PRODUCT CONTAINS FREE CRYSTALLINE SILICA WHICH ACCORDING TO THE IARC HAS EXHIBITED LIMITED EVIDENCE OF CARCINOGENICITY IN HUMANS. PROLONGED INHALATION OF THE POWDER MAY RESULT IN SILICOSIS, A NONCANCEROUS LUNG DISEASE. AVOID CREATING DUSTY CONDITIONS AND USE A NIOSH APPROVED DUST RESPIRATOR.

OTHER HANDLING AND STORAGE REQUIREMENTS

STORE IN SHELTERED AREA OR COVER FOR MOISTURE PROTECTION.

X. DEPARTMENT OF TRANSPORTATION INFORMATION

PROPER SHIPPING NAME :
NOT REGULATED

PLACARDS :
NONE

HAZARD CLASS :
NOT HAZARDOUS

REPORTABLE QUANTITY :
NONE

HAZARDOUS SUBSTANCE :
NONE

ID NUMBER :
NONE

LABEL :
NONE REQUIRED

Prepared by:
Environmental Services

DATE:
March,1992

ALLIED COLLOIDS INC

P.O. BOX 820
SUFFOLK, VA 23434
(804) 934-3700

24-HOUR EMERGENCY CONTACT
CHEMTREC: 800/424-9300

SECTION I - IDENTIFICATION

PRODUCT: **ALCOMER® 75L**

ISSUE/REV DATE 10-May-91

CHEMICAL FAMILY: Acrylic copolymer in an aqueous solution.

DESCRIPTION: Clear to pale yellow liquid. Odorless, or with a slight mild odor.

HMIS RATING (NPCA)

H	0	HEALTH (ACUTE)
F	0	FLAMMABILITY
R	0	REACTIVITY
P	*	PERSONAL PROTECTION

* PERSONAL PROTECTION RATING BY USER, DEPENDENT ON USE.

DEGREE OF HAZARD
4 = SEVERE
3 = SERIOUS
2 = MODERATE
1 = SLIGHT
0 = MINIMAL

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	CAS No.	LIMIT(S) IN AIR PPM	LIMIT(S) IN AIR mg/m³	REMARKS
This product is not hazardous as defined in 29CFR1910.1200				

SECTION III - PHYSICAL PROPERTIES

BOILING POINT: ~ 100 C

SPECIFIC GRAVITY: 1.0-1.4

VAPOR DENSITY (air=1): ND

pH: 6-8

VOLATILES (% by volume): ND

VAPOR PRESSURE (mmHg): AS WATER

EVAPORATION RATE (ether=1): > 1

SOLUBILITY IN WATER: Soluble.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA

NA (will not burn). Use media appropriate for type of fire and combustibles in area.

FLASH POINT: NONE

LEL: NA

UEL: NA

SPECIAL FIRE FIGHTING PROCEDURES

Firefighters should wear normal protective equipment. SCBA is recommended for confined areas. Cool exposed drums or tanks with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NA (No known unusual fire and explosion hazards.)

SECTION V - REACTIVITY DATA

STABILITY

STABLE

HAZARDOUS POLYMERIZATION

WILL NOT OCCUR.

INCOMPATIBILITY Strong oxidants.

Material Safety Data Sheet

ALCOMER IS A TRADEMARK OF ALLIED COLLOIDS INC

Allied Colloids Inc

Material Safety Data Sheet

SECTION VI - HEALTH HAZARD DATA

NATURE OF PRINCIPAL HAZARD(S): NA (not a health hazard as defined by OSHA)

TARGET ORGAN(S): NA

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE:
Eye contact may product slight irritation and/or redness.

CARCINOGENICITY:
Not listed as a carcinogen by IARC, NTP, OSHA or ACGIH

EXPOSURE LIMITS: None established

SAFETY PRECAUTIONS:
Do not get in eyes, on skin, on clothing.
Wash thoroughly after handling.
Avoid prolonged or repeated skin contact.

FIRST AID:

EYE CONTACT:	Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician if irritation continues.
INGESTION:	Give large quantities of water and call a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing and launder before reuse. Wash effected area with soap and water.
INHALATION:	Remove to fresh air.

SECTION VII - ENVIRONMENTAL DATA

SPILL OR LEAK PROCEDURES
Remove all ignition sources. Dike area to control runoff, and collect spill in appropriate container(s). Use an inert absorbant such as vermiculite to collect residual liquid. Then water wash area to waste treatment to eliminate slip hazard.

WASTE DISPOSAL METHOD
Disposal must be arranged in accordance with local, state and federal regulations. This material, when unadulterated, is not a RCRA regulated hazardous waste. However, local disposal regulations will often apply. Care must be taken to prevent environmental contamination from the disposal of material, residues and containers.

SECTION VIII - PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:	Use a NIOSH approved organic vapor respirator, if exposure exceeds TLV. Follow ANSI Z88.2 standard.		
PROTECTIVE GLOVES:	Chemical resistant gloves.	EYE PROTECTION:	Full sideshield safety glasses or goggles (ANSI Z87.1 standard).
VENTILATION:	Recommended general ventilation rate is = 10 air changes per hour.		
OTHER EQUIPMENT:	Provide eyewash station(s). Select additional protective equipment (eg apron, face shield, etc.), depending on conditions of use.		

SECTION IX - REGULATORY INFORMATION

SHIPPING INFORMATION

PROPER SHIPPING NAME: NOT A DOT/IMO HAZARDOUS MATERIAL

ID NUMBER: NA RQ: NA DOT EMERGENCY GUIDE (ERG) #: 31

HAZARD CLASS or DIVISION: NA PACKING GROUP: -

TSCA COMPONENTS APPEAR ON THE TSCA INVENTORY

SARA PRODUCT HAZARD CATEGORIES (Sec 311): PRODUCT NOT SUBJECT TO REPORTING

The following components are defined as toxic chemicals subject to reporting requirements of SARA Section 313 and of 40 CFR 372:

No components are 313 Toxic Chemicals

STATE LABELLING INFORMATION

CA PROP 65: NOT KNOWN TO CONTAIN A REGULATED ITEM

SECTION X - ADDITIONAL INFORMATION

NA=Not Applicable; ND=Not Determined or No Data

Avoid high temperatures and open systems to minimize vapor release and exposures.

Keep containers closed and properly labelled.
Do not reuse containers before contents are completely removed, and the container is properly cleaned and reconditioned. (Refer also to Section VII)

Good personal hygiene practices can reduce potential exposure. Wash with soap and water following any contact with this product, as well as before breaks and meals. Shower and change clothing at end of work shift. If clothing becomes contaminated, remove and launder or dry-clean before reuse.

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M - I DRILLING FLUIDS COMPANY

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME : THERMEX

NFPA HAZARD RATING : HEALTH 1
FLAMMABILITY 0
REACTIVITY 0
SPECIAL HAZARD

EMERGENCY TELEPHONE NUMBERS
(713) 561-1600
(713) 561-1300
DAY OR NIGHT

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the User may rely thereon only at User's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each User of this product to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the User; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME : Phenol-formaldehyde polymer solution
MANUFACTURER : M-I Drilling Fluids Company
PACKAGE QUANTITY : 208 L (55 gal)
USE : Drilling fluid additive
FREIGHT DESCRIPTION : Oil well drilling fluid additive
CONTAINER SPECIFICATIONS : Meets DOT requirements (49 CFR 178)

CHEMICAL FORMULA : Proprietary
CAS NUMBER : 68442-15-9
UNIT OF ISSUE : Liter (gallon)
APPLICATION : Fluid loss control

II. HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	(A) OSHA PEL / (B) ACGIH TVL / (C) OTHER LIMITS RECOMMENDED
No hazardous ingredients		

III. PHYSICAL DATA

BOILING POINT (760 mm Hg) : 100 C 212 F
pH (1% Soln.) : 10.7
SPECIFIC GRAVITY (H2O=1) : 1.1355
VAPOR DENSITY (air=1) : N.D.
PHYSICAL APPEARANCE : Liquid
BULK DENSITY : 9.46

MELTING POINT : N.D.
VAPOR PRESSURE @ 20 deg C : N.D.
SOLUBILITY IN WATER @ 20 deg C : Soluble
EVAPORATION RATE (BUTYL ACETATE=1): N.D.
FLASH POINT (method used) : >99 C >210 F (PMCC)
ODOR & COLOR : Mild odor, amber color

IV. REACTIVITY DATA

PRODUCT IS STABLE? : Yes
PRODUCT DECOMPOSES? : No
PRODUCT POLYMERIZES? : No

INCOMPATIBILITY: AIR _ HEAT X ACID _ BASE _ WATER _ OXIDIZER X
OTHER (Specify): N.D.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than C-Ceiling Limit
Note: For additional information and interpretive assistance, see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL. L.E.L. N.D. U.E.L. N.D. AUTO IGNITION TEMPERATURE N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon, sulfur, and possibly of other elements.
EXTINGUISHING MEDIA	Water, foam, dry chemical, or carbon dioxide.
UNUSUAL FIRE FIGHTING PROCEDURES	Wear self-contained breathing apparatus if material is burning.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Oxides of sulfur and possibly of other elements will be generated when this material is burned.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE: EYE CONTACT X SKIN CONTACT X SKIN ABSORPTION INHALATION X INGESTION

TARGET ORGAN N.D.

CARCINOGENICITY: NTP No IARC No OSHA No

ACUTE EFFECTS OF EXPOSURE	Irritation of skin, eyes, and possibly of respiratory tract if vapor concentration is high.
CHRONIC EFFECTS OF EXPOSURE	N.D.
TOXICITY DATA	None available

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID		
	EYES	Flush with water for at least 15 minutes. Seek medical attention if irritation persists.
	SKIN	Wash thoroughly with soap and water. Seek medical attention if a rash or other symptoms develop.
	INGESTION	If conscious, drink large amounts of water and seek medical attention immediately.
	INHALATION	Remove to fresh air. Seek medical help if discomfort or other symptoms develop.
OTHER INSTRUCTIONS		Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use the proper NIOSH/MSHA-approved vapor respirator for this material if ventilation is not adequate.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Cover all exposed skin with suitable protective clothing and wear chemical resistant gloves.
EYES	Wear chemical safety goggles.
OTHER PROTECTIVE EQUIPMENT	N.D.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	CAUTION! Avoid contact with skin and use with adequate ventilation.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Keep containers closed.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Contain spill and keep out of sewers and waterways. Redrum material if possible. Add absorbent and place in a suitable container.
WASTE DISPOSAL METHOD	Consult your local authorities for the proper procedures for disposing of water-based phenol-formaldehyde polymer solutions.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME : See n.o.s. description HAZARD CLASS : Not restricted

IDENTIFICATION NO. : N.A.

LABEL(S) REQUIRED : None

N.O.S. DESCRIPTION : Drilling fluid additive, n.o.s. (water-soluble polymer)

EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION) : N.A.

MAXIMUM QUANTITY PASSENGER AIRCRAFT : N.D.

IN ONE PACKAGE CARGO AIRCRAFT : N.D.

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME : Drilling fluid additive, n.o.s. (water-soluble polymer) UN NO. : N.A.

HAZARD CLASS : Not restricted FLASH POINT : >210 deg F >98.9 deg C

MAXIMUM QUANTITY PASSENGER AIRCRAFT : N.D. PACKAGING (SEE SECTION) : N.D.

IN ONE PACKAGE CARGO AIRCRAFT : N.D. PACKAGING (SEE SECTION) : N.D.

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME : Drilling fluid additive, n.o.s. (water-soluble polymer) UN NO. : N.A.

HAZARD CLASS : Not restricted CLASS NO. : N.A. PAGE NO. : N.A.

LABEL(S) : None FLASH POINT : >210 deg F >98.9 deg C

DESCRIPTION : Oil well drilling fluid additive containing water-soluble polymers.

