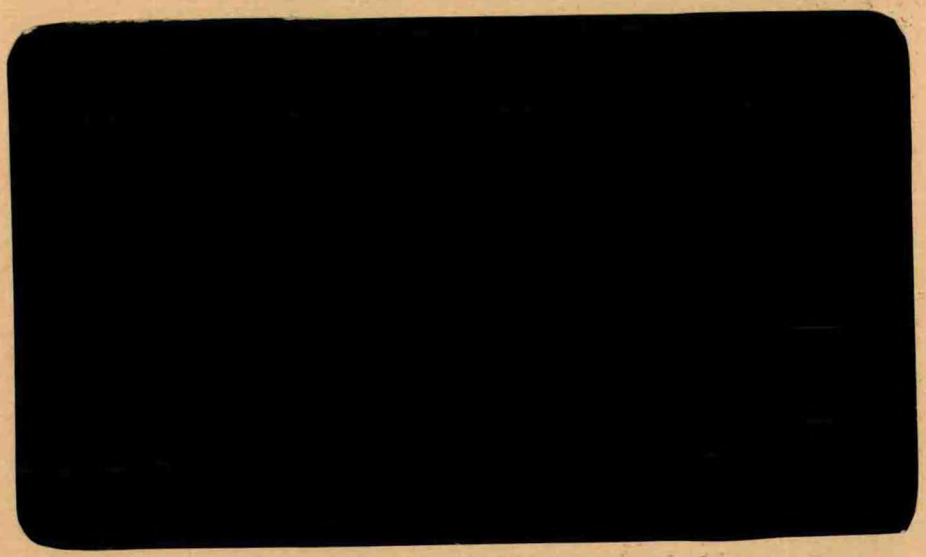

AN EVALUATION OF CLEANUP TECHNOLOGIES POTENTIALLY APPLICABLE TO EXXON VALDEZ OIL SPILL CLEANUP OPERATIONS IN 1990

FINAL REPORT

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1.0 INTRODUCTION

This document addresses the possible cleanup technologies that could be applicable for use on the EXXON VALDEZ oil spill response in 1990. The focus of the report is on the generic aspects of the available technologies and not on an in-depth review of specific devices or products.

Evaluation and testing of specific devices and products has been underway by, among others, Exxon, U.S. Coast Guard Research and Development Center (USCGR&DC), U.S. Environmental Protection Agency (USEPA), and the State of Alaska. The status of this testing and evaluation process was presented at the Cleanup Technology Review Workshop in Anchorage, Alaska on 28-30 November 1989, and proceedings of the workshop are presented in NOAA (1990).

The USCGR&DC was the designated clearinghouse for proposals and suggestions submitted to the Federal Government and State of Alaska. The USCGR&DC's evaluation effort was coordinated with Exxon and the USEPA. As part of their task, the USCGR&DC reviewed the proposals and divided them into two general categories: 1) existing technologies, products, and resources, and 2) new technologies. Information on existing technologies, products, and resources were forwarded directly to Exxon. The USCGR&DC further divided the new technologies into categories of 1) having the potential for immediate testing or evaluation for application in Prince William Sound, 2) having potential for future investigation and development as a longer term R&D effort, and 3) not having the potential in either the short or long term. A summary of the proposals retained by the Coast Guard for further review and those forwarded to Exxon is given in Appendix A.

Within Section 2.0 of this report is a brief description of the physical aspects of the various shoreline types along with the predicted and observed physical impacts oil could have on these environs. Following the description of the shoreline types, Section 3.0 addresses the description of oil cleanup treatment methods that may be applicable to future efforts in Prince William Sound. The items addressed for each treatment method include 1) the objective of the method, 2) technical description of the method, 3) applicable shoreline types, 4) when to use the method, 5) biological constraints of the method, and 6) probable intertidal and subtidal environmental effects if the method is used. At the end of Section 3.0 is 1) a matrix that summarizes applicability of each cleanup method for the various types of shorelines, 2) a table that addresses logistical considerations of cleanup methods, and 3) a table that presents representative Alaskan cleanup costs. The final section of the report (Section 4.0) provides a summary of the 28-30 November 1989 Cleanup Technology Workshop that was held in Anchorage, Alaska as presented by the three panel discussions: Physical Technologies, Chemical Technologies, and Bioremediation.

2.0 DESCRIPTIVE SUMMARIES OF SHORELINE TYPES "PRINCE WILLIAM SOUND"

2.1 INTRODUCTION

The shoreline descriptive summaries of the shoreline types for Prince William Sound and the predicted physical oil impact is a summary of several published sources including shoreline types as outlined in the "EXXON VALDEZ Oil Spill Field Shoreline Treatment Manual (NOAA, 1989)" and several Environmental Sensitivity Index (ESI) atlases published by NOAA/RPI for the following areas: Prince William Sound, Southern Alaska Peninsula, and the Outer Coasts of Oregon, Washington, and Hawaii. This information is complemented by field observations made during the summer of 1989 and during the NOAA winter monitoring program (1989-90) by the authors in Prince William Sound and surrounding vicinity.

The type of shoreline and degree of exposure to waves and currents are one basis for selecting appropriate treatment techniques. The shoreline types in Prince William Sound and the Gulf of Alaska range from exposed, vertical rocky shores to sheltered tidal flats and marshes. Each shoreline type has a particular tendency for penetration and persistence of oil. Oil tends to penetrate deeper with increasing grain size. Most of the oiled beaches are composed of mixtures of gravel and bedrock. The gravel beaches in the spill area vary in clast size from pebbles to boulders. These beaches have variable substrates beneath the gravel ranging from mixed sand and gravel to sand mixed with mud. There are few sand beaches in the impacted area except in the vicinity of the Alaska Peninsula.

The persistence of oil in the spill area is directly related to the degree of exposure to waves and tidal currents and the level of oiling. In Prince William Sound, the classification of a shoreline as exposed or sheltered is relative in that much of the Sound is sheltered from significant wave activity most of the year. In general, the shorelines along the embayments within the Sound are considered to be sheltered.

2.2 EXPOSED ROCKY SHORES

Physical Description

* Exposed rocky shores are common and frequently found along headlands and offshore islands throughout the Gulf of Alaska and Prince William Sound.
* They are composed of steeply dipping to near vertical bedrock, with little to no beach present.
* They are frequently exposed to moderate to high waves.
* Rock surfaces are commonly colonized by barnacles, mussels, algae, and various species of rockweed.

Predicted Physical Impact

* On more-exposed shores:
  - Most commonly, oil will be held offshore by waves reflecting off the steep cliffs.
  - Deposited light oils would be removed rapidly by wave action; heavier sticky oils are likely to remain longer.

* On less-exposed shores:
  - Oil removal would depend upon storm frequency and oil character.

* Oil would tend to adhere more readily to the rough, porous rock surfaces.
* Impacts to intertidal organisms are expected to be of short duration.

2.3 EXPOSED WAVE-CUT PLATFORMS

Physical Description

* Exposed wave-cut platforms are common in the study area.
* They are composed of wave-cut rock terraces, generally exposed to high waves.
* This shoreline type is commonly backed by a steep rock scarp and may be very wide due to large tidal ranges.
* The rock surface is irregular, with numerous tidal pools which support large populations of encrusting plants and animals.
* Often wave-cut platforms have narrow, perched mixed-sediment beaches at the top of terrace.

Predicted Physical Impact

* Oil may be transported across the platform and accumulate along the high-tide swash line.
* Heavy oils and tar balls would tend to persist and seep into crevices and depressions, especially on porous, irregular rock.
* Persistence is generally limited to days or weeks, as a function of wave energy.
* Tidal pool organisms may be killed, but recovery can be rapid.

2.4 SAND BEACHES

Physical Description

* Sand beaches include fine-, medium- and coarse-grained sediments and are not common throughout the study area.
* Found primarily fronting the Copper River Delta, Alaska Peninsula, Trinity Island and at outwash/streams.

* Beach slope and width will vary with grain size and tidal range. Beach width and slope increases with tidal range and grain size.

Predicted Physical Impact

* During small spills, oil tends to be deposited at the high-tide swash line.
* Large spills will cover the entire beach face.
* Initial oil penetration will vary from 10 to 25 cm in accordance with the particle size of the beach; fine sands, shallow penetration; coarse sands, deeper penetration.
* Oil can be buried rapidly by clean sand to depths of 50 cm or more.

2.5 MIXED SAND AND GRAVEL BEACHES

Physical Description

* These beaches are common throughout the spill area.
* They are composed of a mixture of sand and gravel of varying sizes. Gravel shapes (round to angular) may vary considerably from beach to beach.
* They are present in both sheltered and exposed areas.
* They often occur as pocket beaches between headlands, spits and perched beaches on bedrock platforms.
* The larger gravel may provide habitat for mussels, barnacles and rockweed.

Predicted Physical Impact

* During the large spills, oil will spread across the entire beach face.
* Burial of oil may be deep at the high-tide berm.
* Oil penetration may be high with greatest penetration in coarse, well-sorted sediments (mostly gravel).
* Along sheltered shorelines, oil penetration and persistence can be great.
* Along exposed shorelines wave induced sediment movement/transport will remove the oil more rapidly.

2.6 GRAVEL BEACHES

Physical Description

* Gravel beaches are common throughout the area and frequently occur in areas with rocky shores.
* Composed of gravel of varying sizes (pebbles to boulders).
* Gravel shapes may vary from round to angular as related to exposure and tectonics.
* Smaller gravel is dynamic and is easily transported.

Predicted Physical Impact

* Oil on gravel beaches would coat individual clasts and penetrate to several tens of centimeters into the substrate.
* Depth of penetration is somewhat controlled by substrate sediment characteristics (mud, sand, gravel).
* Penetration would be greatest in areas of largest grain sizes and poorest sorting.
* In low-energy areas, buried oil will tend to seep out, generating sheens that can recontaminate the shoreline.
* With heavy oiling the entire beach face may be covered.
* If oil is left to harden, an asphalt/gravel pavement may result.
* Oiled angular granules will take longer to naturally degrade than round granules in a similar setting.

2.7 SHELTERED ROCKY SHORES

Physical Description

* Common within the more sheltered coves and bays in the spill area (i.e., Snugg Harbor, Bay of Isles).
* Sheltered rocky shores occur as vertical rock walls (bedrock outcrops) and gravel-strewn ledges and platforms.
* They are usually heavily encrusted with barnacles, mussels, rockweed and other encrusting organisms.

Predicted Physical Impact

* Oil tends to adhere to rocky surfaces and penetrate into cracks and joints in bedrock outcrops.
* Even light accumulations can persist for years, especially between rocks.
* Heavy accumulations can coat the entire intertidal community.
* Biota living on the bedrock (barnacles, mussels) would be impacted.

2.8 EXPOSED TIDAL FLATS

Physical Description

* Visible only at low tide and composed of mixed sediments (sand, gravel) with only slight amounts of mud.
* Exposed to moderate to low wave energies and/or tidal currents.
* Not common in the study area but found in the vicinity of Copper River Delta front and scattered elsewhere.
* Most commonly found along shorelines with active outwash/streams with abundant sand/gravel sediment sources.

Predicted Physical Impact

* Heaviest concentrations will be along the high-tide line above the tidal flat.
* Most oil will be transported across the flat with the rising tide.
* Heavy oil accumulations will cover the flat during low tide.
* Biological impacts may be severe.

2.9 SHELTERED TIDAL FLATS

Physical Description

* Very common in the vicinity of the Copper River Delta and the upper portions of many fjords.
* Composed of mostly soft muds with only minor amounts of sand and gravel.
* Wave activity is low; these tidal flats may be exposed to moderate tidal currents.
* Found scattered throughout the spill area in calm waters sheltered from major wave activity.
* Sheltered tidal flats usually contain abundant epifauna and enfauna and are critical habitat for seasonally migrating birds.

Predicted Physical Impact

* Oil is most likely to be transported across the tidal flat and deposited along the high-tide line flat fringe.
* Heavy accumulations can cover much of the tidal-flat surface, but penetration will not occur into the water-saturated sediments of the flat.
* In areas of high suspended sediment content, sorption of oil can contaminate sediments that are eventually deposited on the flat.
* If oiled, oil may persist for many years.
* Biological damage may be severe to both residents and users of the flat.

2.10 MARSHES

Physical Description

* Found commonly as a broad fringing marsh along the Copper River Delta.
* Also found at heads of fjords and sheltered settings throughout the spill site (more common along the Alaska Peninsula) nearly always fronted by tidal flats.
* March grasses grow on a mixed-sediment substrate often composed of mud or mixed mud and sand.
* Very sheltered from wave and tidal activity.

Predicted Physical Impact

* Small amounts of oil will contaminate the outer marsh fringe only, natural removal by wave and tidal flushing can occur within months.
* Heavy oiling will cover more area and persist for many years.
* Large spring tides can transport oil deep into the marsh, contaminating areas above normal flushing.
* Oil, particularly heavy oils, tend to adhere readily to marsh grasses.
* Resident biota, including bird life, is likely to be oiled and possibly killed.

3.0 SHORELINE TREATMENT METHODS

3.1 INTRODUCTION

This section of the report presents a generic description of the shoreline treatment methods that have a potential of being used in the EXXON VALDEZ cleanup in the spring and summer of 1990. Parts of Section 3.2 were derived from "EXXON VALDEZ Oil Spill Field Shoreline Treatment Manual (NOAA, 1989)." Selection of the proper treatment method will depend, among other things, on the weathered condition of the oil, amount of oil contamination, depth of oil penetration, type of shoreline, potential impact to the shoreline by cleanup equipment, biological resources that may be affected by the cleanup activity, effect on water quality, and the potential presence of cultural resources. Following the description of possible treatment methods is 1) a matrix which summarizes the recommended treatment by shoreline type, 2) a table that addresses logistical considerations of cleanup methods, and 3) a table that presents representative Alaskan cleanup costs.

3.2 GENERIC DESCRIPTION OF TREATMENT METHODS

3.2.1 Manual Removal

Objective:

Removal of surface oil with hand tools and manual labor.

Technical Description:

Removal of surface oil and oily debris by manual means (hands, rakes, shovels). No mechanized means are employed, with the exception of all-terrain vehicles, wheelbarrows, etc., where approved.

Applicable Shoreline Types:

Can be used on all shoreline types other than mud flats and salt marshes.

When to Use:

Generally used on lightly or very lightly oiled shorelines when oil can be easily removed by this non-mechanical means. Can be used to remove heavy oil accumulation when other techniques are not allowed.

Biological Constraints:

Removes some organisms from the substrate and may crush others.

Environmental Effects:

Intertidal - Minimal if surface disturbance by cleanup activities and work force movement is limited.
Subtidal - None.

3.2.2 Washing/Flooding with Cold Water ("Deluge")

Objective:

Float surface oil, and wash oil from crevices and interstices of rocks to water's edge for pickup. Uses large volumes of ambient seawater at low pressure.

Technical Description:

A large diameter header pipe with holes in it is placed parallel to the shoreline above the oiled area. A flexible perforated header hose is used to better conform to the actual shoreline profile. Ambient temperature seawater is pumped through the pipe and it flows across the surface toward the water's edge. On porous beaches, water flows through the substrate washing loose oil ahead of it or floating it to the surface, then transporting is downslope. Flow is maintained as long as necessary to remove the majority of the free oil. Oil is trapped by booms and picked up with a skimmer or other suitable equipment.