XIII. ADDITIONAL INFORMATION

FOR ADDITIONAL INFORMATION CONTACT:
Manager, Environmental Affairs (713) 561-1507

Prepared by :
Date Prepared : 27 August 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET

NFPA HAZARD INTERPRETATION

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.
3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.
2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.
1 Materials only slightly hazardous to health.
0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.
3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.
2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.
1 Materials that must be preheated before ignition can occur.
0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.
3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.
2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.
1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.
0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A "W" in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From - OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short - or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parent; or cause the production of physical defect in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.
Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.
(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.
(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.
(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure of the chemical.
(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammbility, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.
Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.
Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.
Median Lethal Dose (LD50, LC50): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LDLO is the single lowest reported dose that has proven to be fatal in one individual. TDLO is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

NL Baroid

Environmental, Safety and Transportation Data Sheet

THERMA-CHEK

I PRODUCT IDENTIFICATION

SUPPLIER NL BAROID	TELEPHONE NO 713/987-5900
ADDRESS P.O. BOX 1675 HOUSTON, TEXAS 77251	
TRADE NAME THERMA-CHEK™	
GENERIC DESCRIPTION SULFONO-ACRYLAMIDE CO-POLYMER	

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	HAZARD DATA
BUTANOL	5-10	TLV = 150 mg/m³

III PHYSICAL DATA

BOILING POINT (°F) ND	MELTING POINT 300°C	FREEZING POINT ND
SPECIFIC GRAVITY (H_2O = 1) ND	VAPOR PRESSURE (mm Hg) ND	
VAPOR DENSITY (AIR = 1) ND	SOLUBILITY IN H_2O, % BY WT 50	
% VOLATILES BY VOL. ND	EVAPORATION RATE (BUTYL ACETATE = 1) ND	
APPEARANCE AND ODOR WHITE POWDER	Density @ 20°C ND	
pH 6 TO 7 (10 grams/l in H O)		

NA = Not Applicable ND = Not Determined

THERMA-CHEK™

HEALTH HAZARD: 1

FLAMMABILITY: 1

REACTIVITY: 0

Ratings based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

All information recommendations and suggestions herein concerning our product are based upon tests and data believed to be reliable however it is the user's responsibility to determine the safety toxicity and suitability for his own use of the product described herein Since the actual use by others is beyond our control no guarantee expressed or implied is made by NL Petroleum Services, Inc as to the effects of such use the results to be obtained or the safety and toxicity of the product nor does NL Petroleum Services Inc assume any liability arising out of use by others of the product referred to herein Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations

BEST Sheet

IV FIRE AND EXPLOSION DATA

FLASH POINT: 144°F
FIRE EXTINGUISHING MEDIA: CARBON DIOXIDE, ALCOHOL FOAM, AND WATER MIST

WEAR SELF-CONTAINED BREATHING APPARATUS WHEN ENTERING CONFINED AREAS

V HEALTH HAZARD INFORMATION

CARCINOGENICITY — NOT ON NTP, IARC OR OSHA LISTS

ACUTE ORAL LD_{50} >5000 mg/kg ACUTE DERMAL LD_{50} ND AQUATIC TOXICITY (LC_{50}) 47,000 ppm

ROUTES OF EXPOSURE AND EFFECTS

SKIN: MAY CAUSE IRRITATION
EYES: IRRITATION

EMERGENCY AND FIRST AID PROCEDURES

EYE AND SKIN CONTACT: FLUSH WITH WATER, WASHING SKIN WITH SOAP. FLUSH EYES FOR AT LEAST 15 MINUTES; CONSULT PHYSICIAN IF IRRITATION PERSISTS
INGESTION: CONSULT PHYSICIAN

BEST Sheet

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

STABLE

INCOMPATIBILITY

OXIDIZERS

HAZARDOUS DECOMPOSITION PRODUCTS

ND

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

NONE

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

WEAR PROTECTIVE EQUIPMENT DESCRIBED IN SECTION VIII. SWEEP UP AND SECURELY CONTAIN FOR DISPOSAL. FORMS SLIPPERY SURFACE WITH WATER.

NEUTRALIZING CHEMICALS

ND

WASTE DISPOSAL METHOD

MATERIAL MAY BE DISPOSED IN A LAND FILL. CHECK LOCAL, STATE AND FEDERAL REGULATIONS.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

GENERAL MECHANICAL VENTILATION.
USE LOCAL EXHAUST VENTILATION, TO MAINTAIN TLV (SEE SECTION II)

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

NIOSH APPROVED ORGANIC VAPOR RESPIRATOR

EYE

GOGGLES OR FACESHIELD

GLOVES

RUBBER

OTHER CLOTHING AND EQUIPMENT

APRON, COVERALLS, EYEWASH, AND SHOWER

BEST Sheet

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

KEEP AWAY FROM OPEN FLAMES AND OTHER IGNITION SOURCES

OTHER HANDLING AND STORAGE REQUIREMENTS

STORE AWAY FROM OXIDIZERS AND HEAT SOURCES

DEPARTMENT OF TRANSPORTATION INFORMATION

PROPER SHIPPING NAME: NOT REGULATED

HAZARD CLASS: NONE

HAZARDOUS SUBSTANCE: NONE

PREPARED BY **NL Baroid**
ENVIRONMENTAL SERVICES

DATE
JULY, 1987

NL Baroid

Environmental, Safety and Transportation Data Sheet

THERMA-THIN

I PRODUCT IDENTIFICATION

SUPPLIER NL BAROID	REGULAR TELEPHONE NO. (713) 987-5900 EMERGENCY TELEPHONE NO. (713) 987-4000
ADDRESS P.O. BOX 1675 HOUSTON, TEXAS 77251	
TRADE NAME THERMA-THIN®	
GENERIC DESCRIPTION POLYCARBOXYLIC ACID SALT	

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	%	HAZARD DATA
NONE		

III PHYSICAL DATA

BOILING POINT (°F) 212	MELTING POINT ND	FREEZING POINT ND
SPECIFIC GRAVITY (H_2O = 1) 1.16	VAPOR PRESSURE (mm Hg) ND	
VAPOR DENSITY (AIR = 1) ND	SOLUBILITY IN H_2O, % BY WT. 100	
% VOLATILES BY VOL. 55	EVAPORATION RATE (BUTYL ACETATE = 1) ND	
APPEARANCE AND ODOR PALE STRAW COLOR LIQUID	Density @ 20° C: ND	
pH ND		

NA = Not Applicable ND = Not Determined

THERMA-THIN®

HEALTH HAZARD: 0

FLAMMABILITY: 0

REACTIVITY: 0

Ratings based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

All information recommendations and suggestions herein concerning our product are based upon tests and data believed to be reliable, however, it is the user's responsibility to determine the safety, toxicity, and suitability for his own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by NL Petroleum Services, Inc as to the effects of such use, the results to be obtained, or the safety and toxicity of the product nor does NL Petroleum Services, Inc assume any liability arising out of use, by others, of the product referred to herein. Nor is the information herein to be construed as absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations

IV FIRE AND EXPLOSION DATA

FLASH POINT: NONE

EXTINGUISHING MEDIA: USE MEDIA WHICH IS APPLICABLE TO SURROUNDING MATERIAL.

SPECIAL FIRE FIGHTING PROCEDURE: WEAR FULL PROTECTIVE EQUIPMENT INCLUDING SELF-CONTAINED BREATHING APPARATUS.

UNUSUAL FIRE AND EXPLOSION HAZARD: INCOMPLETE THERMAL DECOMPOSITION MAY PRODUCE TOXIC GASES.

V HEALTH HAZARD INFORMATION

CARCINOGENICITY — NOT ON NTP, IARC OR OSHA LISTS

ACUTE ORAL LD_{50}	ACUTE DERMAL LD_{50}	AQUATIC TOXICITY (LC_{50})
ND	ND	> 100,000 ppm

ROUTES OF EXPOSURE AND EFFECTS

EYES: MAY CAUSE IRRITATION AND REDNESS
SKIN: MAY CAUSE IRRITATION
INGESTION: MAY CAUSE NAUSEA

EMERGENCY AND FIRST AID PROCEDURES

FLUSH EYES WITH RUNNING WATER FOR AT LEAST 15 MINUTES.
WASH SKIN WITH SOAP AND WATER.
IF INGESTED, CONSULT PHYSICIAN.

BEST Sheet

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

NONE

INCOMPATIBILITY

ND

HAZARDOUS DECOMPOSITION PRODUCTS

CARBON DIOXIDE, CARBON MONOXIDE

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

NONE

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

WASH AREA WITH WATER, FLUSH INTO SEWER DRAINS.

NEUTRALIZING CHEMICALS

ND

WASTE DISPOSAL METHOD

AFTER SOLIDIFYING WITH ABSORBENT MATERIAL, DISPOSE INTO SANITARY LAND FILLS.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

NONE

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

NONE

EYE

GOGGLES OR FACESHIELD

GLOVES

RUBBER

OTHER CLOTHING AND EQUIPMENT

APRON, COVERALLS, EYEWASH, AND SHOWER

BEST Sheet

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

AVOID CONTACT WITH EYES.

USE WITH ADEQUATE VENTILATION.

OTHER HANDLING AND STORAGE REQUIREMENTS

STORE IN SHELTERED AREA, OR COVER FOR MOISTURE PROTECTION.

DEPARTMENT OF TRANSPORTATION INFORMATION

PROPER SHIPPING NAME: NONE

PLACARDS: NONE

REPORTABLE QUANTITY: NONE

HAZARD CLASS: NA

ID NUMBER: NONE

HAZARDOUS SUBSTANCE: NONE

PREPARED BY **NL Baroid**
ENVIRONMENTAL SERVICES

DATE
OCTOBER, 1988

NL Baroid

Environmental, Safety and Transportation Data Sheet

THERMA-THIN DP

I PRODUCT IDENTIFICATION	
SUPPLIER NL BAROID	TELEPHONE NO. 713/987-5900
ADDRESS P.O. BOX 1675 HOUSTON, TEXAS 77251	
TRADE NAME THERMA-THIN™ DP	
GENERIC DESCRIPTION SALT OF CARBOXYLIC ACID POLYMER	

II HAZARDOUS INGREDIENTS		
MATERIAL OR COMPONENT	%	HAZARD DATA
NONE		

III PHYSICAL DATA		
BOILING POINT (°F) NA	MELTING POINT NA	FREEZING POINT NA
SPECIFIC GRAVITY (H_2O = 1) NA	VAPOR PRESSURE (mm Hg) NA	
VAPOR DENSITY (AIR = 1) NA	SOLUBILITY IN H_2O, % BY WT. 100	
% VOLATILES BY VOL. NA	EVAPORATION RATE (BUTYL ACETATE = 1) NA	
APPEARANCE AND ODOR WHITE, FREE-FLOWING BEADS	Density @ 20° C: BULK DENSITY	
pH 0.5% SOLUTION		

N/A = Not Applicable N/D = Not Determined

THERMA-THIN™ DP

HEALTH HAZARD: 0

FLAMMABILITY: 0

REACTIVITY: 0

Ratings based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

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BEST Sheet

IV FIRE AND EXPLOSION DATA

VERY LOW RISK.
USE CARBON DIOXIDE, DRY CHEMICAL OR FOAM AS A FIREFIGHTING PROCEDURE.
DUST MAY BE EXPLOSIVE IF SUFFICIENT QUANTITIES ARE MIXED IN AIR.
WHEN FIGHTING FIRES USE SELF-CONTAINED BREATHING APPARATUS.

V HEALTH HAZARD INFORMATION

CARCINOGENICITY — NOT ON NTP, IARC OR OSHA LISTS

ACUTE ORAL LD_{50}	ACUTE DERMAL LD_{50}	AQUATIC TOXICITY (LC_{50})

ROUTES OF EXPOSURE AND EFFECTS

INGESTION, INHALATION EFFECTS OF OVEREXPOSURE: NOT APPLICABLE

EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: IF SPLASHED INTO THE EYES, FLUSH WITH CLEAR WATER TO REMOVE PRODUCT.

INGESTION: IF INGESTED, GIVE EMETIC AND SEEK MEDICAL CARE.

SKIN: WASH WITH SOAP AND WATER.

BEST Sheet

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

NONE KNOWN

INCOMPATIBILITY

STRONG OXIDIZERS

HAZARDOUS DECOMPOSITION PRODUCTS

NA

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

WILL NOT OCCUR

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

DRY PRODUCT SHOULD BE SWEPT UP WITH A BROOM AND SHOVEL. DILUTED SPILLS MAY BE HOSED AWAY OR ABSORBED WITH AN INERT MATERIAL. PRODUCT SHOULD NOT BE ALLOWED TO ENTER WATERWAYS WITHOUT TREATMENT.

NEUTRALIZING CHEMICALS

NA

WASTE DISPOSAL METHOD

DISPOSE OF IN LAND FILL ACCORDING TO FEDERAL, STATE AND LOCAL REGULATIONS.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

ADEQUATE TO MINIMIZE DUST INHALATION.

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

DUST MASK IF CONDITIONS WARRANT

EYE

GOGGLES

GLOVES

NA

OTHER CLOTHING AND EQUIPMENT

NA

BEST Sheet

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

DUST GENERATED IN HANDLING THIS MATERIAL CAN BE EXPLOSIVE IF SUFFICIENT QUANTITIES ARE SUSPENDED IN AIR. IF THIS CONDITION IS LIKELY TO OCCUR, KEEP AWAY FROM IGNITION SOURCES.

OTHER HANDLING AND STORAGE REQUIREMENTS

NA

DEPARTMENT OF TRANSPORTATION INFORMATION

PROPER SHIPPING NAME:

HAZARD CLASS: NOT HAZARDOUS

HAZARDOUS SUBSTANCE:

PREPARED BY	**NL Baroid** ENVIRONMENTAL SERVICES	DATE APRIL, 1988

NL Baroid

Environmental, Safety and Transportation Data Sheet

POTASSIUM CHLORIDE

I PRODUCT IDENTIFICATION

SUPPLIER NL BAROID	TELEPHONE NO. 713/987-5900
ADDRESS P.O. BOX 1675 HOUSTON, TEXAS 77251	
TRADE NAME POTASSIUM CHLORIDE	
GENERIC DESCRIPTION POTASH, MURIATE OF POTASH	

II HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT		HAZARD DATA
NONE		

III PHYSICAL DATA

BOILING POINT (°F) NA	MELTING POINT 1454°	FREEZING POINT NA
SPECIFIC GRAVITY (H_2O = 1) 2.0	VAPOR PRESSURE (mm Hg) NA	
VAPOR DENSITY (AIR = 1) NA	SOLUBILITY IN H_2O, % BY WT. SOLUBLE	
% VOLATILES BY VOL NA	EVAPORATION RATE (BUTYL ACETATE = 1) NA	
APPEARANCE AND ODOR WHITE OR GREY GRANULAR SOLID	Density @ 20° C ND	
pH 10% SOLUTION, 7.3		

N A = Not Applicable N D = Not Determined

POTASSIUM CHLORIDE

HEALTH HAZARD: 1

FLAMMABILITY: 0

REACTIVITY: 0

Ratings based on NIOSH "Identification System for Occupationally Hazardous Materials" (1974)

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IV FIRE AND EXPLOSION DATA

KCl IS NOT FLAMMABLE OR EXPLOSIVE, AND DOES NOT SUPPORT COMBUSTION.

V HEALTH HAZARD INFORMATION

CARCINOGENICITY — NOT ON NTP, IARC OR OSHA LISTS

ACUTE ORAL LD_{50}	2500 mg/kg	ACUTE DERMAL LD_{50}	ND	AQUATIC TOXICITY (LC_{50})	ND

ROUTES OF EXPOSURE AND EFFECTS

EYE CONTACT: SEVERE IRRITATION (500 mg/24H)

SKIN CONTACT: MINOR LOCAL IRRITATION

INHALATION: MINOR IRRITATION

INGESTION: GASTROINTESTINAL IRRITATION, CIRCULATORY PROBLEMS.

NUISANCE DUST TLV = 10 mg/m^3

EMERGENCY AND FIRST AID PROCEDURES

FLUSH SKIN WITH SOAP AND WATER. REMOVE ALL CONTAMINATED CLOTHING.

FLUSH EYES WITH WARM WATER FOR AT LEAST 15 MINUTES. CONTACT PHYSICIAN.

BEST Sheet

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

STABLE SALT

INCOMPATIBILITY

Brf_3

HAZARDOUS DECOMPOSITION PRODUCTS

NONE

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

NONE

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

IN SOLUTION: SMALL SPILL - FLUSH AREA WITH COPIOUS AMOUNTS OF WATER.
LARGE SPILL - CONTAIN WITH DIKE TO PREVENT ENTRY INTO FRESH WATER STREAMS.
SOLID - SWEEP UP AND PLACE IN CONTAINER FOR DISPOSAL.

NEUTRALIZING CHEMICALS

NA

WASTE DISPOSAL METHOD

KEEP OUT OF DRINKING WATER SOURCES.

DO NOT DUMP ANY BRINE INTO NATURAL WATERS OR ANY AREA NOT DESIGNATED FOR DISPOSAL. DESIGNATED LAND FILL.

VIII INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION REQUIREMENTS

GENERAL VENTILATION
USE LOCAL EXHAUST VENTILATION WHEN NECESSARY

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY

NONE NECESSARY IN NORMAL USE.

EYE

GOGGLES

GLOVES

RUBBER GLOVES

OTHER CLOTHING AND EQUIPMENT

EYEWASH, SHOWER
PROTECTIVE CLOTHING, LEATHER SHOES AND GLOVES SHOULD NOT BE WORN WHEN EXPOSED TO HEAVY BRINES BECAUSE THEY ARE DEHYDRATED AND HARDENED.

BEST Sheet

IX SPECIAL PRECAUTIONS

PRECAUTIONARY STATEMENTS

AVOID SPILLING OR SPLASHING.
AVOID PROLONGED SKIN OR EYE CONTACT.
DO NOT WEAR LEATHER ARTICLES. THEY ARE DEHYDRATED AND HARDEN WHEN EXPOSED TO BRINES.

OTHER HANDLING AND STORAGE REQUIREMENTS

STORE IN SHELTERED AREA OR COVER FOR MOISTURE PROTECTION

DEPARTMENT OF TRANSPORTATION INFORMATION

PROPER SHIPPING NAME: NOT REGULATED

HAZARD CLASS: NOT HAZARDOUS

HAZARDOUS SUBSTANCE: NONE

LABEL: NONE REQUIRED

PREPARED BY **NL Baroid**
ENVIRONMENTAL SERVICES

DATE
JULY, 1987

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	CAUSTIC SODA

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Sodium hydroxide	CHEMICAL FORMULA	NaOH
MANUFACTURER	M-I Drilling Fluids Commercial Products	CAS NUMBER	1310-73-2
PACKAGE QUANTITY	22.7, 45.4 kg (50, 100 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	pH modifier
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Steel drum or multiwall paperbag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Sodium hydroxide [1310-73-2]	100	C:2 mg/m3 (1)	2 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	745.8 C (1388 F)	MELTING POINT	306.9 C (590 F)
pH (1% Soln.)	13	VAPOR PRESSURE @ 20°C	42 mm Hg @ 1000 C
SPECIFIC GRAVITY (H_2O=1)	2.13	SOLUBILITY IN WATER @ 20°C	Soluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Pellets, flakes	FLASH POINT (method used)	N.A.
BULK DENSITY	2130.5 kg/m3 (133 lb/ft3)	ODOR & COLOR	Odorless, white color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID	x	BASE		WATER	x	OXIDIZER	
	OTHER (Specify)	Organochlorine solvents, nitro & nitroso compounds, organic peroxides. Metals:Aluminum,Zinc,Tin & their alloys.										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.A.	U.E.L.	N.A.	AUTO IGNITION TEMPERATURE	N.A.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	When heated to decomposition the product emits toxic fumes of Na2O.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals. Noncombustible.
SPECIAL FIRE FIGHTING PROCEDURES	Protective clothing and pressure-demand, self-contained breathing apparatus should be worn by firefighters.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Contact with water can result in violent exothermic reaction. Contact with some metals (see Sec. IV) can generate hydrogen gas.

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	x	SKIN CONTACT	x	SKIN ABSORPTION		INHALATION	x	INGESTION	x
	TARGET ORGAN	Eye, skin, upper respiratory system, lungs			CARCINOGENICITY	NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	This corrosive material is extremely irritating to eyes, any bodily tissue or system with which it comes in contact. It is highly toxic if ingested.(3)
CHRONIC EFFECTS OF EXPOSURE	Product contact may result in perforation or scarring of skin or severe dermatitis. Inhalation may cause damage to respiratory tract or lung tissue varying from mild irritation to severe pneumonitis.(3)
TOXICITY DATA	Skin-Rabbit: 500 mg/24 hrs.: severe. Eye-rabbit: 1 mg/24 hrs.: severe. Oral-Rabbit LDLo: 500 mg/kg.(3)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes. Seek medical attention immediately.
SKIN	Wash thoroughly with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water and milk to dilute. Do not induce vomiting. Seek medical attention immediately.
INHALATION	Remove to fresh air. If breathing becomes difficult or there is a burning sensation seek medical attention immediately.
OTHER INSTRUCTIONS	Good measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. Persons seeking medical attention should carry a copy of this msds to the physician.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA chemical cartridge respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear rubber gloves.
EYES	Wear chemical safety goggles only. Do not use glasses when handling this material.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing. Supply an emergency eye wash and shower while this product is handled.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Danger! Toxic material cause severe burns, perforation and scarring to eyes or skin. Inhalation can cause lung damage.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Protect against physical damage. Do not store near water or acids. See the msds for more information.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment. Contain the spill. Sweep or shovel waste into a suitable container. Recycle if possible. Neutralize residue with dilute acid. Flush with water and cover with $NaHCO_3$.
WASTE DISPOSAL METHOD	This product is a hazardous substance under CERCLA. It has an RQ of 20 sacks (22.7 kg, 50 lb) Consult Environmental Services prior to disposal. Follow applicable regulations dealing with hazardous waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC X	FIRE	REACTIVITY X	SUDDEN RELEASE OF PRESSURE

Sodium hydroxide is listed by the CWA, CERCLA and DOT. It is on the Canadian IDL 1% list and is listed as a hazardous substance by Massachusetts, New Jersey and Pennsylvania.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172)	Yes		
PROPER SHIPPING NAME	Sodium hydroxide, solid	HAZARD CLASS	8, PGII
IDENTIFICATION NO.	UN 1823		
LABEL(S) REQUIRED	Corrosive		
N.O.S. DESCRIPTION	N.A.		
EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION)	173.154; 173.212; 173.240		
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	15 kg (33 lb)	
	CARGO AIRCRAFT	50 kg (110.25 lb)	

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Sodium hydroxide, solid			UN NO.	UN 1823
HAZARD CLASS	8, PGII	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	15 kg (33 lb)		PACKAGING (SEE SECTION)	814
	CARGO AIRCRAFT	50 kg (110.25 lb)		PACKAGING (SEE SECTION)	816

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Sodium hydroxide, solid			UN NO.	UN 1823
HAZARD CLASS	Corrosives	CLASS NO.	8	PAGE NO.	8225
LABEL(S)	Corrosive	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	Caustic Soda (sodium hydroxide)				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

(3) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H Pushney
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 10 July 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET

NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975," National Fire Protection Association, NFPA Publication No. 704, 23 pp)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From - OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short - or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parent; or cause the production of physical defect in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure of the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammbility, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company
P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

ORDER CODE: MSDS-338

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	SODA ASH

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Sodium Carbonate	CHEMICAL FORMULA	Na2CO3
MANUFACTURER	M-I Drilling Fluids/Comm. Prod.	CAS NUMBER	497-19-18
PACKAGE QUANTITY	100 pounds	UNIT OF ISSUE	pound
USE	Drilling Fluid Compound	APPLICATION	Calcium Precipitation
FREIGHT DESCRIPTION	Oil well drilling mud compound.		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
No hazardous ingredients				

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	851 C
pH (1% Soln.)	11.4	VAPOR PRESSURE @ 20°C	NIL
SPECIFIC GRAVITY (H_2O=1)	2.509	SOLUBILITY IN WATER @ 20°C	33.2
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Granular Solid	FLASH POINT (method used)	Noncombustible
BULK DENSITY	48 lb/ft3	ODOR & COLOR	Odorless/White