Applicable Shoreline Types:

Boulder, cobble, gravel, coarse sand mixed with sediment, and rock. Generally not applicable to mud, vegetated upland, or steep rocky shorelines.

When to Use:

This method can be used where shoreline is heavily oiled over large areas, especially if oil is fluid and not tightly adherent to rocks. It can also be used if oil has penetrated in cobble or boulder shorelines. This method is frequently used in conjunction with other washing techniques (low or high pressure, cold or warm water). If oil has weathered, this technique can be used in conjunction with other treatment methods (injection or chemical treatment).

Biological Constraints:

Not appropriate at creek mouths.

Environmental Effects:

Intertidal - Habitat may be physically disturbed as sand and gravel components are mixed and transported. Organisms may be flushed into lower tidal zones.

Subtidal - Some sediment may be transported to shallow subtidal areas and bury benthic organisms.

3.2.3 Cold Water/Low Pressure Washing

Objective:

On weathered oil, this treatment method is mainly used to flush oil downslope that has been loosened by other methods.

Technical Description:

Water is pumped through hoses while nozzle pressures are kept low (less than 50 psi) by controlling flow at the nozzle. Washing begins at the top of the shoreline above the oil and oil is washed downslope. This system can also direct the flow of water and oil down to the water's edge. Oil is trapped by booms and picked up with a skimmer or other suitable equipment.

Applicable Shoreline Types:

Boulder through coarse sand beaches, coarse mixed sediment and rock. Can be used to flush floating or loose oil out of tide pools and crevices. In conjunction with other methods, Cold Water/Low Pressure Washing may be applicable to fine sediments, marshes and wetlands, or vegetated upland shorelines.

When to Use:

This method is often used in conjunction with "deluge" flooding and other shoreline treatment methods.

Biological Constraints:

May not be appropriate for fine-grained (sand to mud) sediment, marshes, tidal flats or vegetated upland shorelines, unless pressure is kept low enough to minimize disturbance and transport of sediment.

Environmental Effects:

Intertidal - Disturbs fine-grained materials and may expose organisms living in tubes or burrows. May drive oil deeper into the substratum if water jet is improperly

applied (e.g., if pressure is too high, "deluge" flooding is not used, etc.). If containment methods are not sufficient, contamination may be flushed into lower intertidal zones that would otherwise not be oiled.

Subtidal - No significant effects expected.

3.2.4 Cold Water/High Pressure Washing

Objective:

On weathered oil, this treatment method is mainly used to flush oil downslope that has been loosened by other methods. On unweathered oil this treatment method can remove oil that has adhered to rocks or has become buried in the substrate and flush it downslope to the shoreline for pickup.

Technical Description:

Similar to low pressure washing except that water pressure is greater (up to 100 psi). High pressure spray will better remove oil that has adhered to rocks, and can agitate the substrate up to large cobble size to expose buried oil. Oil is trapped by booms and picked up with a skimmer or other suitable equipment.

Applicable Shoreline Types:

Boulder, cobble, and rock. May have limited application for gravel, sand, and mixed beaches. Can be used to flush floating or loose oil out of tide pools, and crevices in rock environments.

When to Use:

Where adherent oil must be removed, but destruction of biological communities is to be minimized; where oil has penetrated relatively deeply below the surface; in rugged rocky areas that are extensively and heavily oiled but not biologically sensitive.

Biological Constraints:

Not appropriate for fine-grained (gravel to mud) sediments or vegetated shorelines, or for shoreline where destruction of biological communities must be avoided.

Environmental Effects:

Intertidal - Removes many organisms near the surface. Thoroughly agitates sediments so that burrows and tubes are destroyed, and buries organisms. May drive oil deeper

into the substratum if water jet is improperly applied. If containment methods are not sufficient, contamination may be flushed into lower intertidal zones.

Subtidal - No effect expected.

3.2.5 Warm Water/Moderate-to-High Pressure Washing

Objective:

Mobilize thick and weathered oil adhered to rock surfaces prior to flushing it down shore for pickup.

Technical Description:

Heated seawater is applied at moderate to high pressure (generally up to 100 psi) to mobilize weathered oil that has adhered to rocks. The warm water may be sufficient to flush the oil down the beach. If not, "deluge" flooding and additional low or high pressure washing can be used to float the oil to the shoreline for pickup.

Applicable Shoreline Types:

Boulder, cobble and rock shorelines that are heavily oiled. Generally not appropriate for sedimentary habitats, because mobilized oil may percolate through the sediments.

When to Use:

Where oil is weathered and/or difficult to remove by ambient temperature high pressure water or other physical means; oiling is heavy and/or extensive on potentially productive biological communities.

Biological Constraints:

Not applicable where biological communities are to be protected or in fish-spawning areas.

Environmental Effects:

Intertidal - Can kill or remove most organisms. If containment methods are not sufficient, contamination may be flushed into lower intertidal zones that would otherwise not be oiled.

Subtidal - No effects expected.

3.2.6 Hot Flushing with Hand Wands and Vacuum

Objective:

Dislodge trapped oil from inaccessible locations and surfaces not amenable to mechanical removal.

Technical Description:

Entails using two basic pieces of equipment: water heater with relatively high temperatures available (up to 140°F) and high pressure supporting wand devices to wash off oil. Used without water flooding, this procedure requires immediate use of vacuum to remove oil as it runs from rocks and soil. The vacuum can either be from something like a supersucker or a smaller, portable type, sitting on the shoreline.

Applicable Shoreline Types:

Best used where shoreline is relatively inaccessible and under conditions where warm water flushing is not considered feasible or desirable.

When to Use:

Not applicable to sandy beaches or in locations where getting such equipment on to or close to shoreline is difficult.

Biological Constraints:

Not appropriate where wholesale removal of attached organisms from the surface is unacceptable. Removed oil must be recovered to prevent further oiling of adjacent environments. Generally not appropriate in fish streams.

Environmental Effects:

Intertidal - All attached organisms will be removed. There is a chance for the released oil to contaminate the lower intertidal zone. Improper methods could drive the oil further into the substrate. Deeply penetrated oil will remain, with the threat of re-oiling.

Subtidal - If fine-grained materials are present, they could be transported to the adjacent subtidal zone.

3.2.7 Passive Collection Sorbents

Objective:

Removal of nonsticky oil by sorption onto oleophilic materials placed in the intertidal zone.

Technical Description:

Sorbent material is placed on the surface of the shoreline substrate allowing it to sorb oil at a rate dependent on the type of sorbent. Removal of oil is dependent on the capacity of the particular sorbent. Only recoverable sorbent materials can be used. Use of peat is still in the demonstration phase.

Applicable Shoreline Types:

Can be used on any shoreline type.

When to Use:

When the shoreline oil is mobile and transport of oil is expected on or off the site. The oil must be of such a viscosity and thickness to be sorbed by the sorbent material and be released by the substrate. Not applicable on highly weathered oil.

Biological Constraints:

None, other than the fact that the method can be slow thus allowing oil to remain in critical habitats during sensitive periods of time.

Environmental Effects:

Intertidal - None, except for the amount of oil remaining on the shoreline after the sorbents are no longer effective.

Subtidal - None.

3.2.8 Vacuum

Objective:

Remove free oil from the shoreline surface.

Technical Description:

Use of a suction head, hose, pump, and storage tank to recover free oil from the shoreline surface. The equipment can range from small, portable units which fill

individual 55-gal drums to large supersuckers that are truck-mounted and that can lift large rocks.

Applicable Shoreline Types:

Can be used on any shoreline type, including rocky headlands.

When to Use:

When there are large volumes of free oil. Not effective on highly weathered oil.

Biological Constraints:

Areas where foot traffic and equipment operation should be restricted.

Environmental Effects:

Intertidal - Minimal impacts if used properly and minimal substrate is removed.

Subtidal - None.

3.2.9 Hot Water Injection

Objective:

Removal of oil which has penetrated into the shoreline sediments by injection of hot water below the sediment surface to flush it to the surface for collection.

Technical Description:

A series of small diameter (1 to 2 in.) perforated lances connected to a manifold are driven into the substrate. Hot water is injected through the lances and the released oil floats to the surface for removal by skimmers or sorbents. The effective area of flushing is a function of the grain size, sorting, and heterogeneity of the beach sediments.

Applicable Shoreline Types:

Mixed sand and gravel beaches only. On mostly gravel and larger-sized sediments, the high porosity will result in a very small radius of flushing around each well point.

When to Use:

This method is appropriate for heavily oiled beaches where the oil has penetrated deeply, below that depth of

effective agitation by high-pressure washing with fire hoses.

Biological Constraints:

Should not be used in areas where sensitive biological resources have been identified to occur in the intertidal zone or where sedimentation of fish streams could occur.

Environmental Effects:

Intertidal - If containment methods are not sufficient, contamination may be flushed into lower intertidal zones that would otherwise not be oiled.

Subtidal - Under certain conditions, there could be transport of fine-grained sediment to the subtidal areas, smothering bottom communities and/or depositing contaminated sediments.

3.2.10 Disking of Sand Beaches

Objective:

To turn the sediments over or break up lightly oiled layers in order to enhance the natural degradation of the oil.

Technical Description:

The beach sediments are rototilled or otherwise mechanically mixed. This process can be repeated over time to further speed the rate of degradation.

Applicable Shoreline Types:

Works best on sandy beaches. Could be used on mixed sand and gravel beaches.

When to Use:

Most applicable on shorelines with light oil contamination. On heavily oiled beaches, there is the potential for mixing large amounts of oil into the substrate which may prolong oil residence time.

Biological Constraints:

Could not be used on beaches near shellfish-harvest or fish-spawning areas because of the potential for constant release of oil and oiled sediments.

Environmental Effects:

Intertidal - Because oil is mixed into the sediments, this process could further expose organisms that lived below the original layer of oil. If mixing is repeated over time, it could delay the reestablishment of organisms.

Subtidal - There is a potential for release of contaminated sediments to the offshore zone.

3.2.11 Sediment Removal

Objective:

Removal of surface-oiled sediments.

Technical Description:

Oiled sediments are removed by manually using hand tools or mechanically using various kinds of motorized equipment. The oiled material must be transported and disposed of off-site.

Applicable Shoreline Types:

Can be used on sand, pebble, and cobble beaches depending on limitations of manpower and specific equipment.

When to Use:

This method is to be considered only when very limited amounts of oiled sediments have to be removed. Should not be considered where beach erosion may result. Care should be taken to remove the sediments only to the depth of oil penetration, which can be difficult with heavy equipment on gravel beaches.

Biological Constraints:

Use of mechanized equipment may be restricted by adjacent habitats. Generally not appropriate in or near fish-spawning areas.

Environmental Effects:

Intertidal - The equipment is heavy and large, and is manpower- and support-intensive. Transportation to site may entail aircraft, land vehicle, or barge movement to shoreline. May be detrimental if excessive shoreline is removed without replacement. All organisms resident in the beach will be affected.

Subtidal - Release of oil and fine-grained oily sediments to the water during sediment removal activities. This will be of concern because of tidal flushing of the excavated beach surface.

3.2.12 Shoreline Removal, Cleansing, and Replacement

Objective:

To remove oiled surface material, cleanse it, and replace it onto the shoreline.

Technical Description:

Removal of the oiled substrate into a cleansing container. Methods may include hot water or a cleansing solution with physical agitation. After oil removal, the shoreline material is returned to the shoreline. An example of this treatment method is the Cabana/Carazza Rock Washer.

Applicable Shoreline Types:

Sand, pebble, gravel, etc., depending on the limitations of the cleaning processing equipment. The equipment must be placed close to the beach, with a backshore large enough to support the cleanup equipment.

When to Use:

Applicable to shorelines where removal of sediment is undesired and other cleanup techniques are likely to be ineffective. If cleansing solutions are used, then they must be properly disposed.

Biological Constraints:

Generally unacceptable for areas used for spawning by salmon and herring. There may be site-specific constraints related to the severe displacement of the beach sediments. Replaced materials must be free of oil and toxic substances.

Environmental Effects:

Intertidal - May be detrimental if excessive shoreline is removed without replacement. All organisms resident in the beach will be affected. The equipment can be heavy and large, and is manpower- and support-intensive. Transportation to site may entail aircraft, land vehicle, or barge movement to the shoreline. Due to size and difficulty in relocation, the material must be transported to the machine for processing, contributing to the disruption of the shoreline.

Subtidal - There may be release of oil and fine-grained oily sediments to the water during sediment removal activities. This will be of concern because of tidal flushing of the excavated beach surface.

3.2.13 Relocation to Surf Zone

Objective:

Use natural cleansing action of waves to remove oil which has penetrated deep into beach sediments (mostly gravel and cobble) which is not removed by surface cleaning efforts.

Technical Description:

Physically move beach sediments into surf tidal zone to enhance natural cleansing action. The action of sediment transfer to the low water line of the beach is solely to allow the wave to toss the sediments back onto the berm at the high-tide line.

Applicable Shoreline Types:

Moderate-to-high energy shorelines composed of gravel and cobbles which are lightly to moderately oiled.

When to Use:

On gravel and cobble beaches which are not heavily oiled and where flushing techniques have not been successful in removing oil which has penetrated into the upper beach face. There MUST be large enough waves on the beach to provide the energy for agitation of the sediments. This can include seasonal storm-generated waves, as long as there is enough wave energy at the shoreline segment being considered. The sediments cannot be pushed onto unoiled areas of the beach.

Biological Constraints:

Not to be used on beaches that are used for salmon and herring spawning, or areas where natural flushing may be low at certain times of the year or very sensitive for other reasons, because the oil may be released to the environment without recovery. This technique is not appropriate for heavily oiled beaches that are not located along the outer, exposed shoreline. Not to be used on shorelines with highly productive attached organisms, such as mussel beds, barnacles, and seaweed.

Environmental Effects:

Intertidal - All organisms that use the beach will be either displaced or destroyed. There will be a period of time before the natural beach profile is restored. Removal of stream banks will alter the hydrological regime of the stream.

Subtidal - Any oil that is released will be introduced into the water column, but because of the high-energy conditions, the oil will be widely dispersed.

3.2.14 Burning

Objective:

In situ burning of oiled vegetation and free standing pools of oil.

Technical Description:

The upwind part of the area to be burned is ignited and allowed to burn downwind. The amount of ignition material needed depends on the weathered condition of the oil.

Applicable Shoreline Types:

Can be used on any substrate or vegetation where sufficient oil has collected to sustain ignition.

When to Use:

Generally used when other methods are not environmentally acceptable.

Biological Constraints:

Burning will kill surface organisms caught in the burn area.

Environmental Effects:

Intertidal - Causes heavy air pollution, adds heat to substrate, can cause erosion if root systems are damaged, residual matter may be somewhat toxic (heavy metals).

Subtidal - Possible temporary and local effects on water quality from residual material.

3.2.15 Chemical Treatment

Objective:

Increase the efficiency of oil removal from contaminated shorelines.