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID	x	BASE		WATER		OXIDIZER	
	OTHER (Specify)	Reacts with hydrated lime to form caustic soda										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.A.	U.E.L.	N.A.	AUTO IGNITION TEMPERATURE	N.A.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	Oxides of carbon.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals, water
SPECIAL FIRE FIGHTING PROCEDURES	None required.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	x	SKIN CONTACT	x	SKIN ABSORPTION		INHALATION	x	INGESTION	
	TARGET ORGAN	eyes, skin, upper respiratory system, stomach			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Eye, skin, severe gastrointestinal and respiratory irritant. Skin sensitization may occur in susceptible individuals. (1)
CHRONIC EFFECTS OF EXPOSURE	May cause inflammation of the mucous membranes in the respiratory tract and of the skin.
TOXICITY DATA	Oral: Human LDLo 500 mg/kg; Rat LD50 4000 mg/kg (2) Skin: Human 30 mg/3 days, mild (2); Rabbit 500 mg/24 hr mild (3) Eye: Rabbit 100 mg/24 hr mild (3)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID		
	EYES	Flush with water for at least 15 minutes.
	SKIN	Wash with soap and water. Launder clothes prior to reuse.
	INGESTION	Do not induce vomiting. Drink water or milk of magnesia. Seek medical attention.
	INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS		Avoid working with lime simultaneous with soda ash. Concentrated aqueous solutions exhibit caustic action. Avoid contact with skin and eyes. Suggest TLV for nuisance dust be followed.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton or rubber gloves.
EYES	Wear chemical safety glasses.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! May cause severe irritation of eyes and slight irritation of nose and throat.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Keep dust to a minimum. Do not store near lime or acids.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, ase see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Contain spill. Sweep into waste container. Rebag if possible. Recycle or sell if possible. Wash residue with water.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to state and local regulations dealing with nonhazardous chemical waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE x	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

EPA: Air pollutant 40 CFR 51 (App. C) designation 21 CFR 182.1742; .70, .90

FDA: Safe

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	Not restricted	HAZARD CLASS	Nonhazardous
IDENTIFICATION NO.	None		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	N.A.		
EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION)	N.A.		
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	
	CARGO AIRCRAFT	N.A.	

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION)	N.A.	
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION)	N.A.	

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	N.A.				

XIII. ADDITIONAL INFORMATION

References:
(1) Silvestro, et al. 1980. Toxicity of Chemical Compounds Used for Enhanced Oil Recovery.
(2) Tatken & Lewis, 1983. Registry of Toxic Effects of Chemical Substances.
(3) Sax, 1984. Dangerous Properties of Industrial Materials.

FOR ADDITIONAL INFORMATION CONTACT: Manager, Environmental Services (713) 561-1507	Prepared by: Frederick V. Jones Date Prepared: Revised: Dec. 1988

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET

NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Letnal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

MI 630

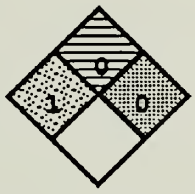
8875M Litho is U S A

M-I Drilling Fluids Co.
Magcobar/IMCO A Dresser/Halliburton Company

P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	SULF-X



Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Zinc oxide	CHEMICAL FORMULA	ZnO
MANUFACTURER	M-I Drilling Fluids Company	CAS NUMBER	1314-13-2
PACKAGE QUANTITY	22.7 kg (50 lb)	UNIT OF ISSUE	kg (lb)
USE	Drilling fluid additive	APPLICATION	Hydrogen sulfide scavenger
FREIGHT DESCRIPTION	Oil well drilling fluid additive		
CONTAINER SPECIFICATIONS	Multiwall paper bag meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Zinc oxide, total dust [1314-13-2]	100	10 mg/m3 (1)	10 mg/m3 (2)	

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.A.	MELTING POINT	1975 C
pH (1% Soln.)	N.A.	VAPOR PRESSURE @ 20°C	N.A.
SPECIFIC GRAVITY (H_2O=1)	5.47	SOLUBILITY IN WATER @ 20°C	Insoluble
VAPOR DENSITY (air=1)	N.A.	EVAPORATION RATE (BUTYL ACETATE=1)	N.A.
PHYSICAL APPEARANCE	Powder	FLASH POINT (method used)	N.A.
BULK DENSITY	2627 kg/m3 (164 lb/ft3)	ODOR & COLOR	Odorless, white color

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes
PRODUCT DECOMPOSES?	No
PRODUCT POLYMERIZES?	No

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	
	OTHER (Specify)	Violent reaction with chlorinated rubber at 215°C. Incompatible with magnesium.										

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	When heated to decomposition, product emits toxic fumes of ZnO. Product is non-combustible.
EXTINGUISHING MEDIA	Carbon dioxide, dry or foam chemicals, and water.
SPECIAL FIRE FIGHTING PROCEDURES	Self-contained breathing apparatus may be required when extinguishing fires involving this material.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Reacts violently with chlorinated rubber, magnesium and linseed oil under elevated temperatures (215°C).

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION	
	TARGET ORGAN	Eyes, skin, gastrointestinal system			CARCINOGENICITY					
					NTP	No	IARC	No	OSHA	No

ACUTE EFFECTS OF EXPOSURE	Moderate eye and skin irritation. If ingested, may cause abdominal discomfort, watering diarrhea and cramps. Inhalation may create symptoms of chills, cough, dyspnea and breathing difficulty.(3)
CHRONIC EFFECTS OF EXPOSURE	N.D.
TOXICITY DATA	Skin-Rabbit: 500 mg/24 hour: mild irritation. Eye-Rabbit: 500 mg/24 hour: mild irritation. Intraperitoneal-Rat LD50: 240 mg/kg. Inhalation-Human TCLo: 600 mg/m3.(3)

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	
EYES	Flush with water for at least 15 minutes.
SKIN	Wash with soap and water. Launder clothes prior to reuse.
INGESTION	Drink water to dilute.
INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS	Ordinary measures of personal hygiene should be observed. Sensitive individuals should avoid further contact. If irritation persists, seek medical attention.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA particulate respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wash thoroughly with soap and water.
EYES	Wear chemical safety goggles or glasses with sideguards. Insure proper fit for best protection.
OTHER PROTECTIVE EQUIPMENT	None required.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! This product may irritate eyes, skin and the upper respiratory system. See the msds for proper protection.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry area. Keep dust to a minimum.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Wear proper protective equipment (Section VIII). Contain the spill. Rebag and sell or recycle if possible. Sweep waste into a suitable container. Keep out of sewers and waterways.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose of according to local or state regulations dealing with nonhazardous waste.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC X	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

Zinc oxide is on the Canadian IDL 1% list and appears on hazardous substance lists in Massachusetts, New Jersey and Pennsylvania.

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	See n.o.s. description	HAZARD CLASS	Not restricted
IDENTIFICATION NO.	N.A.		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	Drilling fluid additive, n.o.s. (zinc oxide)		
EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION)	N.A.		
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	
	CARGO AIRCRAFT	N.A.	

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Drilling fluid additive, n.o.s. (zinc oxide)			UN NO.	N.A.
HAZARD CLASS	Not restricted	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION)	N.A.	
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION)	N.A.	

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Drilling fluid additive, n.o.s. (zinc oxide)			UN NO.	N.A.
HAZARD CLASS	Not restricted	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	None	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	N.A.				

XIII. ADDITIONAL INFORMATION

References:

(1) Chemical Guide to the OSHA Hazard Communication Standard, Sixth Edition; Clansky, K. B., Ed.; Roytech: Burlingame, CA, 1991.

(2) 1991-1992 Threshold Limit Values; American Conference of Governmental Industrial Hygienists: Cincinnati, 1991.

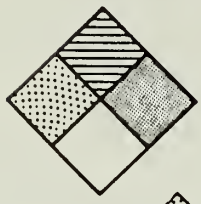
(3) Sax, N. I.; Lewis, Sr., R. J.; Dangerous Properties of Industrial Materials, Seventh Edition; Van Nostrand Reinhold: New York, 1989.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by: James H Rushing
Manager, Environmental Affairs (713) 561-1507	Date Prepared: Revised 9 July 1992

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET



NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

SECTION VI. HEALTH HAZARD INFORMATION

Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

Acute Effects of Exposure: Acute effect applies to injuries which rapidly follow through direct exposure to a hazardous material without implying degree of severity.

Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I Drilling Fluids Co.
Magcobar/NCO A Dresser/Halliburton Company
P.O. Box 42842 Houston, Texas 77242, (713) 561-1507

ORDER CODE: MSDS-044

TRANSPORTATION & MATERIAL SAFETY DATA SHEET

TRADE NAME	CONQOR 404

Emergency Telephone Number	(713) 561-1600 561-1300 Day or Night

PREAMBLE

M-I Drilling Fluids Co. is pleased to furnish this data at your request independent of any sale of the product. While every effort has been made to accurately describe this product and associated manifestations, some of the data is obtained from the open literature, independent laboratory studies, or other sources beyond our direct supervision. We cannot make any assertion as to the reliability or completeness; therefore, the Buyer may rely thereon only at Buyer's risk. We have made no effort to censor nor to conceal deleterious aspects of this product. Since we cannot anticipate or control the many different conditions under which this information and our products may be used, we make no guarantee that the health and safety precautions we have suggested will be adequate for all individuals and/or situations involving its handling and use. Likewise we make no guarantee or warranty of any kind that the use or disposal of this product is in compliance with all federal, state or local laws. It is the obligation of each user of this product mentioned herein to determine and comply with the requirements of all applicable statutes. M-I Drilling Fluids Co. will furnish, upon request, any additional available information to assist the Buyer; however, no warranty, either expressed or implied, nor liability of any nature with respect to the product or to the data herein is made or incurred hereunder.

I. PRODUCT IDENTIFICATION

COMMON NAME	Phosphate ester salt	CHEMICAL FORMULA	Blend
MANUFACTURER	M-I Drilling Fluids/Comm. Prod.	CAS NUMBER	Multiple
PACKAGE QUANTITY	5, 55 gallons	UNIT OF ISSUE	gallons
USE	Drilling Fluid Compound	APPLICATION	Corrosion inhibitor
FREIGHT DESCRIPTION	Oil well drilling mud compound		
CONTAINER SPECIFICATIONS	Steel drum meets DOT requirements (49 CFR 178)		

II. HAZARDOUS INGREDIENTS (DOT, EPA, OSHA, ACGIH)

MATERIAL OR COMPONENT	%	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
No hazardous ingredients				

III. PHYSICAL DATA

BOILING POINT: 760 mm Hg	N.D.	MELTING POINT	N.A.
pH (1% Soln.)	7-8	VAPOR PRESSURE @ 20°C	N.D.
SPECIFIC GRAVITY (H_2O=1)	1.41	SOLUBILITY IN WATER @ 20°C	soluble
VAPOR DENSITY (air=1)	N.D.	EVAPORATION RATE (BUTYL ACETATE=1)	N.D.
PHYSICAL APPEARANCE	Liquid	FLASH POINT (method used)	>200 F PMCC
BULK DENSITY	11.7 lbs/gal	ODOR & COLOR	No odor; light amber

IV. REACTIVITY DATA

PRODUCT IS STABLE?	Yes	
PRODUCT DECOMPOSES?	No	Biodegradable
PRODUCT POLYMERIZES?	No	

INCOMPATIBILITY	AIR		HEAT		ACID		BASE		WATER		OXIDIZER	X
	OTHER (Specify)											

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than

Note For additional information and interpretive assistance, please see last page

V. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABLE LIMITS BY AIR, % BY VOL.	L.E.L.	N.D.	U.E.L.	N.D.	AUTO IGNITION TEMPERATURE	N.D.