Technical Description:

Weak chemical dispersants are applied to the substrate, as a presoak and/or a flushing solution, to wet the substrate so that other treatment methods are more efficient (over time) and effective. Loosened oil is trapped by booms and picked up with a skimmer or other suitable equipment.

Applicable Shoreline Types:

Can be used on any beach type.

When to Use:

When oil is weathered, thick, or penetrated into the sediments. This approach may be most applicable when flushing becomes more difficult with more weathered oil.

Biological Constraints:

Will require extensive biological testing for toxicity and water-quality sampling prior to receiving approval for use.

Environmental Effects:

Intertidal - Possibly short-term toxic effects to organisms on the substrate and in the nearshore water column.

Subtidal - It is likely that some of the oil will be dispersed into the water column and not recovered by booms or sorbents.

3.2.16 Bioremediation

Objective:

To accelerate the degradation rates of oil by natural microbial communities.

Technical Description:

Accelerated biodegradation of oil can be achieved by 1) addition of nutrients (principally nitrogen and phosphorus) to enhance natural biodegradation, 2) addition

of chemicals to the oil to render the oil more accessible to microorganisms, 3) addition of indigenous microorganisms to increase bacterial biomass, and 4) a combination of the above.

Applicable Shoreline Types:

Can be used on any beach type, but may be less effective on high energy shorelines where the applied substances are rapidly flushed away. In these latter environs, weak concentrations of the additive dissolved in saltwater can be periodically sprinkled or sprayed on the affected area.

When to Use:

Bioremediation techniques can be used when the oil has penetrated into the substrate or where other physical removal methods are ineffective. It may also be used as a secondary treatment method to enhance the natural removal of oil left by physical cleanup efforts.

Biological Constraints:

Additives may cause short-term water-quality problems or undesirable algae production.

Environmental Effects:

Intertidal - Algal blooms and short-term water-quality problems due to added nutrient levels.

Subtidal - Same as above.

3.2.17 Natural Recovery

Objective:

Let the natural energy of the environment and natural microbial activity degrade the oil.

Technical Description:

No action is taken. The oil is left to degrade naturally.

Applicable Shoreline Types:

Can be used most effectively on high energy beaches (primarily gravel, cobble, and boulder) where wave, tidal action, and microbial activity will degrade the oil. May also be applicable to other shoreline types.

When to Use:

Recommended for areas where other types of treatment would be more harmful to the environment.

Biological Constraints:

Natural recovery may allow oil to remain in critical habitats for a prolonged period of time.

Environmental Effects:

There will be potential toxic effects and smothering of organisms by the oil.

3.3 SUMMARY OF RECOMMENDED TREATMENTS BY SHORELINE TYPES, LOGISTICAL CONSIDERATIONS, AND REPRESENTATIVE CLEANUP COSTS

Final selection of the preferred treatment method or combination of methods will depend, among other things, on the weathered condition of the oil, amount of oil contamination, depth of oil penetration, type of shoreline, potential impact to the shoreline by cleanup equipment, biological resources that may be affected by the cleanup activity, effect on water quality, and the potential presence of cultural resources. Further considerations of cleanup technologies and their applicability to spring 1990 are addressed in Section 4.0. Table 3.1 presents logistical considerations of cleanup methods, and Table 3.2 gives representative Alaskan cleanup costs under the categories of labor, materials and supplies, and equipment.

Table 3.1. Logistical considerations for cleanup treatment methods.

TREATMENT METHOD	EQUIPMENT	PERSONNEL	LOGISTICAL SUPPORT
HAND CLEANING	Sorbent pads Sorbent rolls Sorbaid Viscous sweeps Assorted hand tools: rakes, shovels, scoops 2 Jon boats	23 Laborers/ operators 1 Foreman 1 Supervisor 4 Boat operators	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 1 work unit 1 Supply barge
HOT WATER WASH WITH HAND WANDS	2 Hot water pressure washers 4 Hand wands 1 LCV 500 ft Containment boom 1000 ft Sorbent 1 Small portable skimmer 2 Pumps (2 in.) 2 Jon boats	10 Laborers/ operators 1 Foreman 1 Supervisor 4 Boat operators	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 2 work units 1 Supply barge
TILLING/ REWORKING	1 Track-type tractor 1 Discing machine 1 Barge with large gate 1 Tug boat 1 Jon boat	2 Equipment operators 4 Laborers/ operators 5 Boat operators/ crew 1 Foreman 1 Supervisor	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 2-3 work units 1 Supply barge
RELOCATION TO THE SURF	2 Track hoes 1 Barge with large gate 1 Tug boat 500 ft Containment boom 1000 ft Sorbent 1 Small portable skimmer 2 Jon boats	4 Equipment operators 10 Laborers/ operators 5 Boat operators/ crew 1 Foreman 1 Supervisor	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 1-2 work units 1 Supply barge
MAXIBARGE HOT WATER PRESSURE WASH	1 Barge (40 ft x 120 ft) 1 Tug boat 4 Jon boats 20,000 ft sorbent boom 10,000 ft containment boom 6 Hot water heaters Portable skimmers Crane mounted sprayers 8 - 10 Pumps 1 Crew trailer	18 Laborers/ operators 12 Boat operators 2 Foremen 2 Supervisors	2 Personnel support boats (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 1 work unit 2 Supply barges

Table 3.1. (Continued)

TREATMENT METHOD	EQUIPMENT	PERSONNEL	LOGISTICAL SUPPORT
OMNIBARGE HOT WATER PRESSURE WASH	1 Barge (30 ft x 60 ft) Tug boat 2 Jon boats Electrical power plant 6 Hot water heaters 4 - 5 pumps Portable skimmer 10,000 ft Sorbent boom 10,000 ft Containment boom Crane mounted sprayer	12 Laborers/ operators 6 Boat operators 2 Foremen 2 Supervisors	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 1 work unit 1 Supply barge
MINIBARGE HOT WATER PRESSURE WASH	1 Landing Craft Vessel (LCV) 1 Jon boat 2 Hot water heaters 2 - 3 pumps Portable skimmer 2,000 ft Sorbent boom 1,000 ft Containment boom	12 Laborers/ operators 3 Boat operators 1 Foreman 1 Supervisor	1 Personnel support boat (26-30 ft) per work unit 1 Mothership (180-200 ft, USCG COI) for berthing and food for 1-2 work units 1 Supply barge
BIOREMEDIATION, OLEOPHILIC	1 LCV Oleophilic fertilizer Airless sprayers Heaters	6 Laborers/ operators 3 Boat operators 1 Foreman 1 Supervisor	1 Mothership (180-200 ft, USCG COI) for berthing and food for 2-3 work units 1 Supply barge
BIOREMEDIATION, SPRINKLER	1 LCV Liquid or water soluble fertilizer Sprinklers, pipe, fittings Pumps and mixer	AFTER INSTALLATION 4 Laborers/ operators 3 Boat operators 1 Foreman 1 Supervisor	1 Mothership (180-200 ft, USCG COI) for berthing and food for 2-3 work units 1 Supply barge

Table 3.2 Representative Alaskan oil spill cleanup costs.

Labor Rates (dollars per non-overtime hour)	
Laborer/Deckhand	$16 - $24
Technical specialist/Operator	$25 - $29
Foreman/Supervisor	$30 - $35
Senior Supervisor/Advisor	$35 - $70
Material and Supplies (dollars as indicated)	
Personnel protective gear	$30 - $50 per man per day
Boom, 18 in.	$1.25 per ft per day
Sorbent boom, 8 in.	$140 per 40 ft bale
Sorbent pads	$70 per 20 lb bale
Sorbaid	$100 per 100 head bale
Viscous sweep	$350 per 100 ft bale
Rakes, shovels, scoops	$15 - $30 each, one-time charge
Equipment rental rates (dollars as indicated)	
Helicopter, 206 Bell	$500 per hour
Airplane, Beaver	$500 per hour
Airplane, Twin Otter	$850 per hour
Mothership, 180 - 200 ft	$5,500 per day including fuel
Landing Craft Vessel (LCV)	$4,500 - $7,000 per day
Support boat, 26 - 30 ft	$2,200 - $3,000 per day
Tug boat	$1,800 - $3,000 per day
Jon boat, 18 ft	$200 per day
Pumps, 2 - 4 in.	$100 - $200 per day
Skimmers, portable	$500 - $1,000 per day
Hot water pressure washer	$800 - $1,000 per day
Track-type tractors	$600 - $800 per day

4.0 WORKSHOP SUMMARY OF CLEANUP TECHNOLOGIES

4.1 INTRODUCTION

A Cleanup Technology Review Workshop, sponsored by NOAA, was held in Anchorage, Alaska, on 28-30 November 1989 (NOAA, 1990). Workshop participants included representatives of industry; federal, state, and local governmental agencies; and private organizations. The objectives of the workshop were to 1) present ideas and recommendations for possible cleanup activities for 1990, 2) strive toward reaching a consensus of what cleanup activities to pursue, and 3) view the status of the shoreline from various vantage points. Discussions on cleanup technology were essentially divided into three generic sessions: Physical Technologies, Chemical Technologies, and Biological/Bioremediation Technologies. At the end of each of the three sessions there was a panel discussion which focused on available technology that could be applicable for use in 1990. A summary of these panel discussions is presented in the following sections.

4.2 PHYSICAL TECHNOLOGIES

After review of the treatment methods given in Section 3.0, the panel discussion on Physical Technology subdivided treatment methods into those applicable for oiled debris, surface oil, subsurface oil, and asphalt pavement. The panel concluded that the only practical method to deal with oiled debris was Pickup/Removal and subsequent disposal.

By 1990, surface oil probably will be weathered to such an extent that manual removal (wiping with sorbents) will not be practical except in very specific and localized areas. Within the realm of physical technologies, Flushing and Washing is probably the only general methodology that can be used for removal of surface oil. This methodology involves the application of volumes of water, under various combinations of pressure and heat, to the oiled surface. The oil which is removed is generally washed to a collection point at the base of the shoreline. This technique was used on a grand scale during the summer and fall of 1989. Methodology ranged from application by hand-wand to application by crane-mounted sprayers (Omni-boom sprayers) that were mounted on a 40-ft Landing Craft Vessel (LCV) or a 120-ft barge (Maxibarge). It was the consensus of the Panel that this may have limited application on weathered oil. The Panel discussed the following possible negative effects of this technology: disruption of the biological recolonization that has taken place during the winter, washing sediment off the beaches, and damaging the "green zone" with heated water. Use of this and other technologies must be in concert with the timing of the regions faunal reproductive cycles. Negative effects on the "green zone" can be diminished by using a cold-water deluge system at the base of the wash zone.

Physical technologies available for removal or for the aid of removal of subsurface oil include: Excavation/Replacement, Tilling/Reworking, and Water Injection/Flushing. The process of Excavation/Replacement involves the removal of the oiled subsurface layer and replacing it with clean material to restore the shoreline.

This could be applicable for small isolated areas where it would be practical to remove the subsurface material, clean it in some way, and return the cleaned material to its original location. Removal of the subsurface material and replacing it with new material would not only necessitate finding and getting approval of a borrow site, but it would also pose a disposal problem for the material that is removed. The process of Excavation/Replacement will disturb archeological sites, destroy associated biological resources, and may significantly change the geomorphology of the site.

Tilling/Reworking, commonly referred to as land farming, involves the use of agricultural-type plows and/or harrows to bring the subsurface material to the surface to facilitate the use of other methods or technologies, i.e., flushing and washing, natural degradation, bioremediation techniques, etc. Tilling/Reworking will disturb archeological sites and could affect the biological environment.

The Water Injection technique involves introducing water into the subsurface by either perforated pipe or rods. Injection of warm water mobilizes the subsurface oil then the associated flushing moves the oil to a collection location. This technique generally mobilizes the oil in an inverted-cone area immediately around the injector rod and is thus applicable only in very limited, heavily oiled areas where the injector rods can be driven into the subsurface. One problem with this technique is that instead of rising to the immediate surface, mobilized oil may migrate laterally. Environmental concerns are similar to those expressed for other warm to hot water applications.

Physical technology applicable to mitigate the formation of asphalt pavement includes: 1) physical removal of the pavement, and 2) breaking up the pavement by tilling. Breaking the pavement into small pieces will enhance natural degradation through bacterial activity and through abrasion by wave action.

In summary, the panel on physical technologies concluded that each method has its own site specific applicability, and treatment plans for 1990 must be based upon the 1) shoreline type, 2) amount of oil present, 3) weathered condition of the oil, and 4) depth of oil penetration.

4.3 CHEMICAL TECHNOLOGIES

The panel on chemical technologies explained that chemicals would only be used as an adjunct to the physical methods because, with the exception of bioremediation chemicals, which are considered under a separate heading, there are no available chemical methods that can be used by themselves. If used with the surface action physical process of flushing/washing, chemicals can be used to enhance oil removal either by decreasing the time or mechanical energy required in accomplishing generally accepted physical processes. The panel concluded that with the present approval process and considering modifications that have been recommended, it will be difficult to use or even plan on using chemicals to any great extent in the spring of 1990. The only chemical that has gone through a partial approval process is the beach cleaner,

Corexit 9580. Corexit 9580 is a hydrocarbon-based formula that acts as a lifting agent to remove oil from rock surfaces. Once the oil is loosened, it is washed downslope where ideally it is contained with booms and collected with sorbents or skimmers. The panel recommended additional testing of Corexit 9580 under environmental conditions that would be conducive to the containment and recovery of the oil that has been removed from the shoreline. In the case of subsurface oil removal, chemicals can be used to enhance oil removal after employing the physical processes of excavation/replacement or tilling/reworking. The panel did not recommend subsurface injection of chemicals.

4.4 BIOREMEDIATION

The panel discussed four categories of bioremediation formulations: oleophilic fertilizers, slow release fertilizers, fertilizers in aqueous solution, and inoculant. The oleophilic fertilizer discussed was Inipol EAP22, which is manufactured by Elf Aquitaine Company, France. The main ingredients in Inipol EAP22 are oleic acid and urea, along with chemicals to maintain them in an emulsion. Results of testing Inipol EAP22 in Prince William Sound showed substantial visual improvement of the shoreline surface. The product was not directly applied to the subsurface, and any improvement to the subsurface from the surface application could not be determined. The panel was concerned that 1) there is not enough information on how the product actually works and 2) there is also a lack of information on its efficiency on weathered oil.

Several formulations of slow release fertilizers were tested in Prince William Sound. These formulations were manufactured into the shape and size of briquettes and were generally placed into mesh bags for application to the shoreline. The panel concluded that these fertilizers were easy to apply to the shoreline and had potential for getting nutrients into the subsurface; however, an even dosage was difficult to control. One of the most promising techniques in the use of bioremediation fertilizers is to dissolve the fertilizer in seawater and apply the solution to the shoreline via a sprinkler system. This technique allows control over aerial coverage and dose rate. Preliminary results suggest this technique enhances both surface and subsurface biodegradation. Under the heading of Inoculation, the panel discussed shoreline applications of enzymes; mixed or pure cultures of bacteria, fungi, and yeast; and genetically engineered organisms. Tests in the natural environment show indigenous fauna and flora to be adequate in type and quantity. The major problems with inoculation are 1) selecting the type of inoculant and 2) obtaining the public acceptance of the possibility of introducing foreign organisms into the Alaskan environment.

4.5 SUMMARY

Panel members concluded that there would be no new cleanup technologies available for the spring of 1990, and due to the time required for approval using the in-place and proposed protocols, it is unlikely that additional chemical agents could be used in 1990. Essentially, the technologies available for use in 1990 are those which

were used in 1989. Due to the more weathered condition of the oil, and if it is decided that natural recovery is not occurring fast enough, more aggressive use of available cleanup techniques will have to be employed in 1990 than were used in 1989. Removal of the surface oil by flushing and washing will require higher water pressures and temperatures than were used in 1989. If the physical technology of excavation/removal or tilling/reworking is used, then the use of a chemical could be used to enhance oil recovery. Of great concern was the possibility of extensive pavement formation. Mitigation techniques for pavement formation include physical removal or breaking the pavement into smaller pieces that will be agitated and subsequently degraded by natural weathering processes. Bioremediation may be the only feasible technology available for wide-spread mitigation of subsurface oil, and the most promising technique may be to apply an aqueous solution to the shoreline with a sprinkler system. It was the consensus of the panels that there is no one technique for treating all the oiled shoreline, but that it must be a systems approach involving matching the proper combination of physical, chemical, and biological treatments with a specific shoreline condition. Monitoring of the shoreline conditions during winter and early spring should provide information on the condition of the shoreline. This information can be used by the resource trustees to determine: 1) where the rate of natural cleaning is adequate, and 2) where cleanup intervention is needed and how aggressive the cleanup technique should be.

5.0 LITERATURE CITED

NOAA. 1989. EXXON VALDEZ Oil Spill Field Shoreline Treatment Manual. Interagency Shoreline Cleanup Committee. 3 June 1989 with 25 July 1989 revisions. Made available by National Oceanic and Atmospheric Administration, Hazardous Material Response Branch, Seattle, Washington.

NOAA. 1990. EXXON VALDEZ Cleanup Technology Workshop. 28-30 November 1989. Anchorage, Alaska. Transcribed minutes of the proceedings. Made available by National Oceanic and Atmospheric Administration, Hazardous Material Response Branch, Seattle, Washington. 2 March 1990. 88 pp.

APPENDIX A

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
U.S. Coast Guard
Research & Development Center

Avery Point
Groton, CT 06340-6096
Phone: (203) 441-2650
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NOV. 10 RECD

Mr. Bela James
Continental Shelf Associates, Inc.
7607 East Mark Drive
Suite 250
College Station, Texas 77840

Dear Mr. James:

As discussed in telephone conversations with myself and DR. Bob Hiltabrand, we are forwarding summary information on the proposals we have reviewed this summer as input to the upcoming NOAA workshop in Anchorage. To summarize our involvement in this effort, in April the R&D Center undertook the task of acting as a clearing point for proposals and suggestions submitted to the federal government and State of Alaska on the cleanup of the EXXON VALDEZ oil spill. Our original intent was to coordinate the review of proposals and suggestions for new technologies. In addition, we also received information on existing technologies, products and resources offered for use in the cleanup effort, as well as letters with inquiries and opinions on the spill.

Our original strategy for handling this information was to categorize and disseminate the proposals to the appropriate group for further action. Suggestions for new technologies were reviewed and divided into categories of having potential for immediate test and evaluation for application in the Valdez cleanup effort, potential for future investigation and development as a longer term R&D effort, or not having potential in either the short or long term based on our current knowledge of cleanup technology. Information on existing technologies, products and resources were forwarded directly to Exxon in Houston.

In reviewing various proposals for immediate test and evaluation in Alaska, we coordinated our efforts with the Environmental Protection Agency Labs in Edison, NJ, and Exxon Research and Engineering in Florham Park, NJ. On May 31, I met with EPA and Exxon in Edison for an initial review of proposals received to date. Although numerous proposals were discussed in general, the review effort focused on the current strategy (removing oil from the shoreline without allowing it to re-enter the water), using the current tactic (chemical presoaking, followed by flushing of the beach with dispersant and water, and containing and recovering the oil at the water's edge). Based on this, the concensus recommendation was to focus initially on the chemical/dispersant tests originally proposed by Exxon, and proceed with further review and recommendations based on the results of these tests. These tests were conducted by Exxon in Alaska throughout the summer as monitored by the NOAA SSC and

Shoreline Cleanup Committee, and to our knowledge resulted in the limited application of COREXIT 9580 on the beaches.

In addition, as the R&D Center had limited expertise in bioremediation, we coordinated review of these proposals with the EPA Labs in Edison, NJ and Cincinatti, OH. Of the proposals submitted to them for review, five were recommended for further consideration by the EPA/Exxon Bioremediation Task Force in Alaska. These were forwarded to the Task Force, but to our knowledge these bioremediation methods were not tested in Alaska.

The proposals summarized in enclosures 1 and 2 represent less than half of the 625 proposals we received; the others we have been excluded as not workable or not applicable to the cleanup effort in Alaska. Enclosure (1) summarizes proposals that we have retained here at the R&D Center for followup review. Enclosure (2) summarizes proposals that were forwarded on to Exxon as they described currently available, off-the-shelf equipment and technology. If you want us to provide copies of the proposals summarized in enclosure (1) for the workshop, please let us know. Also, if you need additional information on the proposals or our review process, please contact me or Dr. Hiltabrand.

Sincerely;

P. A. TEBEAU
Lieutenant Commander
U. S. Coast Guard

Encl: (1) Summary of Proposals Retained at R&DC
Summary of Proposals to Exxon

Copy to: Dr. Dave Kennedy, NOAA SSC Seattle w/encl

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INCINERATION

Angelina B. Salvador
Physical Sciences, Inc. (PSI)
Research Park, P.O. Box 3100
Andover, MA 01810-7100

COMMENTS: Helicopter-borne lasers to burn off oil spills. Tested Kanata, Ontario, by Environment Canada. Actual results not known, but ignition did take place.

Walter Kuhr, Sr., President
Dona Karen Marine Fisheries, Inc.
Suite 211
4215 21st Avenue West
Seattle, WA 98199

COMMENTS: Incineration of oil using ship (APOLLO ONE) proposed by commercial fisherman. No data on temperatures/quantity burned/hour. Contact company for details.

Clem Cody
Cody & Associates, Inc.
7510 Wake Robin Drive
Cleveland, OH 44130

COMMENTS: Pontoon designed to pull in oils, seaweed, kelp and vaporize it at 3000° to 7000°C. That is hot! Plasma gasification to burn debris/oil. Requirements may be too demanding; electrical drawings of apparatus included. Material type unknown to hold this amount of heat.

Bobby G. Walston, CEO
A Fair Cleaning Co., Inc.
228 Davey Street
Bloomfield, NJ 07003

COMMENTS: Oil burning concept, hand drawings, pump sludge to burn, laboratory study. No data.

BIOREMEDIATION

Richard J. Kersey
Senior Vice President
Unitech International, Inc.
12651 S. Dixie Hwy, Suite 315
Miami, FL 33156

CROSS REFERENCE: Christian Basler
Alaska Pacific Distributors
123 W. 53rd Avenue
Anchorage, AK 99518

G. Thomas Braznell
Alfa Products Co.
5990 S.W. Ninth Street
Fort Lauderdale, FL 33317

COMMENTS: Rolfzyme concentrate on NCP product schedule; agent is multi-enzyme causing natural biocatalytic action on oil-bioremediation product for cleanup. Proposal reviewed by EPA Labs in Edison and Cincinnati and forwarded to EPA/EXXON Bioremediation Task Force in Alaska as NCP approved using indigenous organisms.

Ed Cronick, President
Sound Environmental Services, Inc.
7851 Atlanta Avenue
Anchorage, AK 99516

COMMENTS: Boelsing process for hydrocarbon cleanup, bioremediation, transforms liquid to solid phase (oil) using limestone, animal fats. Not on NCP product schedule; used on AMOCO CADIZ incident. Concerns were raised by EPA over potential as sinking agent, and exothermic reaction. Sound Environmental has adjusted buoyancy to prevent sinking and is proceeding with aggressive development effort. SSC and Shoreline Committee have reviewed technology.

Mr. Randy Daniel, President
DPR, Inc. (Diversified Petroleum Recovery, Inc.)
P.O. Box 561
Clifton, TX 76634

COMMENTS: Vegetable oil recovery technique. NCP product schedule listing probably not required. Tested in April, 1989, University of Arkansas. May use Power Vac system to collect material after application. Proposal forwarded to SSC for review as wildlife cleaning agent.

BIOREMEDIATION (CONT'D)

Joseph F. Jennings
Waste Microbes, Inc.
P.O. Box 500541
Houston, TX 77250-0541

COMMENTS: Bioremediation using dried bacteria culture, field application testing required. Reviewed by EPA Labs in Edison and Cincinnati. Not recommended to EPA/Exxon Task Force for use in AK as involves non-indigenous organisms.

George R. Wilcox
Vice President, Marketing & Promotion
GBR Bioreactors Ltd
611 Manitou Road, S.W.
Calgary, Alberta
Canada T2G 4C2

COMMENTS: Bioremediation used on Esso Arrow spill, Nova Scotia. Proposal for beaches, description of bacteria, application required. Not on NCP List. Reviewed by EPA Labs Edison/Cincinnati. Proposal well-developed. Forwarded to EPA/Exxon Task Force in AK for further consideration.

Michael Hunter, Chairman and CEO
Hunter-Wells International, Inc.
700 Brooklawn Avenue
Bridgeport, CT 06604

COMMENTS: Siberian Organism. Uses pseudomonas putida-36 bacteria by dry powder bioremediation on water or beaches application. Not on NCP list. Reviewed by EPA Labs Edison/Cincinnati. Organism may prove indigenous to Prince William Sound. Soviets report good results. Forwarded to EPA/Exxon Task Force in AK for further consideration.

Ralph Guttman
POLYBAC Corporation
954 Marcon Blvd
Allentown, PA 18103

CROSS REFERENCE: Jim Elsey
POLYBAC Corporation
8800 University Parkway
Suite B-3
Pensacola, FL 32514

COMMENTS: Product Petrobac, bioremediation, bacteria application. Permit may be required for field use - used on Eleni-V spill in Britain. Has experience in using CTX-10 BIOX as biodegradation product. Product is on NCP Product Schedule.

BIOREMEDIATION (CONT'D)

G. Scott Miller (in association with Worne Biotechnology, Inc.)
Specialty Chemicals Division
Formula IV Corporation
9755 North 90th Street
Suite 200
Scottsdale, AZ 84258

CROSS REFERENCE:

Stephan Jacob, President
Maxwell Mountain Enterprises
P.O. Box 16
Saltspring Island, British Columbia
Canada VOS 1EO

COMMENTS: Toxigon TM2000, polyphasic suspension agent, forms emulsion with oil, accelerates natural biodegradation; listed on NCP product schedule. Use mycozym system Nutripac, nutrient available for system. Uses include oil, cyanide waste water, halogenated hydrocarbons; material data sheets available. Contact company for details.

Fred Jacobson
Lossie Pacific, Inc.
12832 N.E. 83rd
Kirkland, WA 98033

COMMENTS: Bioremediation, corn cob, NH^3 N^2 base with activated sludge. Could be used as fertilizing agent. Material Safety Data Sheets available. Not on NCP Product Schedule.

Kermit J. Lee, Jr.
Energenesis Development Corporation
104 Berkeley Drive
Syracuse, NY 13210

COMMENTS: Bioremediation; use microorganisms. No description of process via slurry. Permit may be required for field tests.

Ron Browning-Nash
INSATECH
Riverside Corporate Center
Suite 106
240 Corporate Blvd
Norfolk, VA 23502

COMMENTS: Biological remediation, laboratory tested, lack of field data. PETRODEG-100 on NCP product schedule. Reviewed by EPA Labs in Edison/Cincinnati. Not recommended to EPA/Exxon Task Force in AK as involves non-indigenous organism.

BIOREMEDIATION (CONT'D)

Thomas Kataoka
MT-Bio Chemicals, Inc.
650 Steeprock Drive
Downsview, Ontario M3J 2X1, Canada

COMMENTS: Bioremediation "Hi-Clean 2001" aerobic bacteria; lack of control data. Will not work under cold temperatures; needs research here. Reviewed by EPA Labs in Edison/Cincinnati. Not recommended to EPA/Exxon Task Force in AK as involves non-indigenous organism.

George L. Lucas
Microbe Masters, Inc.
11814 Coursey Blvd, Suite 285
Baton Rouge, LA 70816

COMMENTS: Micro Pro "D", enzymes, bioremediation. Micro Pro "Detoxifier 6" may not pass safety requirements. Dry and liquid bacterial cultures available. Physical properties available. Reviewed by EPA Labs in Edison/Cincinnati. Not recommended to EPA/Exxon Task Force in AK as involves non-indigenous organisms.

G. Mitchell Olds
Merkert Laboratories, Inc.
18 Perimeter Park Drive, Suite 108
Atlanta, GA 30341

COMMENTS: ML-21 hydrocarbon oil digestant. Limited to long-short chain hydrocarbons. Applied by suspension. Not on NCP Product Schedule. Reviewed by EPA Labs in Edison/Cincinnati. Not recommended to EPA/Exxon Task Force as involves non-indigenous organism.

Susan Sakaki
URIBE & Associates
262 Grand Avenue, Suite 210
Oakland, CA 94610

COMMENTS: Begin study from scratch - literature survey, then tests, field measurements. No specific plan. General and scientific procedures already known.

Norman L. Easley
BCA
Biological Complex Australia
11607 S.W. Military Road
Portland, OR 97219

COMMENTS: BCA - Actizyme - used in Australia solving sludge/fat buildup problems. Enzyme product, oil effectiveness not known; "maybe" it would not be effective. Not on NCP Product Schedule.

BIOREMEDIATION (CONT'D)

G. Thomas Braznell
Alfa Products Co.
5990 S.W. Ninth Street
Fort Lauderdale, FL 33317

COMMENTS: De-Skum enzyme formulation, beach specialty cleanup - biocatalytic liquid concentrate biodegrade digest oil - catalyst. Rolfzyme concentrate. Rolfzyme on NCP Product Schedule, See Cross-Reference.

CROSS REFERENCE: Richard J. Kersey
Senior Vice President
Unitech International, Inc.
12651 S. Dixie Hwy, Suite 315
Miami, FL 33156

Christian Basler
Alaska Pacific Distributors
123 W. 53rd Avenue
Anchorage, AK 99518

Miles W. Dean
Sherwyn & Assoc. Ltd
P.O. Box 201341
Anchorage, AK 99520

COMMENTS: HELO - high enzyme liquid organic cleaner. Not on NCP product schedule. Common name: coconut diathanolamide. Physical properties available. Health hazard unknown.

Professor Yechezkel Barenholz
Department of Biochemistry
The Hebrew University
Hadassah Medical School
P.O.B. 1172, Code 91010
Jerusalem, Israel

COMMENTS: Use liposomes in cleanup. Toxicological test must be performed. More data required. More RDT&E required.