PRODUCTS EVOLVED WHEN SUBJECTED TO HEAT BY COMBUSTION	CO, CO2
EXTINGUISHING MEDIA	CO2, dry chemical, water may be used for cooling containers
SPECIAL FIRE FIGHTING PROCEDURES	None
UNUSUAL FIRE AND EXPLOSION HAZARDS	None

VI. HEALTH HAZARD INFORMATION

PRIMARY ROUTES OF EXPOSURE	EYE CONTACT	X	SKIN CONTACT	X	SKIN ABSORPTION		INHALATION	X	INGESTION		
	TARGET ORGAN	Eye, skin, upper respiratory system			CARCINOGENICITY						
					NTP	No	IARC	No	OSHA	No	

ACUTE EFFECTS OF EXPOSURE	Not expected to be a problem under normal conditions.
CHRONIC EFFECTS OF EXPOSURE	Prolonged or excessive exposure may result in respiratory irritation, headaches and nausea. May cause gastrointestinal disturbances if ingested. May produce mild irritation on prolonged skin contact.
TOXICITY DATA	None reported for blended product.

VII. EMERGENCY AND FIRST AID PROCEDURES

FIRST AID	EYES	Flush with water for at least 15 minutes.
	SKIN	Wash with soap and water. Launder clothes prior to reuse.
	INGESTION	Induce vomiting; dilute with water; seek medical attention.
	INHALATION	Remove to fresh air.
OTHER INSTRUCTIONS		Ordinary measures of personal hygiene should be observed.

VIII. OCCUPATIONAL CONTROL MEASURES

RESPIRATORY	Use an approved NIOSH/MSHA respirator.
VENTILATION	Supply adequate natural or mechanical ventilation.
SKIN	Wear cotton or rubber gloves.
EYES	Wear chemical safety glasses.
OTHER PROTECTIVE EQUIPMENT	Wear long, protective clothing.

IX. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING	Warning! May cause irritation if exposed for a prolonged period. Avoid contact with eyes, skin, clothing. Do not inhale.
PRECAUTIONS FOR TRANSPORTATION HANDLING AND STORAGE	Store in dry cool area. Keep away from oxidizers.

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, ~~see~~ see last page.

CONQOR 404, p. 2

X. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Contain spill. Cover with absorbent material. Sweep into waste container. Keep out of sewer and waterway. Recycle if possible.
WASTE DISPOSAL METHOD	Material is not classified as a hazardous waste by RCRA standards. Dispose according to local or state regulations dealing with chemical wastes.

XI. U.S. GOVERNMENT & OTHER REGULATORY AGENCY CONTROLS

SARA TITLE III	ACUTE X	CHRONIC	FIRE	REACTIVITY	SUDDEN RELEASE OF PRESSURE

XII. TRANSPORTATION INFORMATION

A. DEPARTMENT OF TRANSPORTATION (DOT)

CLASSIFIED AS A HAZARDOUS MATERIAL ACCORDING TO DOT (49 CFR 172) No

PROPER SHIPPING NAME	Not restricted	HAZARD CLASS	Nonhazardous
IDENTIFICATION NO.	None		
LABEL(S) REQUIRED	None		
N.O.S. DESCRIPTION	N.A.		
EXCEPTIONS & PACKAGING REQUIREMENTS (SEE SECTION)	N.A.		
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	
	CARGO AIRCRAFT	N.A.	

B. AIR TRANSPORT REGULATIONS (IATA/ICAO)

PROPER SHIPPING NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	FLASH POINT	N.A. °F	N.A. °C	
MAXIMUM QUANTITY IN ONE PACKAGE	PASSENGER AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		
	CARGO AIRCRAFT	N.A.	PACKAGING (SEE SECTION) N.A.		

C. INTERNATIONAL MARITIME ORGANIZATION REGULATIONS (IMO)

SUBSTANCE NAME	Not restricted			UN NO.	N.A.
HAZARD CLASS	Nonhazardous	CLASS NO.	N.A.	PAGE NO.	N.A.
LABEL(S)	N.A.	FLASH POINT	N.A. °F	N.A. °C	
DESCRIPTION	N.A.				

XIII. ADDITIONAL INFORMATION

References:
None.

FOR ADDITIONAL INFORMATION CONTACT:	Prepared by:
Manager, Environmental Services (713) 561-1507	Date Prepared: Revised: Dec. 1988

N.D.-Not Determined N.A.-Not Applicable <-Less Than >-Greater Than
Note: For additional information and interpretive assistance, please see last page.

EXPLANATION OF THE TRANSPORTATION AND MATERIAL SAFETY DATA SHEET

NFPA Hazard Alert Symbols

From - "Identification System: Fire Hazards of Materials 1975", National Fire Protection Association, NFPA Publication No. 704, 23 pp.)

Degree of Health Hazard

Type of Possible Injury

4 A few whiffs of the vapor could cause death; or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing which is designed for resistance to heat.

3 Materials extremely hazardous to health, but areas may be entered with extreme care. Full protective clothing should be provided. No skin surface should be exposed.

2 Materials hazardous to health, but areas may be entered freely with self-contained breathing apparatus.

1 Materials only slightly hazardous to health.

0 Materials which on exposure under fire conditions would offer no health hazard beyond that of ordinary combustible material.

Degree of Flammability

Susceptibility of Materials to Burning

4 Very flammable gases, very volatile flammable liquids, and materials that in the form of dusts or mists readily form explosive mixtures when dispersed in air.

3 Liquids ignitable under almost all normal temperature conditions solids that burn rapidly, and any material that ignites spontaneously at normal temperatures in air.

2 Liquids which must be moderately heated before ignition will occur and solids that readily give off flammable vapors.

1 Materials that must be preheated before ignition can occur.

0 Materials that will not burn.

Degree of Reactivity

Susceptibility to Release of Energy

4 Materials which in themselves are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures.

3 Materials which in themselves are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation.

2 Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate.

1 Materials which in themselves are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.

0 Materials which are normally stable even under fire exposure conditions and which are not reactive with water.

A W in the bottom space of the diamond alerts fire fighting personnel to the possible hazard in use of water. The violence of the reaction with water is indicated by the degree number in the REACTIVITY category.

SECTION II. HAZARDOUS INGREDIENTS

For the purposes of this form, a material shall be defined as hazardous if it meets any one of the following criteria (From — OSHA 29 CFR Part 1910 Hazard Communication):

(1) Toxicity - A toxic substance is one that has demonstrated the potential to: endanger human life by exposure via any route found in the workplace; produce short- or long-term disease or bodily injury; affect health adversely; induce cancer or other neoplastic effects in man or experimental animals; induce a transmissible change in the characteristics of an offspring from those of its human or experimental animal parents; or cause the production of physical defects in the developing human or experimental animal embryo. As required by OSHA, these substances are identified if they are present in quantities greater than 1%, or in the case of carcinogens, greater than 0.1%, or if a hazard is determined at a lower concentration.

Toxic substances not regulated under OSHA 29 CFR 1910 but covered by other governmental regulations will be listed as required under any state regulation or the following federal regulations: CERCLA/Superfund 40 CFR 117; Toxic Substance Control Act (TSCA), FIFRA pesticide registration; Resource Conservation and Recovery Act (RCRA), and the Federal Clean Air and Water Acts 40 CFR 60-61, 40 CFR 401 and 116.

(2) Corrosive - As defined by OSHA is a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

(3) Irritant - As defined by OSHA is a chemical which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

(4) Sensitizer - As defined by OSHA is a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

(5) Physical Hazards - As defined by OSHA, DOT and RCRA will be based on the flammability, corrosivity, reactivity and/or explosive nature of the product as a whole, the mixture or individual ingredients as determined to be the most hazardous.

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Primary Routes of Exposure: Should indicate one or more possible pathways by which substance may affect the human body.

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Chronic Effects of Exposure: Chronic effect applies to injuries which are delayed and occur after repeated or prolonged exposure to a hazardous material without implying degree of severity.

Median Lethal Dose (LD_{50}, LC_{50}): Median Lethal Dose (MLD) refers to the Lethal Dose (LD) or Lethal Concentration (LC) of the material which will produce death in 50 percent of the test animals. LD_{LO} is the single lowest reported dose that has proven to be fatal in one individual. TD_{LO} is the single lowest reported dose which has caused a specific toxic effect in an individual.

SECTION XI. U.S. GOVERNMENT AND OTHER REGULATORY AGENCY CONTROLS

Specifies if the use and marketing of the product is restricted by the indicated federal regulatory agencies or state and local regulations. This list is not intended as a comprehensive review of all regulations or concerned agencies; rather, it is a quick check of several major agencies or regulations.

M-I PRODUCT BULLETIN

CONQOR 404

CONQOR 404 corrosion inhibitor is an all purpose water-soluble organophosphorous compound. It forms a strong protective film on metal surfaces downhole which protects against corrosion attack.

TYPICAL PHYSICAL PROPERTIES

Appearance	light amber liquid	Flash Point	>200°F; (93°C)
Specific Gravity	1.406 @ 77°F (25°C)	pH	7.5
Solubility	100% water	Viscosity (CPS)	± 21 @ 60°F (15.6°C)

APPLICATION

CONQOR 404 is effective in all water-base muds. It is particularly effective against oxygen corrosion in aerated muds, low solids non-dispersed polymer muds, and potassium muds.

CONQOR 404 is effective at relatively low concentrations and should be dispersed evenly throughout the mud system. It should be added through the chemical barrel or directly to the mud.

For mud systems, an initial treatment of 2-4 gallons per 100 bbls is recommended.

For aerated systems, an initial treatment of 1-2 gallons per 100 bbls is recommended.

The recommended CONQOR 404 concentration maintained in the system is dependent upon the corrosive environment. Corrosion rates should be monitored with drill pipe corrosion rings at all times. If the corrosion rate is unacceptably high, a treatment of seven gallons CONQOR 404 per 100 bbls of fluid should be added and maintained to control the problem.

ADVANTAGES

1. CONQOR 404 is very effective against oxygen corrosion, the most common form of corrosion in drilling fluids.
2. It is not usually necessary to use an oxygen scavenger when using CONQOR 404.
3. CONQOR 404 is a potassium based product and is compatible with all potassium based fluid systems.
4. CONQOR 404 has very little effect on fluid rheology.
5. CONQOR 404 is effective in fresh to saturated salt concentrations.
6. CONQOR 404 is effective in aerated fluids, such as those used in air drilling operations.
7. CONQOR 404 is effective up to 400°F.

LIMITATIONS

1. CONQOR 404 loses some of its effectiveness when Ca^{++} concentrations exceed 200 mg/l.
2. Higher concentrations of CONQOR 404 are required when Ca^{++} concentrations exceed 200 mg/l.

TOXICITY AND HANDLING

Bioassay results for CONQOR 404 are available upon request.

There are no special handling requirements with CONQOR 404, however, as in the case of all liquid chemicals, skin contact should be avoided and safety goggles should be worn when mixing.

PACKAGING/HANDLING

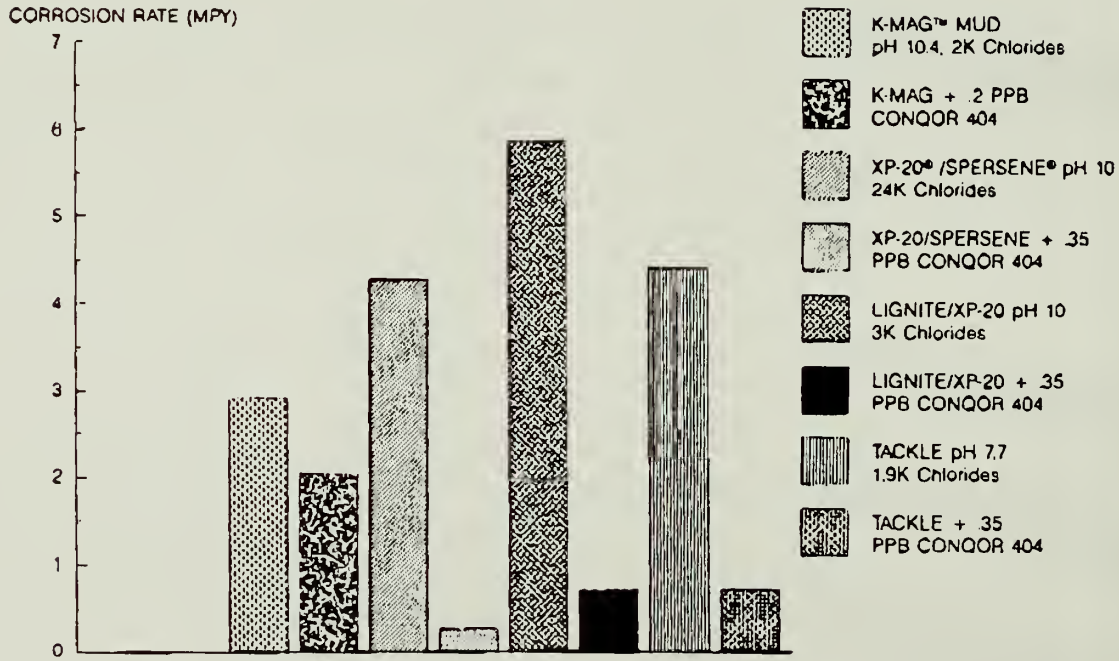
CONQOR 404 is packaged in 55 gallon (208 dm^3) drums and is available at M-I stockpoints.

The above data is supplied solely for informational purposes and M-I Drilling Fluids Company makes no guarantees or warranties, either expressed or implied with respect to the accuracy or use of this data. All product warranties and guarantees shall be governed by the standard contract terms at the time of sale.

CORROSION RATE PERFORMANCE DATA OF CONQOR 404 M-I DRILLING FLUID SYSTEMS

ROTATED 16 HOURS @ 180 DEGREES FAHRENHEIT

CORROSION RATES IN WATER MUD SYSTEMS AS COMPARED TO THE BASE SYSTEM. RATES IN MPY (MILS PER YEAR)



ROTATED 16 HOURS @ 180 DEGREES FAHRENHEIT

CORROSION RATES IN WATER MUD SYSTEMS AS COMPARED TO THE BASE SYSTEM. RATES IN MPY (MILS PER YEAR)

M-I Drilling Fluids Co.
P.O. Box 42842 Houston, Texas 77042
(713) 561-1300

MI 4004(10872M) Litho In U.S.A.

ALLIED COLLOIDS INC

2301 WILROY ROAD, P.O. BOX 820
SUFFOLK, VA 23439-0820
(804) 538-3700

24-HOUR EMERGENCY CONTACT
CHEMTREC 800/424-9300

Material Safety Data Sheet

SECTION I - IDENTIFICATION

PRODUCT **ALCOMER® 120**

ISSUE/REV DATE 17-Aug-92

CHEMICAL FAMILY Copolymer of sodium acrylate and acrylamide.

DESCRIPTION White, free flowing micro-beads with little or no odor.

HMIS RATING (NPCA)

H 0
F 1
R 0
P *

SECTION II - HAZARDOUS INGREDIENTS

INGREDIENT	CAS No	LIMIT(S) IN AIR PPM	LIMIT(S) IN AIR mg/m³	REMARKS
This product is not hazardous as defined in 29CFR1910.1200				

SECTION III - PHYSICAL PROPERTIES

BOILING POINT NA

SPECIFIC GRAVITY 0.8-1.0

VAPOR DENSITY (air=1) NA

pH NA

VOLATILES (% by volume) NA

VAPOR PRESSURE (mmHg) NA

EVAPORATION RATE (ether=1) NA

SOLUBILITY IN WATER Soluble - solubility limited by viscosity.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
Carbon dioxide, dry chemical or foam.

FLASH POINT NA

LEL NA

UEL NA

SPECIAL FIRE FIGHTING PROCEDURES
No special procedures. However, wetted product presents a slip hazard. Pedestrian and vehicular traffic must proceed with caution where wet product may exist.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Dust in sufficient concentration can result in an explosive mixture in air. Handle to minimize dusting, and eliminate open flame and other sources of ignition.

SECTION V - REACTIVITY DATA

STABILITY
STABLE

HAZARDOUS POLYMERIZATION
WILL NOT OCCUR.

INCOMPATIBILITY Strong oxidants such as liquid chlorine, enriched gaseous or liquid oxygen, and sodium or calcium hypochlorite.

HAZARDOUS DECOMPOSITION PRODUCTS:
Thermal decomposition or combustion may produce oxides of carbon and nitrogen, various hydrocarbons, and/or ammonia which may be irritating or harmful.

ALCOMER IS A TRADEMARK OF ALLIED COLLOIDS INC

Allied Colloids Inc

Material Safety Data Sheet

SECTION VI - HEALTH HAZARD DATA

NATURE OF PRINCIPAL HAZARD(S): NA (not a health hazard as defined by OSHA)

TARGET ORGAN(S): NA

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE:
Eye contact may produce slight irritation and/or redness.
Inhaled dust may cause some respiratory irritation.

CARCINOGENICITY:
Not listed as a carcinogen by IARC, NTP, OSHA or ACGIH

EXPOSURE LIMITS (as particulates not otherwise regulated):
The OSHA 8-hour TWA for total dust is 15 mg/cu-meter (5 mg/cu-meter for the respirable fraction). The ACGIH TLV-TWA is 10 mg/cu-meter.

SAFETY PRECAUTIONS:
Do not get in eyes, on skin, on clothing.
Wash thoroughly after handling.
Avoid prolonged or repeated inhalation of dust.
Avoid prolonged or repeated skin contact.
Caution - slip hazard - see Sections IV and/or VII.

FIRST AID:

EYE CONTACT: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION: Do not give an emetic unless directed by a physician. Never give anything by mouth to an unconscious person.

SKIN CONTACT: Remove contaminated clothing and launder before reuse. Wash effected area with soap and water.

INHALATION: Remove to fresh air.

SECTION VII - ENVIRONMENTAL DATA

SPILL OR LEAK PROCEDURES

Product becomes slippery and difficult to handle when wet; spills are best handled while still dry. Sweep up and collect dry product. Absorb wet product with vermiculite or other inert material. Then water wash area to waste treatment to eliminate slip hazard.

WASTE DISPOSAL METHOD

Disposal must be arranged in accordance with local, state and federal regulations. This material, when unadulterated, is not a RCRA regulated hazardous waste. However, local disposal regulations will often apply. Care must be taken to prevent environmental contamination from the disposal of material, residues and containers.

SECTION VIII - PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION	Use NIOSH approved dust respirator as required to control exposure. Follow ANSI Z88.2.		
PROTECTIVE GLOVES	Not normally required.	EYE PROTECTION	Goggles (ANSI Z87.1 std; safety glasses alone do not protect from dust).
VENTILATION	Provide mechanical ventilation to prevent dust concentrations, and to reduce potential exposure.		
OTHER EQUIPMENT:	Provide eyewash station(s). Select additional protective equipment (eg apron, face shield, etc.), depending on conditions of use.		

SECTION IX - REGULATORY INFORMATION

SHIPPING INFORMATION

PROPER SHIPPING NAME NOT A DOT/IMO HAZARDOUS MATERIAL

ID NUMBER NA RQ. NA DOT EMERGENCY GUIDE (ERG) # 31

HAZARD CLASS or DIVISION NA PACKING GROUP -

TSCA COMPONENTS APPEAR ON THE TSCA INVENTORY

SARA PRODUCT HAZARD CATEGORIES (Sec 311) PRODUCT NOT SUBJECT TO REPORTING

The following components are defined as toxic chemicals subject to reporting requirements of SARA Section 313 and of 40 CFR 372.

No components are 313 Toxic Chemicals

STATE LABELLING INFORMATION

NJ RTK LABEL - COMPONENTS INCLUDE	CAS or ID #
COPOLYMER OF ACRYLAMIDE:SODIUM ACRYLATE	25085-02-3
WATER	7732-18-5
UREA	57-13-6

CA PROP 65 CALL FOR ADDITIONAL INFORMATION

SECTION X - ADDITIONAL INFORMATION

NA=Not Applicable; ND=Not Determined or No Data

Good personal hygiene practices can reduce potential exposure. Wash with soap and water following any contact with this product, as well as before breaks and meals. Shower and change clothing at end of work shift. If clothing becomes contaminated, remove and launder or dry-clean before reuse.

The information and recommendations contained herein are, to the best of Allied Colloids Inc's knowledge and belief, accurate and reliable as of the date issued. This document is offered in good faith. The information is related to the specific material designated, and may not be valid for such material used in combination with any other material or in any process or in a manner other than for which it is intended.

Allied Colloids Inc does not warrant or guarantee accuracy, reliability or completeness. It is the user's responsibility to satisfy himself as to the suitability and completeness of such information for his own particular use. We do not accept liability for any loss or damage that may occur from the use of this information, nor do we offer warranty against patent infringement.

Allied Colloids Inc
Material Safety Data Sheet

APPENDIX B

LETTER TO NATIONAL PARK SERVICE, ANCHORAGE, ALASKA, WITH SITE LAYOUT FOR EXTENDED SEASON OPERATION

Sandia National Laboratories

Albuquerque, New Mexico 87185

September 10, 1992

Joan Darnell, Chief
Division of Environmental Quality
National Park Service, Alaska Regional Office
2525 Gambell Street
Anchorage, Alaska 99503-2892

Dear Joan:

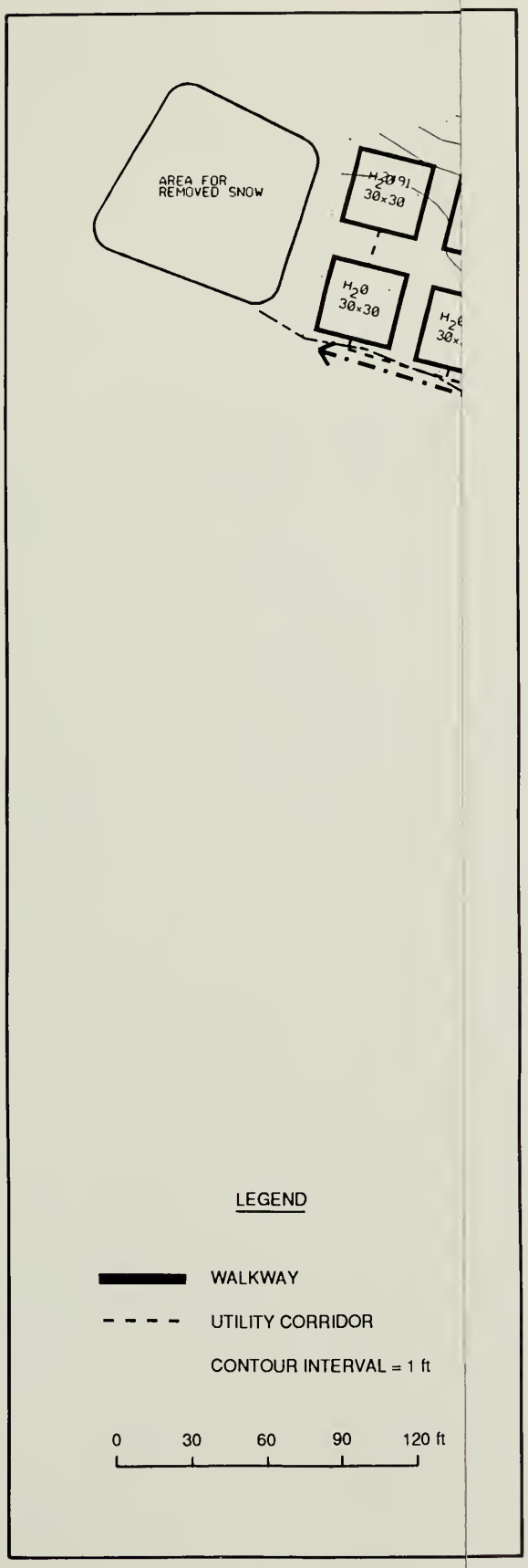
I am enclosing a site layout for the split season operation. There is a great similarity to the site layout for the basic two season proposal described in the Revised Operations plan, which was sent out on August 19. Note, however, that provisions have been made for additional water and fuel storage as well as areas where snow can be piled. This layout has no direct analogue in the Revised Operations Plan.