Robert Penney, President
Penland Sales, Inc.
3620 Penland Parkway
Anchorage, AK 99508-2033

COMMENTS: BY-PAS biodegradable synthetic cleaning agent distributor. Toxic data missing. Components described on material data sheet. Not on NCP product schedule.

BIOREMEDIATION (CONT'D)

Bill Rolfing
Marketing Director
Dr. Stays Enzyme Systems, Inc.
631 Carnation Place
Oxnard, CA 93030

COMMENTS: Enzyme floculation system; four compatible enzymes, 65°-125° pH (5-9) anaerobic-aerobic application. No details for oil application, toxicity unknown. May warrant environmental controlled use; details unknown. Not on NCP product schedule. Reviewed by EPA Labs in Edison/Cincinnati. Forwarded to EPA/Exxon Task Force recommending further inquiry.

Jerry Dale Rusher
Rusher's Services
HC33 Box 2866
Wasilla, AK 99687

COMMENTS: Environmental 75, diatomaceous earth, actually adsorbant. Information on this known for years. Will work on oil, but cleanup procedures are a problem after application.

Wesley G. Smith, President
BBC Systems, Inc.
2298-C Alahao Place
Honolulu, HI 96819

COMMENTS: PX-700C biodegradable concentrate. Material data sheet available. Not on NCP product schedule. Increase cell metabolism for bioremediation review.

Joseph A. Resnick
R.D. #1, Box 415A
Natrona Heights, PA 15065

COMMENTS: Bioremediation, laboratory study of ideal species of microbe. NASA involvement, massive quantities available. Permit to apply may be required. Microcapsulation technology of cells involved. Possible future R&D.

RADM George Lively
Blue Sky Chemicals
15770 N. Dallas Parkway, #600
Dallas, TX 75248

COMMENTS: "Oil Spill Eater," bactozyme. Same as Rolfzyme listed on EPA NCP list. Proposer compares to Corexit 9580, Inipol, EAP22, biodegradation product. Cross-reference to other Rolfzyme listings.

BIOREMEDIATION (CONT'D)

Hirotaka Gion, President
Gion Corporation
3-11, South 11, West 8,
Cho-ku, Sapporo 064, Japan

COMMENTS: Biopack I, bioremediation 520 varieties, enzyme, bacteria. Decomposition to water/carbon dioxide. Destroys smell. Not on NCP list.

J. Leon Potter
Environmental Engineering Consultants, Inc.
2323 W. 7th Place
Stillwater, OK 74074

COMMENTS: Biodegradation, product. Listed on NCP Product Schedule. Uses nitrogen, phosphorous, microorganisms. Absorbent corncob fibers; brand name - "EEC" Oil Removal Concept. Data available. Problem response pH 7.0-60 - may not work in seawater. Attached professional qualifications.

Dan K. Kuykendall
Vice President
Alpha Environmental
517 3rd Street, S.E.
Washington, DC 20003

COMMENTS: Alpha, microorganisms in bentonite. Powder application developed by Carl Oppenheimer. Very worthy of future investigations; meets most criteria for application. Oxygen catalyst supports oil degradation. Works in anerobic environment and could be used below surface in beaches.

COLLECTION - CHEMICAL (DISPERSANT-DEGREASER)

G. Troy Mallett, President
Delta-Omega Technologies, Ltd
P.O. Box 81518
Lafayette, LA 70598-1518

COMMENTS: Omni-Clean dispersing agent. Water-based; listed on NCP Product Schedule.

Mr. Fairleigh S. Dickinson, Jr.
185 Ridge Road
Rutherford, NJ 07070

COMMENTS: Experimental oil recovery; dispersant. No data. Tested at LaBrea tar pits.

Mary Lynn Dressell
Gail's Maintenance
259 N. Capitol Avenue 193
San Jose, CA 95127

COMMENTS: Wetting agent, material data sheet, data sparse. NOKOMIS #3 (F4), not a soap or detergent, used in storage tank cleaning. Not on NCP list; general discussion of use.

Lee Northcutt
Vice President
Cabot Chemical Corporation
P.O. Box 9632
Brea, CA 92622

COMMENTS: Cabot Formula X-266 cleaner/degreaser. Spray by high-pressure nozzle; biodegradable. Toxicity information available. Not on NCP list.

Pat Doughty
Mirachem Corporation
2107 East 5th Street
Tempe, AZ 85281

CROSS REFERENCE: Jim Edwards, MIRACHEM

COMMENTS: MIRACHEM 100 Cleaner/Degreaser, water soluble, tested non-toxic. Not on NCP product schedule; toxic data available. Not a solvent; disposal after use may be problem. Aqueous emulsion, water, detergent, stabilizers, may require pH adjustment during application. Product biodegradable. Protect from freezing.

COLLECTION - CHEMICAL (DISPERSANT-DEGREASER) (CONT'D)

Junius Hayes, III
Pyrocap, Inc.
6551 Loisdale CT, Suite 400
Springfield, VA 22150

COMMENTS: Emulsifier, PYROCAP. Patent. Not on NCP product schedule.

Mr. Ron L. Hodge
Pacific Northwest Chiller Controls, Inc.
P.O. Box 58143
Tukwila, WA 98188

COMMENTS: Product to clean oil; no data. Not on NCP product list. No information.

Andrew Nixon, President
Pan-Thor Technologies
P.O. Box 207
West Cornwall, CT 06796

COMMENTS: Wants to test surfactant, trade name may be Xiphydor. No data. Not on NCP product schedule. Activ 8000 - highly synergistic detergent - emulsification - biodegradable, toxic data available.

Mr. R. Winstanley
Henkel Corporation
300 Brookside Avenue
Ambler, PA 19002

COMMENTS: Alkyl polyglycoside surfactant APG 325. Biodegradable, toxicity unknown; non-sensitive to temperature, general physical data presented. Not on NCP product list.

Mr. H.A. Berger, President
Titan Laboratories
1240 Mtn. View-Alviso Road
Sunnyvale, CA 94089

COMMENTS: Solvent base oil cleaner, Oil-Flo. Degreaser, water soluble. Has been used in California. Emulsifies grease/oil. Non flammable. Safety data sheet available. Contains aromatic hydrocarbons and ether. Toxicity unknown. Not on NCP product schedule. Vapor problem?

COLLECTION - CHEMICAL (DISPERSANT-DEGREASER) (CONT'D)

Jimmy Gravois
Jeanway Chemicals, Inc.
P.O. Box 1521
Gramercy, LA 70052

COMMENTS: Z-100 industrial strength cleaner/degreaser. Data available. No NCP product schedule listing. LD50 toxicity, 2.7g/Kg. Problem?

Todd Gaylord
10900 S.W. Avery Street
P.O. Box 1149
Tualatin, OR 97062-1149

COMMENTS: Formula G-510, concentrated oil cleaner, biodegradable. No NCP product schedule listing. Toxicity tested; irritation to skin.

Paul Marks
20 Ferrier Street
Markham, Ontario L3R 2Z5
Canada

COMMENTS: Solution 2000 degreaser. Material data sheet available; physical data present. Available in quantity. L-12 concentrate added. Not on NCP product schedule.

Novar International Corporation
5191 Oceanus Drive
Huntington Beach, CA 92649

Representatives: Mr. Ian Dickson & Mr. Luke Fontana

COMMENTS: CN-110 surfactant chemical for shoreline cleanup. Water soluble polymer, does not emulsify; oil floats or suspends itself on water. Listed on NCP Product Schedule. Demonstrated in lab at R&D Center showed some potential but full-scale potential unknown as it was not tested on beaches in AK. Reviewed and lab tested by Exxon. Toxicity information available. Should be considered with other alternative chemicals.

COLLECTION - CHEMICAL (DISPERSANT-DEGREASER) (CONT'D)

Bioversal U.S.A. Inc.
1703 Victoria Drive
Mount Prospect, IL 60056

Representative: Mr. Charles L. Wilde

COMMENTS: Bioversal, new chemical developed in West Germany. Biodegradable and low toxicity. Tested and approved in West Germany for cleaning both oil and water spills. Acts as both dispersant and biodegradation enhancer. Listed on NCP Product Schedule. Reviewed and lab tested by Exxon, but not tested in AK. Should be considered with other alternative chemicals.

COLLECTION - PHYSICAL (SOLIDIFICATION - ABSORBENT, ETC.)

John Ryan
American Thruster
7777 Fay Avenue, Suite K-232
La Jolla, CA 92037

COMMENTS: High pressure nozzle, air/water application, in development stage; may control oil movement in water.

Huey Cain
Huey Cain Enterprises, Inc.
3436 North Kennicott, Suite 150
Arlington Heights, IL 60004

COMMENTS: Patent, using clays to absorb oil and sink or collect it from surface of the water; boom and ship used in application process. Concept known since 1972.

James B. Verrastro
Matusick, Spadafora & Verrastro
Attorneys and Counsellors at Law
Suite 500
42 Delaware Avenue
Buffalo, NY 14202

COMMENTS: Application to crude oil, immediate coagulation on spillage.

Mr. Robert D. Ellis
Ellis Marine Systems
P.O. Box 340
Flora, IL 62839

COMMENTS: Invention, undersurface discharge of sorbents and flotable material. Performance standards discussed; general information.

Joel Hughes
Vice President - Operations
Container Products Corporation
P.O. Box 3767
Wilmington, NC 28406

COMMENTS: "KELLY Decontamination System" - spray hot water at oil, strong vacuum applied, breaks up oil on contaminated surface. Cleanup may be problem after application? No data.

COLLECTION - PHYSICAL (SOLIDIFICATION - ABSORBENT, ETC.) (CONT'D)

E. LeRoy Swindell
Mechanical Research & Development Associates
P.O. Box 36, Tower Hill Road
Millbrook, NY 12545

COMMENTS: Two patents: (1) Environmental Aerial Dispensing Device - dispense dry absorbent material, applied directly to the oil; (2) Marine Material Collecting Means, removes absorbent and oil. Patent drawings - discussion available. **Proposer deems proprietary.**

Larry F. Thompson
Vice President, Operations
Tricor Envirobonds, Ltd
P.O. Box 36
Gaylord, MI 49735

COMMENTS: Material bonds oil forming rubber-like mass for collection. May be used as fuel later. Does not sink. Required field tests of collection procedures. Would require NCP Product Schedule listing.

Ken Marshbank
Project Development
Northwest Processing, Inc.
P.O. Box 940
1707 Alexander Avenue
Tacoma, WA 98401-0940

COMMENTS: Developing pilot plant to separate hydrocarbon from other sources, sediments, natural material. Concept uses existing dredge technology. May have promise in specific areas.

Mrs. A. Lee Nicodemus
Helios Research Corporation
38 Dakin Street
Mumford, NY 14511

COMMENTS: HelioPac (pressure amplifier condenser). Steam clean, automatic dispensing of chemicals, modified for siphoning/vacuuming. Dept. of Energy testing as backup safety pump. Available commercially.

COLLECTION - PHYSICAL (SOLIDIFICATION - ABSORBENT, ETC.) (CONT'D)

John Akiskalian, President
Eneresource, Inc.
P.O. Box 6630
Santa Barbara, CA 93160-6630

COMMENTS: Oil separation system; helicopter using nozzle for some application. "Westol" process for cleaning oil, ultrasonic frequency application. Product being introduced for NCP product schedule approval.

Sture Eriksson
CEC A/S
P.B. 149
3160 Stokke
Norway

COMMENTS: General discussion using artificial seaweed mats to collect oil, with oil boom assistance. Has tested in Norway. Recent design involves suspending synthetic fronds from floats to create porous barrier i.e. catches oil but lets water through. May have potential as future R&D.

Garvan P. Bucaria
Wildlife Biologist
Chugach National Forest
201 E. 9th Ave., Suite 206
Anchorage, AK 99501

COMMENTS: Method to purge oil from sand/gravel; used at Valdez spill. No new technology.

Max A. Fonger, President
Safety, Inc.
1515 E. Tudor Road, #11
Anchorage, AK 99507

COMMENTS: Petro-Lock, encapsulates oil, gel results. Floats; does not sink. Recovery with shovels and nets. No NCP product schedule listing. No emulsification; biodegradation not addressed.

Mr. Red Decker
Bear Pump & Chem. Co.
HC-34-6525D
Wasilla, AK 99687

COMMENTS: Dilutin, terpene hydrocarbons (safe?). No listing on NCP product schedule, strong oxidizer. Claims biodegradable. Brief description for application.

COLLECTION - PHYSICAL (SOLIDIFICATION - ABSORBENT, ETC.) (CONT'D)

Charles C. Carte, President
Sierra High Tech, Inc.
First Interstate Bank Bldg, Suite 217
Elko, Nevada 89801

COMMENTS: Safe natural mineral powder, coagulates oil for skimming; will sink. Not on NCP product schedule. EPA regulations exclude sinkers.

Bob Singh
153-A Progress Circle
Venice, FL 34292

COMMENTS: Orange Plus, orange extract/water. Wipe oil away after application. Problem with application procedures, household only. Field testing on oil absent. Not on NCP product schedule.

G. Troy Mallett, President
Delta-Omega Technologies, Ltd
P.O. Box 81518
Lafayette, LA 70598-1518

COMMENTS: Omni-Clean. Material data sheet available. Colloid-type, water based, biodegradable micellular bioremediation application, chemical components known. Non-toxic; listed on NCP product schedule.

J.P. Reyss
Commercial Dept., SERTEC S.A.
(Societe d'Etudes et de Realisations Techniques)
"Le Martinet"
34700 SOUBES
France

COMMENTS: NORSOREX, powder, irreversible plastification of hydrocarbons/oils, plastic sponge floats, collected, non-toxic; listed on NCP product list. Interesting concept, cleanup problems after application unknown.

William J. Slater
Slater Enterprises
1418 Patterson
Anchorage, AK 99504

COMMENTS: GRANCONTROL-O, chemical herder, registered with EPA. Pushes oil to area of mechanical cleanup; subject to weather variables.

COLLECTION - SHIP TYPE/VESSEL

Keith O. Palmer
Marine Debris Management, Inc.
P.O. Box 2322
Sarasota, FL 34230-2322

COMMENTS: New feasible design for oil recovery and processing ship (ORPS). Technical overview, design, conceptual drawing. Development required.

Jack H. Berg
Pacer Cleaning Equipment
1234 Depot Street
Glenview, IL 60025

COMMENTS: Light plastic bag, pumping system for containment, manufacturer.

Peter N. Lang
410 Bayou View Drive
Seabrook, TX 77586

COMMENTS: Oil salvage vessel; contact company for details.

C.T. Humeniuk
813 N. Fairfield
Layton, UT 84041

COMMENTS: Proposes skimming, deployment of skimmers, requests readiness "standby." No data; no concept.

James C. Willingham
642 Fenwick Street
San Antonio, TX 78239

COMMENTS: Unit available for tankers; enables tanker to "back off" grounded obstacle. No data; no concept; no procedure.

Mr. Dan Leffingwell
1162 S.H. Street
Lakeview, OR 97630

COMMENTS: Vortex Vulcrum Keel pontoon; no concept, no drawings, just an idea.

Richard Lazes, President
Petro Group, Inc.
804 First Avenue
Harvey, LA 70058

COMMENTS: Product "Oil Stop," on-board containment system mounted on tanker. No data.