Sincerely,

A. R. Sattler
Geotechnology Research
Department 6112

Enclosure

Copy to: (w/enc)
A. Eliason, NPS, King Salmon, AK
R. Potts, NPS, King Salmon, AK
W. Rice, NPS, Anchorage, AK
C. Neal, USGS, Anchorage, AK
T. Keith, USGS, Anchorage, AK
W. Hildreth, USGS, Menlo Park, CA
W. Luth, DOE/OBES, Wash., DC
T. Torgersen, DOE/OBES, Wash., DC
J. Eichelberger, U of AK, Fairbanks, AK
J. Hemming, Dames & Moore, Anchorage, AK
E. Johnson, Dames & Moore, Seattle, WA
H. Friedman, Ch2M Hill
D. Blankenship, RE/SPEC
J. Papike, UNM, Albq., NM
210 R. Park
210 C. Hall
6100 P. Hommert, Acting
6111 J. Dunn
6112 D. Northrop
6112 A. Sattler
6116 W. Walck
7731 T. Wolfe
7731 J. Halpern



Kat-82-0

Figure B-1. Site Layout for Extended Season Operations

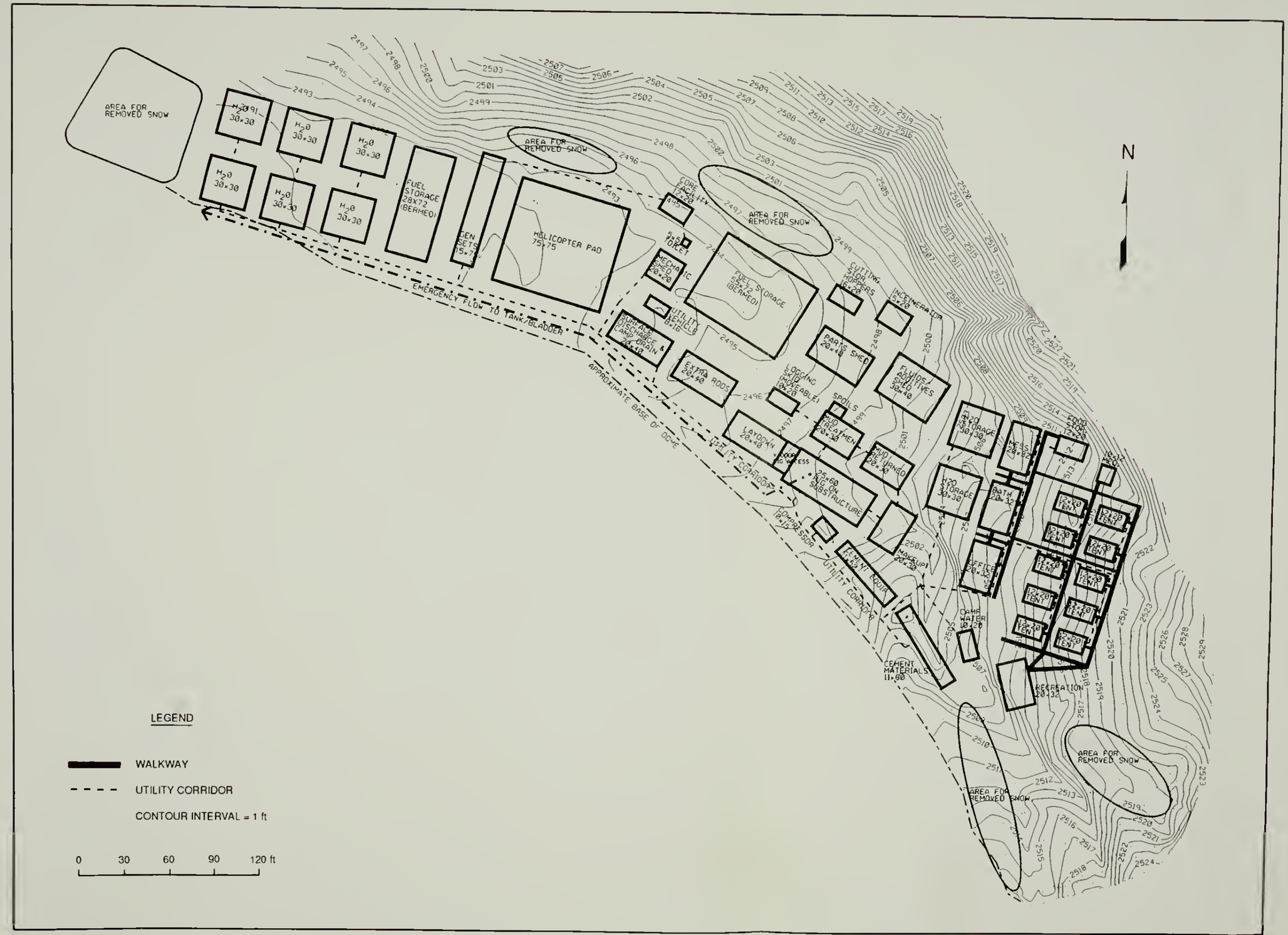


Figure B-1. Site Layout for Extended Season Operations

APPENDIX C

LETTER TO NATIONAL PARK SERVICE, ANCHORAGE, ALASKA, AND KATMAI NATIONAL PARK AND PRESERVE, KING SALMON, ALASKA, WITH REVISED SITE LAYOUT AT NOVARUPTA DOME, REVISED SITE LAYOUT AT ASH-FLOW SITE, AND REVISED WATER LINE LAYOUT

Sandia National Laboratories
Albuquerque, New Mexico 87185

August 19, 1992

Joan Darnell, Chief
Division of Environmental Quality
National Park Service, Alaska Regional Office
Anchorage Alaska
2525 Gambell Street
Anchorage, Alaska 99503-2892

Rick Potts
Chief, Resource Management
Katmai National Park & Preserve
P. O. Box 7
King Salmon, Alaska 99613

Enclosed are the revised site layouts for the proposed Katmai Scientific Drilling program. These layouts are available as a result of surveys carried out at the proposed drill sites July 8-10. This work was carried out under a permit issued by the Katmai National Park office. The layouts of the waterline routes have been revised slightly and are enclosed also. There are then three layouts:

- A layout of the drill site and camp at dome site. The boundary of the dome is shown from survey data. This supersedes Figure 4-10 of the Revised Operations Plan.

- A layout of the ash-flow site. This supersedes Figure 4-11 of the Revised Operations Plan.

- A layout of the primary and alternate routes of the waterline. This figure supersedes Figure 8-1 of the revised operations plan.

Please keep in mind that the Valley of Ten Thousand Smokes is very active geologically. The surface of the valley consists largely of unconsolidated ash and pumice. There is a large amount of erosion and local alluviation. This undoubtedly will necessitate some minor rerouting of portions of the water line and some adjustments to the site layouts if the project is fielded.

Sincerely,

Allan R. Sattler

Allan R. Sattler
Geotechnology Research
Department 6112

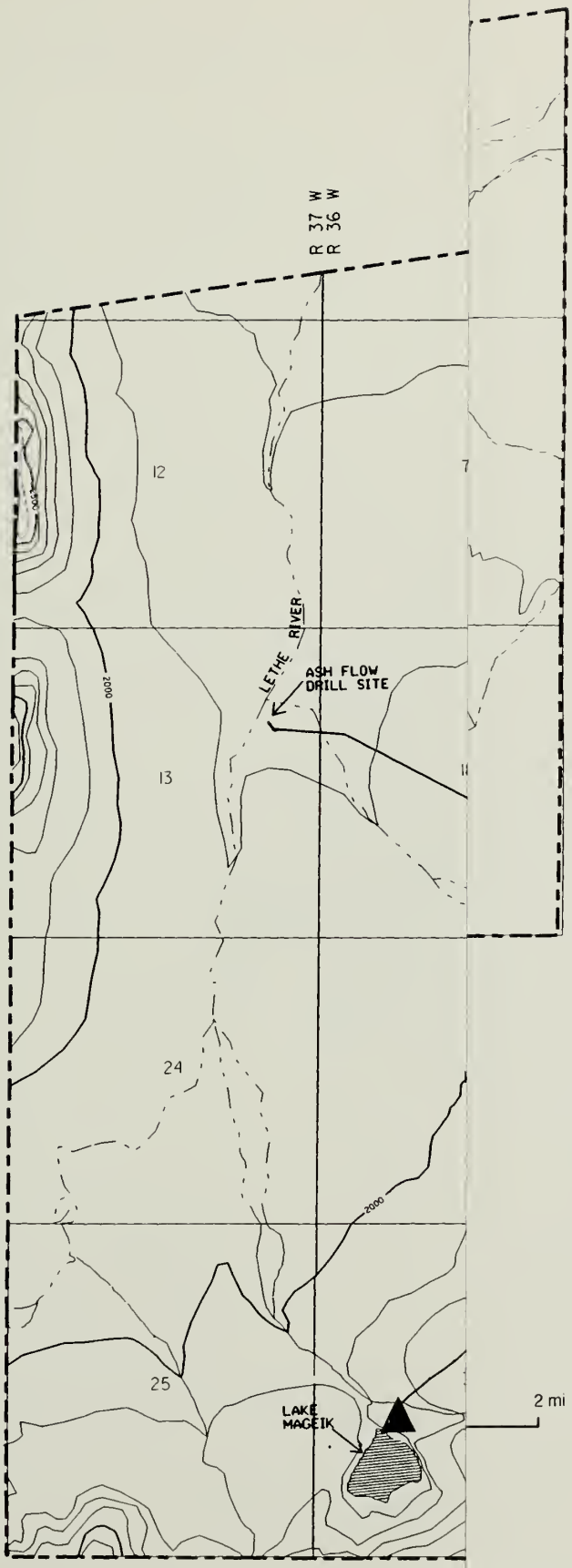


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Figure C-3. Revised Water Line Layout