COLLECTION - SHIP TYPE/VESSEL (CONT'D)

Angelo Thomas Fillios
4422 Robin-Dale Court
Wilmington, NC 28405

COMMENTS: Requesting info on how much information to send, containment of oil in tanker's hold, plus crude oil recovery system (inventor). No data; no concept, no drawings.

William R. Hamilton, President
RINCON Corporation
3620 Fifth Avenue
Newport Beach, CA 92625

COMMENTS: "Water Rake" vessel to clean up oil, catamaran type. News articles; no data, obtain more details.

Mo Husain
MH Systems
P.O. Box 825
908 Stratford Court
Del Mar, CA 92014

COMMENTS: Proprietary MH system - patent pending. Containment, rupture. No data. May be just an idea.

Larry T. Rigdon
Vice President, Operations
Zapata Gulf Marine Corporation
P.O. Box 4240
Houston, TX 77210-4240

COMMENTS: Company has available dedicated offshore vessels for oil response.

Kenneth L. Treiber
Columbia Research Corporation
2531 Jefferson Davis Highway
Arlington, VA 22202

COMMENTS: Patent disclosure. Oil collection and removal; ship design.

Michael S. Castro, President
Alaska Gulf Marine Services
P.O. Box 23-1709
Anchorage, AK 99523

COMMENTS: Develop/construct 7-ship support program for oil spill contingency. Engineering drawing available of ship type.

COLLECTION - SHIP TYPE/VESSEL (CONT'D)

Fred M.G. Sullivan, President
EROS Environmental Technologies, Inc.
501 -2001 Beach Avenue
Vancouver, B.C. V6G 1Z3
Canada

COMMENTS: EROS oil spill recovery system, containment recovery, process separation, storage. Submersible available for oil recovery with remote sensing capability.

M.M. (Bill) Wylie, Manager
Wylie Oilspill Recovery Systems
2821 Wentworth
Courtenay, B.C. V9N 6B7
Canada

COMMENTS: Informal discussion of invention; no data, concept, procedure. General information on oil/water separator, recovery information available.

Ivan Ivanov
1303 S. Riverview
Gardnerville, NV 89410

COMMENTS: System design using envirocraft for skimming, with containment skirt, polyurethane bags, floating platform; general discussion.

CROSS REFERENCE: James B. Hobbs, Zephyr Cove NV, use of life rafts with Mr. Ivanov's envirocraft system.

COLLECTION - MECHANICAL AND VESSEL

Rodney C. Whitney, President
RST Systems, Inc.
408 West Main Street
P.O. Box 357
Larose, LA 70373

COMMENTS: Letter, drawing on retrieval/separation process of oil-water (mechanical). RST ships available for use; operate from mother ship.

Robert Surber
612 W. Union Avenue
Modesto, CA 95356

COMMENTS: **CONFIDENTIAL DISCLOSURE.** Porta-dike concept to hold and collect oil spill, different design suggestions, general concept, dike filled with water to stay in place, or inflated with air; boom for both water and beach.

Mr. Robert Steckler
Concept Sales, Inc.
8895 N. Military Trail
Suite 204D
Palm Beach Gardens, FL 33410

COMMENTS: Richter pump. Operates in oil and water, using specific gravity; special Richter fluid driver.

W.E. Rothe
Rothe Development, Inc.
4614 Sinclair Road
San Antonio, TX 78222

COMMENTS: Active company, oil storage devices aboard ships. Replace tankers with rubberized rafts.

Capt. Stig-W Reinlert
Liahusgatan 8
S-260 23 KAGEROD
Sweden

COMMENTS: At-sea oil recovery system. Multi-purpose Oil Recovery Catamaran. No engineering drawings. General description, with dimensions. Boat could be used for a variety of other missions.

COLLECTION - MECHANICAL AND VESSEL (CONT'D)

James Young
504 E. Edgar Avenue
Mishawaka, IN 46545

COMMENTS: Ferromagnetic material dispensed over oil slick, collect using electric magnetism method. Material may change density and sink! Suggest testing at OHMSETT. Patent involved. Included brochure on slick bar products. Trans-V AC 500D, ADAPTS, Uniroyal oil salvage containers. Derrick-Linatex dewatering screen. Derrick-Linatex vacu-deck option. Commercial company with variety of product line.

William J. Stanley
371 Dania Avenue
Buellton, CA 93427

COMMENTS: Hand drawings, oil spill containment, storage and assembly methods.

Troy Miller, President
Computerized Business Enterprises, Inc.
3463 Castleton Way North
Lexington, KY 40502

COMMENTS: Wants to meet with people on containment devices. No suggestions, drawings or concept available.

Tony Marchionda
Discount Records and Tapes, Inc.
545 Market Street
Youngstown, OH 44502

COMMENTS: Patent protected. Oil spill collector, large roller absorbs oil an material deposited in barge. Materials not identified. No tests known. Concept may not be built or tested.

Mr. D.L. McWhorter
1934 Lincoln #14
Port Orchard, WA 98366

COMMENTS: Oil spill salvage tanker, hand drawings of concept available. Suggest keel tank be flexible. Used in 1977 spill, coast of Mexico. Suggested alterations to present tankers to support concept; claims several systems. Patent not identified.

Rich Herendich
Box 4034
Canyon Lake, CA 92380

COMMENTS: Oil spill reclamation barge, rough draft; baffles used with separate holding tanks.

COLLECTION - MECHANICAL AND VESSEL (CONT'D)

C.E. Ashline
P.O. Box 93657
Las Vegas, NV 89193-3657

COMMENTS: Concept for salvage craft for oil pollution (SCOOP). Study proposed, general schematic diagrams, many mechanisms suggested. No concrete engineering diagram. Very general.

John Hammer & Associates
4067 Hardwick Street
Suite 197
Lakewood, CA 90712

COMMENTS: Multisep Flotation Separator - spray on oil/water, solidification, density problem may exist? Hard solid waste. Permit may be required. No data.

Alan E. Belcher
59 Maple Avenue #17
Keene, NH 03431-1652

COMMENTS: Self-propelled water craft. Will build prototype for oil debris removal.

Dennis Brovarone
Wapiya Corporation
445 Albion Street
Denver, CO 80220

COMMENTS: Provides slop oil/oil sludge remediation services using centrifuge, heating technology.

Michael L. Chapman
Chapman/Lorey Enterprises
3475 RueDePaul St., N.E.
Louisville, OH 44641

COMMENTS: Small working model oil recovery system available. Requires prototype development. May be interesting.

John A. Kalpaxis
61-17 68 Avenue
Ridgewood, NY 11385

COMMENTS: Design for oil ship cargo. No data.

SKIMMER-BOOM

Theodore W. Vegh
12956 Arlingford Avenue
Baton Rouge, LA 70815

COMMENTS: Blueprint "Proposal for Emergency Recirculation of Spilled Oil," 15 April 1989, using skimmer, containment boom, siphon pump - verbal equipment. Very brief verbal description.

Rodney C. Whitney, President
RST Systems, Inc.
408 West Main Street
P.O. Box 357
Larose, LA 70373

COMMENTS: Letter, drawing on retrieval/separation process of oil-water (mechanical). RST ships available for use; operate from mother ship.

Mr. Clayton Rodriguez
P.O. Box 1895
Metairie, LA 70001

COMMENTS: Oil skimmer development, oil cleanup barge. Used/tested by Franklyn Oil Spill Recovery Co. Unit available for tests.

E.S. Robbins
221 East South Street
Kennett Square, PA 19348

COMMENTS: Oil skimmer proposal based on gravity, density, surface tension. No drawings; general description. Would require complete engineering investigation.

Harry Pierson, Jr.
SCOR-V
109 Spring Street
West Bridgewater, MA 02379

COMMENTS: SCOR-V oil recovery device, high volume, all-weather versatile method. Patent protected; gravity flow, oil pumped to main storage tanks. Must build or convert vessels for process. Hand drawings with labels designating piping pumps, chambers, etc. Laboratory brochure with prototype. Results of laboratory application unknown.

SKIMMER-BOOM (CONT'D)

William T. Mack
The William T. Mack Trust
P.O. Box 6112
Tyler, TX 75701

COMMENTS: MAKCO Barrier - Mack Skimmer Separator. Drawings; no correspondence between model and prototype design. Tests conducted in wave tank. Movie film type experiment. Barrier not tested against oil-water mixture. Towing tests conducted. Patent involved. Skimmer designed to accompany barrier. No tests; vague description. Infant stage of concept.

Al Jorgensen
A.J. Energy, Inc.
P.O. Box 876154
Wasilla, AK 99687

COMMENTS: Wash tank, skimming, trash collector concept. No detail, drawings or data necessary for complete review. Concept in infant stages.

Bruce L. Hutchison
Vice President
The Glosten Associates, Inc.
600 Mutual Life Bldg, 605 First Ave.
Seattle, WA 98104-2224

COMMENTS: Oil spill containment booms applied, pumping mechanism, skimming floating oil. More detail required. In infant stage. Concept may be used.

Michael G. Johnson
5279 State St., P.O. Box 945
Kelseyville, CA 95451

COMMENTS: Water jets and high-speed skimmer used at OHMSETT, NJ; tested there. Information provided. Recommend use by author who has been employed at OHMSETT.

Joseph B. Garrett
70 Canterbury Road
Chatham Township, NJ 07928

COMMENTS: Containing tank, density and solubility of water-oil causes separation; separates components before storing. New skimmer design proposed; geometric configuration of tanks discussed, drawings without detail are incorporated.

SKIMMER-BOOM (CONT'D)

Joe Greer
Suite 211, 4618 JFK Blvd
North Little Rock, AK 72116

COMMENTS: Schematic diagram of "portable flexible tank" with laminar flow pump system. Hand drawings, water-oil separated by density and solubility. Concept is generally known.

Jurgen Hanke, President
Criteria Petroleum Corporation
Dominion Plaza
600 17th Street
Denver, CO 80202

COMMENTS: Kreierhoff system, ship mounting skimming/filtration system, jet pumps, self-cleaning filtration apparatus. Apparatus available for testing. Six weeks notification. Filtration system patent protected.

Raymond E. Hutchinson
166 Main Street
Cheriton, VA 23316

COMMENTS: Patent application involved; skimmer, drawings by hand. Utilizing conduit pipe system "Valdez Oil Spill Skimmer." Device would have to be constructed/tested on small scale prior to field use.

Larry Frisch
Hydro Aeration, Inc.
31031 Center Ridge Road #4
Cleveland, OH 44145

COMMENTS: Floating boom, gas distribution device for inducing currents and circulation to keep oil from direct contact with boom.

Raymond N. Auger
Power Shade Corporation
530 E. Bleeker Street
Aspen, CO 81611

COMMENTS: Skimming Oil Boom cuts upper layer from water; schematic diagram available. Discussion of mechanics of boom under various conditions. Oil boom concentrates oil slick. Two designs available for perusal. Small-scale testing observed. Results unknown.

SKIMMER-BOOM (CONT'D)

Mr. Douglas Bowers #939626
Twin Rivers Correction Center
Unit A-5-6
P.O. Box 888
Monroe, WA 98272

COMMENTS: Idea on oil containment boom. No data; no information.

Bruce D. Scoles
Infinity Research and Development, Inc.
P.O. Box 5533
Helena, MT 59604

COMMENTS: Floating containment barrier; no data, concept, procedures.

John R. Tusson
Tusson Research & Engineering Center
Belle Chasse, LA 70037-1626

COMMENTS: Rapid open-water oil spill recovery unit; trawling scoop and bag concept. Disposal not addressed.

Mr. Joseph J. Dooley
3718 Frankford Avenue
Philadelphia, PA 19124

COMMENTS: Petroleum reclamation ship design, hand drawings, oil-separated from water, siphoned off, booms required. Description vague.

Harold P. DuShane
1774 Greenwood Avenue
Trenton, NJ 08609

COMMENTS: Disclosure, apparatus collecting and separating floating liquids, collecting floating debris, catching fish, general concepts discussed with figures. Density and solubility used to separate water/oil. Apparatus would have to be built, new engineering drawings required; details must be dealt with.

Bill Bowers
General Manager
Vortoil
9391 Grogan's Mill Road, Suite A-5
The Woodlands, TX 77380

COMMENTS: Oil/water separator, centrifuge concept. Vortoil oily water separators commercially available.

SKIMMER-BOOM (CONT'D)

Dr. R.B. Sanders
Sanders Resource Associates, Inc.
11661 Rockridge Drive
Anchorage, AK 99516

COMMENTS: No concept, no engineering details. Telescopy boom, rubberized tracks and flotation tanks for oil collection.

Louis G. Vallieres
5470 Braesvalley #322
Houston, TX 77096

COMMENTS: Oil removal. No concept, no data, no procedures. Idea only.

Wayne White
St Rt 1, Box 419B
Rockport, TX 79382

COMMENTS: Oil containment, suction boom concept, hand drawing, engineering drawings required. Discussion on use.

Charles Gambel
511 Hector Avenue
Metairie, LA 70005

COMMENTS: Patent; containment equipment, flotation unit, booms, engineering drawing description.

Robert Clark
L.A.R.C. Marketing, Inc.
P.O. Box 2417
Sidney, B.C. V8L 3Y3
Canada

CROSS REFERENCE: Graeme Sorley
OSR Systems Ltd
1830 Oak Bay Avenue, Suite 1B
Victoria, BC V8R 1C2, Canada

COMMENTS: OSCAR, oil/water separator, not like skimmer; will not sink. Advance skimmer technology?

Robert J. Steinback
Centrite
9 N. Five Point Road
West Chester, PA 19380

COMMENTS: "Shore Patrol" floating breakwater system, request research funding. No details.

SKIMMER-BOOM (CONT'D)

James Young
504 E. Edgar Avenue
Mishawaka, IN 46545

COMMENTS: Skimmer design, utilizes magnetic energy field with modified vacuum process; separates oil from water, also centrifugal wheel used. Good general discussion of technology.

Calvin Hollis
Hollis Manufacturing Company
P.O. Box 16
Spearsville, LA 71277

COMMENTS: Oil skimming device; patent. Brief description, no details.

HULL PATCH

Don R. Owen, President
SeaPatch, Inc.
800 Gessner, Suite 860
Houston, TX 77024

COMMENTS: Patching system for holed ships; patch material unknown. May use cement and foam for tighter seal; winched tight by mechanical means. Pressure problems of fabric addressed. Patches are available for purchase. Test results in field are not known or described.

Nick Chornyj
Chornyj Fiberglass Products
and Electrical Contractors Ltd
182 Church Street
Sault Ste. Marie, Ontario P6A 3H5
Canada

COMMENTS: General drawing for method to seal hole in hull of ship; suction cups - electromagnet concept - deployed by boom.

Sebree J. Allen
103 N. 7th Street
Murray, KY 42071

COMMENTS: Patch plan, mechanical for ship hulls, general discussion; no new ideas.

Amedeo Giallorenzi
25 Hickory Place Apt. D-32
Chatham, NJ 07928

COMMENTS: Oil containment, "Dracon," sealant, rupture and puncture, patching.

OIL MOVEMENT

William W. Bannister
University of Lowell
College of Pure and Applied Science
Department of Chemistry
One University Avenue
Lowell, MA 01854

COMMENTS: Radar reflecting dye markers, follow currents. Use of oleophilic Day-Glo metallic-tinsel enhances sonar signals to detect submerged oil.

Kenneth M. Skinner
Everest Geotech, Inc.
10101 S.W. Freeway
Houston, TX 77074

COMMENTS: Digital Image Analysis, aerial photography, aerial photographs, infrared.

George Todd
Encore Energy, Inc.
Suite 616 Meadows Bldg
5646 Milton
Dallas, TX 75206

COMMENTS: Hand drawings of off-the-shelf pumping and separation equipment.

CLEANUP - WILDLIFE

Joseph M. Jackovich, Chairman
Jackovich Industrial & Construction Supply
P.O. Box 407 - A.R.R.
Fairbanks, AK 99707

COMMENTS: ENERGY PLUS, wildlife cleaning - toxicity unknown. No pertinent information for evaluation. No NCP product listing.

D. Bartoli
c/o Embassy Suites Hotel/Miami Airport
Miami, FL

COMMENTS: Shore Wash. Cleans wildlife, rock, beaches. No specific data.

Robert L. Klopfenstein, President
Envirosolv, Inc.
1840 Southside Blvd
Jacksonville, FL 32216

COMMENTS: Re-Entry, non-toxic biodegradable solvent; possible animal cleaning. Non-emulsified solvent. Wildlife application toxicity known; other effects not addressed.

Mr. H.G. Winter
H.G. Winter Co.
701 Kings Row, Suite 6A
San Jose, CA 95112

CROSS REFERENCE: Kenneth D. Coleman
Atlantic Pacific Industries
P.O. Box 3827
321 Northlake Blvd, Suite 116B
North Palm Beach, FL 33408

COMMENTS: NOKOMIS-3 used in other countries. Cleans wildlife, port facilities. Material data sheet available. Blend of celloids, sterilants, surfactants, chelates, hyperwetting agents. 99% biodegradable - colloidal - no detergent. Not on NCP product schedule.

MISCELLANEOUS

Mr. Frank J. Koczon
51 Cedarcrest Drive
Pawtucket, RI 02861

COMMENTS: General statements. No procedure, concepts or data.

Louis Lamont
P.O. Box 1776
Key Largo, FL 33037

COMMENTS: Idea on oil cleanup. No procedure, concept or data.

Bruce Tricinella
Evans Manufacturing
17812 Jamestown Lane
Huntington Beach;, CA 92647

COMMENTS: No information.

Sam Verdin
2600 Breton Drive
Marrero, LA 70072

COMMENTS: No proposal attached.

Dr. Steven McNabb
Social Research Institute
6133 Kensington Drive
Anchorage, AK 99504

COMMENTS: Think tank; risk analysis, assessments.

Will Ozier, President
Ozier, Perry & Associates
870 Market Street, Suite 1001
San Francisco, CA 94102

COMMENTS: Risk analysis, think tank, assessments.

William T. Mack
The William T. Mack Trust
P.O. Box 6112
Tyler, TX 75701

Richard Pearson
Chester, CT

COMMENTS: Fill oil tankers only 90%; use remaining space for emergency transfer of spilled oil.

MISCELLANEOUS (CONT'D)

Will Ozier, President
Ozier, Perry & Associates
870 Market Street, Suite 1001
San Francisco, CA 94102

COMMENTS: Risk analysis, think tank, assessments.

William T. Mack
The William T. Mack Trust
P.O. Box 6112
Tyler, TX 75701

Richard Pearson
Chester, CT

COMMENTS: Fill oil tankers only 90%; use remaining space for emergency transfer of spilled oil.

CONSULTANT

John B. Fairbanks, Jr.
3927 South 3030 East
Salt Lake City, UT 84124

COMMENTS: Consultant available for oil spills.

TESTING AVAILABLE

Mr. Emile Arsenault
Pollution and Oxidation Consultant
7645, Rousselot
Montreal, Quebec
H2E 1Z2 Canada

COMMENTS: Consulting available/laboratory testing of biodegradable products.

AFTER COLLECTION

Ted Baker
Applied Environmental Systems, Inc.
3 Liberty Avenue
Marblehead, MA 01945

COMMENTS: Recycle oil sludge - produce material for paving by cold-mix bituminous paving for roads.

EXXON - INCINERATION

J.D. Hahn
Resource Recycling
Box 1010
Willow, AK 99688

COMMENTS: Incinerators for cleanup.

Mark Hooper
Air Programs Branch
EPA, Region X
1200 Sixth Avenue
Seattle, WA 98101

COMMENTS: Apollo incineration vessel.

Simon Srybnik
President and CEO
All-American Environmental Corp.
140 53rd Street
Brooklyn, NY 11232-4387

COMMENTS: Two rotary kiln incinerators for cleanup.

Robert C. Thomas, Sr.
Petroleum Recovery Systems, Inc.
2116 Westchester Drive #08
Bartlett, TN 38184

COMMENTS: Portable retort machine

George M. Vorel
Vice President, Engineering
Thermojet, Inc.
P.O. Box 1799
Butler, PA 16003

COMMENTS: Portable burner system

EXXON - BIOREMEDIATION

Daniel A. Barash
Enzyme Products American, Inc.
8062 Steven-David Drive
Strongsville, OH 44136

COMMENTS: Bacto-Zyme product

William Ferguson
Ferguson Harbor Service, Inc.
P.O. Box 830
Hendersonville, TN 37077-0830

COMMENTS: Environmental remediation

EXXON - CHEMICAL COLLECTION
(DISPERSANT/DEGREASER)

Fritz Kramer
CoverFoam Technology, Inc.
3001 Redhill Avenue
Bldg 4, Suite 108
Costa Mesa, CA 92626

COMMENTS: 3M Sanifoam for cleanup.

Gene Sterling
Vice President, Marketing
Gulf Coast - Bio Solve
P.O. Box 976
Belleville, TX 77418

COMMENTS: Bio Solve for cleanup.

Lorraine Studin
Stutton Corporation
P.O. Box 7913
Matairie, LA 70010

COMMENTS: TOPSALL #30 for cleanup.

Jerry Trippe
General Technology Applications, Inc.
7720 Mason King Court
Manassas, VA 22110

COMMENTS: ELASTOL for cleanup.

Joseph H. Cartoski
MARPOL, Inc. of Virginia
P.O. Box 569
Norfolk, VA 23501

COMMENTS: ELASTOL oil/water separator

John Kearns
Nickey Petroleum Company
1335 Santiago
Santa Ana, CA 92701

COMMENTS: Bio Solve for cleanup.

John Levine, President
Environmental Security of California
11686 Darlington Avenue #3
Los Angeles, CA 90049

COMMENTS: PHIREX oil dispersant.

EXXON - CHEMICAL COLLECTION
(DISPERSANT/DEGREASER) (CONT'D)

Art McComsey
Fire Control Systems, Inc.
Drawer 4150
283-7518
Kenai, Alaska 99611

COMMENTS: Bio Solve for cleanup.

Richard L. Mosena, President
Mosena Enterprises, Inc.
P.O. Box 175
Franklin, VA 23851

COMMENTS: TC-80 tank and bilge cleaning machine.

F. Banka
Overseas Business Div.
NEOS Company Ltd
Sanwa Bldg, 4th Floor
27-17, Hamamatsu-Cho 1-Chome
Minato-KU, Tokyo, Japan

COMMENTS: NEOS dispersants/gelling agent.

Kenneth D. Coleman
Atlantic Pacific Industries
P.O. Box 3827
321 Northlake Blvd, Suite 116B
North Palm Beach, FL 33408

COMMENTS: NOKOMIS-3 oil dispersant.

Mr. Charlie Grimm
Polar Supply Co.
5001 Eagle Street
Anchorage, AK 99503-7434

COMMENTS: Devprep 88 water-based cleaner.

Harry Jonas, Jr., President
Souwest Band Corporation
400 Australian Avenue
Suite 725
West Palm Beach, FL 33401

COMMENTS: "Tur-Off" non-toxic oil removal product.

EXXON - CHEMICAL COLLECTION (DISPERSANT/DEGREASER) (CONT'D)

Jan Storey
Manager, Consumer Relations
The Murphy-Phoenix Company
Corporate Place
25800 Science Park Drive, Suite 200
P.O. Box 22930
Beachwood, OH 44122

COMMENTS: Murphy's Oil Soap for cleanup.

Gary Watkins, President
ESI, Inc.
P.O. Box 8008, Suite 308
Gloucester, MA 01930

COMMENTS: PHIREX oil dispersant.

Robert W. Cohen
Portage Synergetics
89 N. Main Street
Akron, OH 44308

COMMENTS: Sun Solve oil emulsifier.

Robert Galanis
Fortune Chemical Company
2250 West Desert Cove
Warehouse D
Phoenix, AZ 85029

COMMENTS: X-IT 5 Cleaner/Degreaser

Roy L. Grimes
President, Grimes, Inc.
P.O. Box 29322
Oakland, CA 94604

COMMENTS: SEALCRETE cleansing agent.

Don Hass
P.O. Box 691439
Tulsa, OK 74169-1439

COMMENTS: BioT solubilizer for cleanup.

EXXON - CHEMICAL COLLECTION (DISPERSANT/DEGREASER) (CONT'D)

James T. Hasty
Zaruba & Associates, Inc.
Jordan Creek Center
P.O. Box 34316
Juneau, AK 99803

COMMENTS: Moxie Sodium Silicate Solution

Andrew C. Ott
Olympic Mountain Products
8300 S. 206th
Kent, WA 98031

COMMENTS: Citrasol for cleaning.

Rex Rowell
Rowell Manufacturing, Inc.
22322 Acorn Chase
Spring, TX 77389

COMMENTS: IC-22 emulsifier.

Ember J. Safford, President
Dutch Pride Products
1287 Rainbow Drive
P.O. Box 1651
Cottonwood, AZ 86326

COMMENTS: ECO/+ dispersant.

Joyce Williams
118½ William Drive
Grand Junction, CO 81503

COMMENTS: Amway Liquid Organic Cleaner

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC.

Dave Chase
Alfred Karcher, Inc.
155 Easy Street
Carol Stream, IL 60188

COMMENTS: High pressure hot water for cleanup.

Juha Hakola, President
FINHA Trading Oy
Museokatu 9 B 17, 00100
Helsinki, Finland

COMMENTS: Sansorb for cleanup.

Ed O'Beirne III
Wolter Environmental Systems, Inc.
1100 Harrison Avenue
Cincinnati, OH 45214

COMMENTS: HOT DOG, portable hot water heater for cleanup.

Masami Ohi, Manager
Non-Woven Fabrics Dept.
Mitsui Petrochemical Industries, Ltd
Kasumigaseki Bldg
2-5 Kasumigaseki 3-Chome
Chiyoda-Ku, Tokyo, Japan

COMMENTS: Tafnel oil blotter for cleanup.

James W. Ross
Albany Industrial Tech.
2224 Three Lakes Road
P.O. Box 204
Albany, OR 97321

COMMENTS: Grass seed/straw for cleanup.

Scott Sibriski
General Maintenance Co.
10815 J Beaver Dam road
Cockeysville, MD 21030

COMMENTS: QWIK-SCRUB for cleanup.

Stephen B. Wishek
American Kleaner Mfg. Co., Inc.
9415 Kruse Road
Pico Rivera, CA 90660-1474

COMMENTS: Steam cleaning equipment.

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC. (CONT'D)

Keith W. Adamson, President
ROBWEN, Inc.
1945 Blake Avenue
Los Angeles, CA 90039

COMMENTS: Flow mix in-line proportioner.

Terry L. Johnson, Alaska Manager
Blaze Construction, Inc.
P.O. Box 230087
Anchorage, AK 99523

COMMENTS: "Oil Otter" and crude X595 for cleanup.

Joseph Neubauer, President
GeoCHEM, Inc.
3200 New Seward Highway, Suite 201
Anchorage, AK 99503

COMMENTS: Elastol cleaning agent.

Mr. Eric Noe
Alexander Shane Industries, Inc.
923 Newbury Road
Thousand Oaks, CA 91320

COMMENTS: Steam cleaning devices.

Mr. Michael Pipella
Vice President
Oil Otter, Inc.
4839 East Greenway Road, Suite 231
Scottsdale, AZ 85254

COMMENTS: Oil Otter foam pads.

Leonard O. Walde, President
Sigma Enviro Enterprises
140 Spring Road
Orinda, CA 94563

COMMENTS: SEE-JELL for cleanup.

Richard A. Wilden, General Manager
Weber & Sons, Inc.
P.O. Box 328
Oakmont, PA 15139

COMMENTS: RAWFLEX absorbent for cleanup.

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC. (CONT'D)

Marilyn M. Campbell
Environmental Sales Director
Excel-Mineral Company, Inc.
111 South La Patera Lane
P.O. Box 878
Goleta, CA 93116

COMMENTS: Sorbent clay product.

Richard G. McPherson
Vice President
Newtech Resources
151 Kalmus Drive
Bldg C-204
Costa Mesa, CA 92626

COMMENTS: ZORBITUP 97 absorbent material.

Mr. Trevor Millia
DuUnn Burt & Partners
Thames House
Southwark Bridge Road
London SE1 0A8

COMMENTS: Oil/water separation system.

Hiroshi Nakano
Ajinomoto Co., Inc.
Specialty Chemicals Dept.
1-5-8 Kyobasi, Chuo-ku
Tokyo 104, Japan

COMMENTS: Oil spill gelatinization agent.

John Simmons, President
Carbontec Corp.
400 East Broadway, Suite 609
P.O. Box 2252
Bismarck, ND 58501

COMMENTS: CCD chips for cleanup.

Jack H. Berg
Pacer Cleaning Equipment
1234 Depot Street
Glenview, IL 60025

COMMENTS: Portable steam cleaning.

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC. (CONT'D)

Mr. David N. Eaden
Cole Industrial, Inc.
P.O. Box 1336
Lynnwood, WA 98046

COMMENTS: Clever-Brooks portable steamer.

Mr. Bill Folsom
F&B Fencing Co.
P.O. Box 2048
Palmer, AK 99645

COMMENTS: Steel drums/plastic buckets for cleanup.

Mr. C.S. Mirjahangir
15569 Graham Street
Huntington Beach, CA 92649

COMMENTS: Absorbent CD 89 for cleanup.

Mr. John Powell
SKW/Eskimos, Inc.
Anchorage, AK 99518

COMMENTS: Steam generators available.

Mr. Jerry Wendel
Industrial Technologies, Inc.
10284 Page Boulevard
St. Louis, MO 63132

COMMENTS: Sorbent fabric.

John Akiskalian, President
Eneresource, Inc.
P.O. Box 6630
Santa Barbara, CA 93160-6630

COMMENTS: WETSOL process.

Chris Christiansen
Absork International
5924 Daley Street
Goleta, CA 93117

COMMENTS: Baked cork material for cleanup.

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC. (CONT'D)

John E. Foster
Absorption Corp.
P.O. Box 5667
Bellingham, WA 98227

COMMENTS: Absorbent products.

Michael A. Hachez
Material Separation, Inc.
P.O. Box 2073
Fairbanks, AK 99707

COMMENTS: MI-LO Material Separation System.