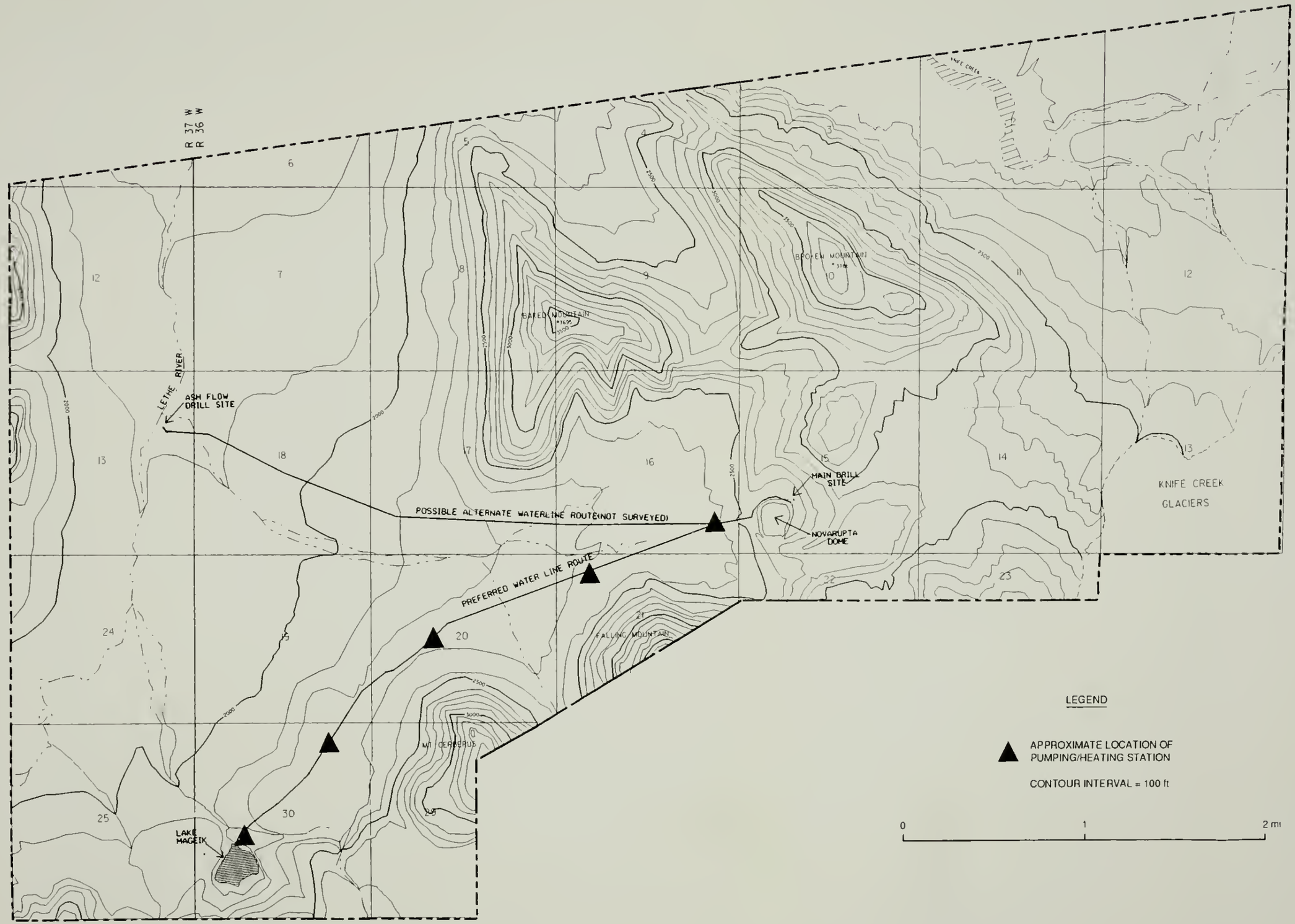

Figure C-3. Revised Water Line Layout

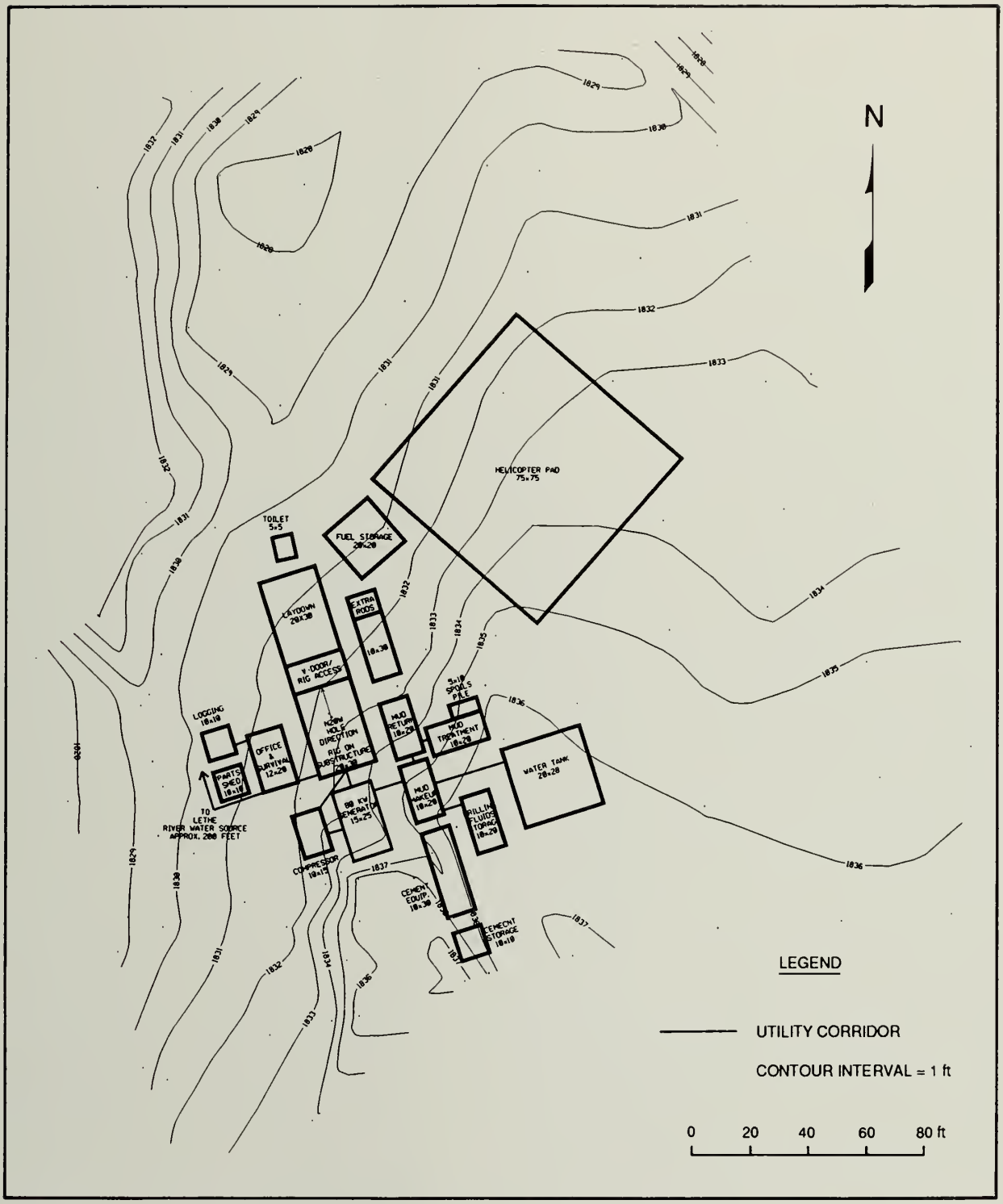

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Figure C-2. Revised Site Layout at Ash-Flow Site

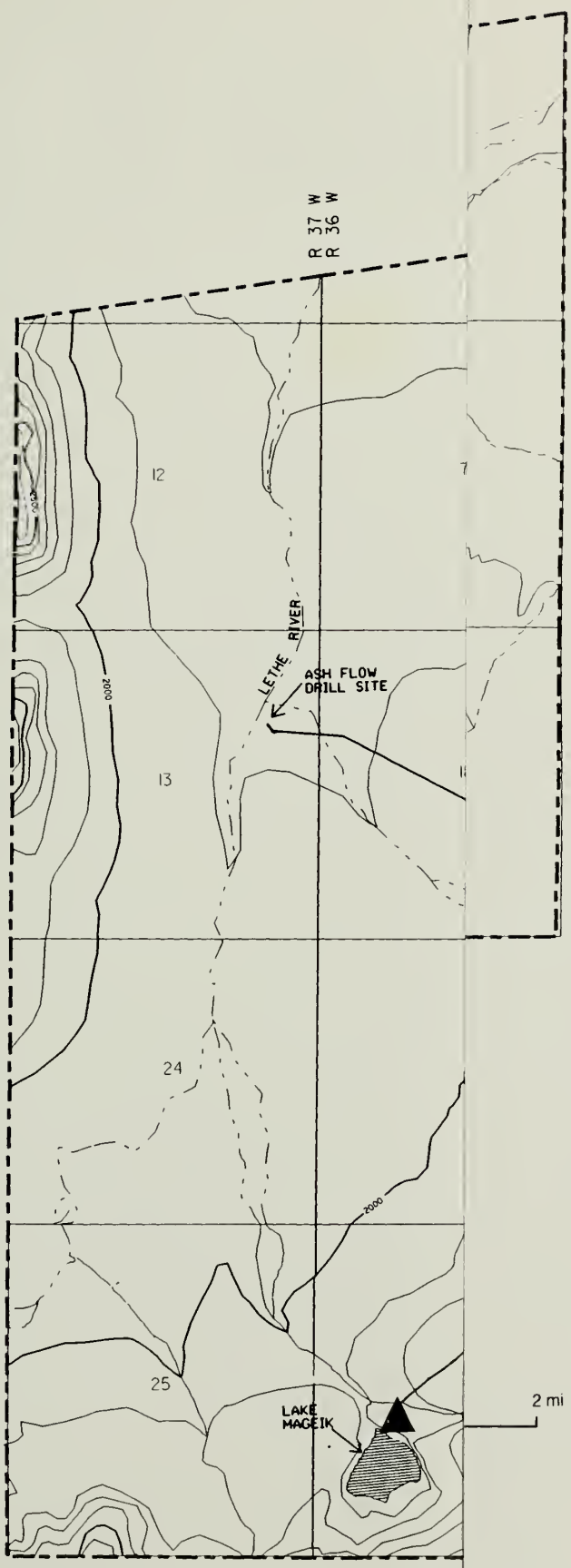

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Figure C-3. Revised Water Line Layout

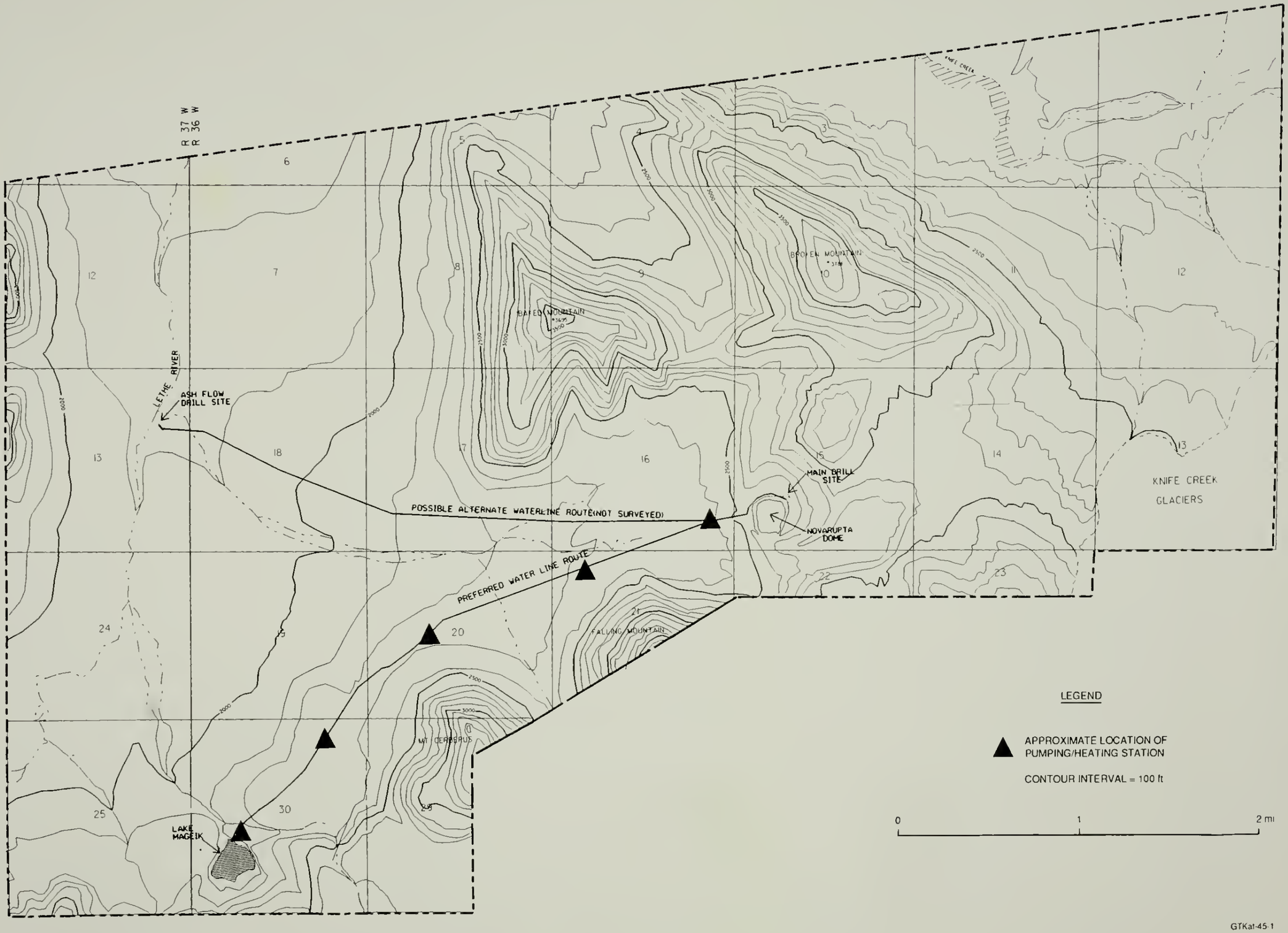

Figure C-3. Revised Water Line Layout

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