Alf Haines
Managing Director
Gamesea Pty Ltd
P.O. Box 171, Tin Can Bay
Queensland 4570
Australia

COMMENTS: SOKEROL Organic Oil Absorbent.

Frederick J. Haydock
Whitney Chemical, Inc.
8907 Damascus Way
West Jordan, UT 84088

COMMENTS: Oil/water separation system.

Kirsti Hveding, President
Scan Pacific Enterprises, Inc.
P.O. Box 915
Mukilteo, WA 98275

COMMENTS: FOXTAIL Oil Recovery System.

Darrell R. Kinsey
Goliath Marketing
Rt. 6, Box 246
Lindale, TX 75771

COMMENTS: Absorbent towels.

Thomas Liu, President
PACWEST
1420 E. Cooley Drive, Suite 200N
Colton, CA 92324

COMMENTS: Ground-up corn cobs for cleanup.

EXXON - PHYSICAL COLLECTION, ABSORBENT, SOLIDIFICATION, ETC. (CONT'D)

Gentaro Takeda, President
International Natural Resources and
Energy Development Corporation (INREDC)
Resources Project Dept.
c/o Nissho Iwai Corp.
Tokyo, Japan

COMMENTS: NEOS AB-3000 for cleanup.

Floyd Wihstutz
Longline Fisherman's Supply Co., Inc.
2772 N.E. 1st Street
Pompano Beach, FL 33062

COMMENTS: Oil catcher rope for cleanup.

EXXON - COLLECTION VESSELS

Danny Anderson
Anderscape, Inc.
666, Sherbrooke Street West
23rd Floor
Montreal, Quebec
H3A-1E7, Canada

COMMENTS: UNIMOP ANTI-POLLUTION BARGE/CONVEYOR ASSEMBLY.

ROBERT L. BEEGLE, PRESIDENT
MARCON INTERNATIONAL, INC.
22 FRONT STREET, P.O. BOX 1170
COUPEVILLE, WA 98239

COMMENTS: BARGE AND LOADING/HANDLING CONTAINERS.

JAMES K. CASH, PRESIDENT
CASH'S MACHINE & WELDING
340 E. 76TH AVENUE
ANCHORAGE, AK 99518

COMMENTS: TUGS AND VARIOUS EQUIPMENT

HAL B. CHRISTENSEN
OPERATIONS MANAGER
SANTA BARBARA SEATECH, INC.
6 HARBOR WAY, SUITE 201
SANTA BARBARA, CA 93109

COMMENTS: USE OF VESSEL "SEATECH"

FRED H. ELVSAAS
SELDOVIA NATIVE ASSOCIATION, INC.
P.O. DRAWER L
SELDOVIA, AK 99663

COMMENTS: M/V GLADYS E AND M/V CINMAR AVAILABLE FOR CLEANUP.

JEFF HARALA, VP
MDSIX, LTD
2225 4TH AVENUE
SEATTLE, WA 98121

COMMENTS: BARGE AVAILABLE.

EXXON - COLLECTION VESSELS (CONT'D)

SEC - C. LUHRING
SCHIFFSWERFT GMBH & CO. KG
POSTFACH 1263
D-2880 BRAKE
FEDERAL REPUBLIC OF GERMANY

COMMENTS: BOTTSAND TWIN-HULL OIL RECOVERY SHIP

H.H. MUNTE
JASTRAM-WERKE GMBH CO. KG
POSTFACH 80 05 27
D-2050 HAMBURG 80
FEDERAL REPUBLIC OF GERMANY

COMMENTS: ORAS II OIL RECOVERY VESSEL

EDWARD C. NIEDERMEYER, PRESIDENT
NIEDERMEYER-MARTIN CO.
1727 N.F. 11TH AVENUE
P.O. BOX 3768
PORTLAND, OR 97208

COMMENTS: BARGES AND SELF-CONTAINED LIVING UNITS

JERRY O. NORMAN
WESTERN ALASKA CONTRACTORS, J.V.
6120 A STREET
ANCHORAGE, AK 99518-1817

COMMENTS: FLOATING LABORATORY FOR CLEANUP

ROBERT M. SHAHNAZARIAN, PRESIDENT
AMERICAN WORKBOATS
618 PILCHARD STREET
TERMINAL ISLAND, CA 90731

COMMENTS: TUGBOATS AVAILABLE

RON SMITH
GRAND CANYON EXPEDITIONS
P.O. BOX 144
KANAB, UT 84741

COMMENTS: PONTOONS/RAFTS FOR CLEANUP.

HENRY L. TOMINGAS
INSTITUTIONAL SERVICES
2522 ARCTIC BLVD, SUITE 200
ANCHORAGE, AK 99503

COMMENTS: VESSELS AVAILABLE FOR CLEANUP.

EXXON - COLLECTION VESSELS (CONT'D)

OLNEY WEBB
DON'S BUSINESS SUPPLIES
KETCHIKAN, AK 99950

COMMENTS: 40-FOOT FIBERGLASS BOAT AVAILABLE.

EXXON - MECHANICAL VESSELS

Claude Duval, President
Marine AQUA Tech
Division of Sub Aqua Tech, Inc.
7195 Ch. Chambly, St-Hubert Quebec
Canada J3Y 3R7

COMMENTS: Deep Sea Oil Boom

Dennis Nottingham, President
Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
1508 West 38th Ave.
Suite 101
Anchorage, AK 99503

COMMENTS: Deep Water Oil Boom

Ted Palmer
TRANSVAC
11851 Dyke Road
Richmond, B.C., Canada V7X 4X8

COMMENTS: Vessel and two vacuum pumps available.

Al Avitabile, President
Davit Sales, Inc.
P.O. Box 232
Jefferson Valley, NY 10535

COMMENTS: OSED oil skimmer for cleanup.

David Badger
9450 Chateaux
Coeur D'Alene, ID 83814

COMMENTS: Falcon III hovercraft for cleanup.

Edwin A. Emerson, Jr.
Emerson Enterprises, Inc.
Star Route 65, Box 89
Norway, ME 04268

COMMENTS: Oil/water separator

Joseph M. Giefer
4 Crab Cove
Funtes Bay, AK 99850

COMMENTS: M/V Cest si Bon available for cleanup.

EXXON - MECHANICAL VESSELS (CONT'D)

Al Hand, President
Commerce Alaska Corp.
P.O. Box 92304
Anchorage, AK 99503

COMMENTS: Beach cleaning system.

Brian D. Kelm, Esquire
Law Offices of William Bixby
P.O. Box 1229
Valdez, AK 99686

COMMENTS: Captain Christian Lint's offloading oil barges.

Kremen Company
Attn: Gary
326 "L" Street
Anchorage, AK 99501

COMMENTS: K-Boom oil recovery system.

W. Gerald Lott
Flo Trend Systems, Inc.
707 Lehman
Houston, TX 77018-1513

COMMENTS: Mastr-pump emergency response system.

Frank Meyers, President
Kepner Plastics Fabricators, Inc.
3131 Lomita Blvd
Torrance, CA 90506

COMMENTS: SeaVac self-propelled skimmer system.

Monosep, Inc.
P.O. Box 3604
Lafayette, LA 70502

COMMENTS: Multisep flotation separator.

Ulrich Petersen
Niedersachsisches Ministerium fur
Wirtschaft, Technologie und Verhehr
Friedrichswall 1
3000 Hannover 1
Postfach 101
Federal Republic of Germany

COMMENTS: Twin-hull multipurpose ship available.

EXXON - MECHANICAL VESSELS (CONT'D)

Paul Preus, President
Clean Water, Inc.
204 Horner Street
Toms River, NJ 08753

COMMENTS: Sorbent C - Sorbent C filter booms

Kenneth W. Roth, President
Aqua-Dozer International, Inc.
940 Lincoln Road, Suite 323
Miami Beach, FL 33139

COMMENTS: Aqua-dozer floating debris dumpster.

Louis E. Shenman
United Marine International, Inc.
2337 Lemoine Avenue
Fort Lee, NJ 07024

COMMENTS: Trash and debris skimming equipment

Brent Stoehr
Dura-Lume Boats
P.O. Box 520069 - Mile 3.5
Big Lake, AK 99652

COMMENTS: Shall water oil skimmer available.

Monte D. Stutes, Controller
POSCON, Inc.
P.O. Box 596
Nederland, TX 77627

COMMENTS: Hydraulic skimmer system.

EXXON - MISCELLANEOUS

D.D. Barlow, President
National Association of Dredging Contractors
(NADC)
1625 I Street, NW, Suite 321
Washington, DC 20006

COMMENTS: Services offered; dredging.

Thomas F. Dalton, President
Spill Control Association of America
40 Joni Avenue
Hamilton Square, NJ 08690

COMMENTS: Spill Control Association (contractor, personnel available).

Bruce Fenton
RFD 1, Box 307
Warren, ME 04864

COMMENTS: Suggestion to minimize oil spill impact.

Mr. Eddie Goodman
CUDD Pressure Control, Inc.
Emergency Management Services
P.O. Box 53476
Lafayette, LA 70505

COMMENTS: Fire pump system for cleanup.

William B. Schoephoester
4041 B Street, Suite 207
Anchorage, AK 99503

COMMENTS: 16" cutter suction dredge available.

John J. Stout
EIGHT STAR
P.O. Box 91556
Anchorage, AK 99509

COMMENTS: Manpower and equipment for cleanup.

Richard Hope
Environmental Assessment Laboratories
P.O. Box 872988
Wasilla, AK 99687-2988

COMMENTS: Laboratory services.

EXXON - MISCELLANEOUS (CONT'D)

Joel Hughes
Vice President - Operations
Container Products Corporation
P.O. Box 3767
Wilmington, NC 28406

COMMENTS: KELLY Decontamination System.

Richard L. MacDonald
Bolder Sand & Gravel, Inc.
11012 Mukilteo Speedway
Everett, WA 98204

COMMENTS: Ecology blocks, filter fabric, processing plant for oil cleanup.

Walter Youngblade
Vice President, Government Services
OHM Corporation
16406 U.S. Route 224 East
P.O. Box 551
Findlay, OH 45839-0551

COMMENTS: Personnel and equipment available for cleanup.

John E. Gillis
J.C. Company & Associates
5520 Lake Otis, Suite 102
Anchorage, AK 99507

COMMENTS: Hot water generation systems.

Gregory P. Chaney
8477 #1 Thunder Mt. Road
Juneau, AK 99801

COMMENTS: Suggestion for cleanup.

Mr. Ronald Cooper
Alaska Pump & Supply, Inc.
261 East 56th Street
Anchorage, AK 99518

COMMENTS: Use of hydraulic pumps.

Randy E. Easley
Oil Spill Consultants
P.O. Box 220412
Anchorage, AK 99522-0412

COMMENTS: Oil spill consultants.

EXXON - MISCELLANEOUS (CONT'D)

D.W. Lerch, Vice President
MARCO Pollution Control
2300 West Commodore Way
Seattle, WA 98199

COMMENTS: Expertise in pollution control.

Mr. Peter McPhee
Pearson of Alaska, Inc.
5100 Cordova, Suite #206
Anchorage, AK 99503

COMMENTS: Oil spill equipment and manpower available.

Raimund Pfaff
Auf dem Damm 8
5910 Kreutztal-5
Federal Republic of Germany

COMMENTS: Vacuum unit and manpower available.

Marc C. Waszkiewicz
3370 Bielmeier Rd., SE
Space #56
Port Orchard, WA 98366

COMMENTS: Manpower and expertise available.

Jo Ellen Whaley
Founder/Publisher
North American Salmon Anglers, Inc., and
Salmon Kings Magazine (NASA/SKM)
11127 Old Eagle River Road
Eagle River, AK 99577

COMMENTS: Equipment and personnel available.

Mr. Michael K. Able
Production Manager
Auto Body Shop
Alaska Correctional Industries
P.O. Box 919
Palmer, AK 99645

COMMENTS: Pump/trailer for cleanup.

EXXON - MISCELLANEOUS (CONT'D)

Frank DeJens
4X Corporation
P.O. Box 509
Neenah, WI 54957-0509

COMMENTS: 4X 2-way radio systems.

Jolene Lombardo
USDA Forest Service - Alaska Region
Anchorage, AK 99510

COMMENTS: Beach cleaning services.

Mr. Charlie Pickett
K&K Recycling, Inc.
P.O. Box 10687
Fairbanks, AK 99710

COMMENTS: Inventory listing.

Mr. Harry Pursell
Arctic Camps and Equipment
P.O. Box 102142
Anchorage, AK 99510

COMMENTS: Proposed office building.

Ajit Shah
A.S.I.
1326 W. 12th Street
Long Beach, CA 90813

COMMENTS: Offshore oil equipment.

John Simpson
Martech Construction, Inc.
300 East 54th Avenue
Anchorage, AK 99518

COMMENTS: Martech land-based boat cleaning station.

Wilford D. Tannehill
12122 Adrian, Unit # 6-212
Garden Grove, CA 92640

COMMENTS: Waste oil cleaning apparatus.

EXXON - MISCELLANEOUS (CONT'D)

John A. Zitney
Robinson Pipe Services, Inc.
2309 E. 28th Street
Lorain, OH 44055-2003

COMMENTS: Vacuum trucks for cleaning.

Mr. Ihor Lysyj
C-E Environmental, Inc.
A Subsidiary of Combustion Engineering, Inc.
4765 Calle Quetzal
Camarillo, CA 93010

COMMENTS: Monitor long-term effects.

W.H. Tyson, Jr.
Product and Business Development
1874 School Street
Moraga, CA 94556

COMMENTS: Claypro oily debris separator.

Dennis G. Kelley, P.E.
Phoenix Environmental
P.O. Box 1555
Sand Springs, OK 74063

COMMENTS: Waste oil cleaning apparatus.

David Hull
Managing Director, ASTCO
Box 1933
Taber, Alberta TOK 2GO
Canada

COMMENTS: Oil field waste reclaiming equipment.

John E. Klepac
Sverdrup Corporation
2600 Denali Street, Suite 501
Anchorage, AK 99503

COMMENTS: Management/cleanup services.

Greg McIntosh, President
McIntosh Marine, Inc.
621 Idlewyld Drive
Fort Lauderdale, FL 33301

COMMENTS: "Mailbox System" for oil removal.

EXXON - MISCELLANEOUS (CONT'D)

John E. Gillis
J.C. Company & Associates
5520 Lake Otis, Suite 102
Anchorage, AK 99507

COMMENTS: Hot water generation systems.

Mr. Terry Flinn
Manager, Diving Division
Underwater Construction, Inc.
8740 Hartzell Road
Anchorage, AK 99507

COMMENTS: Underwater construction technical support.

Ms. Hilde Sanstead
Greenpeace U.S.A.
P.O. Box 104432
Anchorage, AK 99510

COMMENTS: Frogmat/boom beach cleanup.

Michael L. Stepetin, President
Michael Service Corporation
8532 S.E. 17th Avenue
Portland, OR 97202-7327

COMMENTS: Oil spill cleanup equipment.

James E. Tobleck, President
JET Consulting Corp.
P.O. Box #5190
North Muskegon, MI 49445

COMMENTS: Assistance for cleanup.