DRAFT AGENDA TO IMPROVE OIL SPILL RESPONSE IN ICE-COVERED WATERS

prepared for

Prince William Sound Oil Spill Recovery Institute

Cordova Alaska

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PROJECT BACKGROUND

The overall objective of this project is to identify areas where further research and development will improve the ability of responders to deal with an accidental oil spill into a marine environment in the presence of ice. Such an event could include spills of oil on top of or underneath solid, stable ice extending out from shore (landfast), into an area of drifting ice floes (pack ice) or onto an ice covered shoreline. This subject is of concern to development companies, local residents, and government agencies participating in oil exploration, production and transportation in such diverse regions of the world as: Cook Inlet and the North Slope of Alaska, Sakhalin Island (Sea of Okhotsk), Norwegian Barents Sea, Baltic Sea and the Caspian Sea.

The initial task was to identify critical deficiencies in the current state of knowledge. Technical presentations made to the International Oil and Ice Workshop (Anchorage, Alaska, April 2000) were used as the basis for a preliminary listing of deficiencies and possible solutions. Over 300 participants at this event heard an international group of scientists and engineers cover the key response issues surrounding spills in ice, including: fate and behavior, detection and monitoring, logistics, operational lessons from case studies, burning, mechanical recovery, and dispersants.

Following the International Oil & Ice Workshop, Alaska Clean Seas carried out an extensive review of spill response, ice conditions, oil behavior and monitoring (Dickins et al., 2000). Additional ideas were added with comments received from the original workshop authors. A preliminary technical report was issued to the Prince William Sound Oil Spill Recovery Institute (Dickins, 2002 for OSRI).

The second (current) Phase of the project began in the spring of 2003 with the aim of producing a final work plan or agenda by December 2003. The final document will be published jointly by OSRI (Cordova, Alaska) and the United States Arctic Research Commission (offices in Washington DC and Anchorage).

The current phase (ongoing) includes the following activities:

1. Appoint a steering committee to coordinate and comment on the direction of the project (refer to Attachment A).

2. Develop a simplified extract of the 2002 project report and distribute for comments and new ideas to approximately 50 key researchers in private, academic and government organizations worldwide (completed August 2003).

3. Develop a completely revised set of priority ideas incorporating all comments received to date, and discussions with the steering committee.

4. Incorporate the revised idea list into a new document for public comment (this file posted on the web in September, 2003).

It is hoped that this project will lead to the development of more capable prevention and response strategies for oil spills in ice-covered waters. It is recognized that in order to make a real difference, further engineering and scientific studies must be accompanied by appropriate training, public education, media awareness, political will and sensible, realistic regulations and standards.

A number of these non-R&D issues were raised during the process of screening priority ideas. They are maintained in this document as a reminder that a successful spill response hinges on more than the potential availability of the best available technology. Responders need to have timely access to all possible tools, and the means to apply the tools in the most flexible manner possible.

DRAFT LIST OF R&D IDEAS

Priorities are assigned to specific research and development efforts considered: (1) to have a high potential of improving response effectiveness for oil in ice, and (2) to have a reasonable chance of success based on past results and known limitations. In some situations, the potential for large benefits may justify a relatively high risk R&D program (very uncertain outcome). Examples would include a new system for detecting oil trapped in ice or proving that existing strategies using dispersants could have applications to certain spills in ice.

There is little point in coming up with a massive "shopping list" of all possible ideas without going through the necessary steps to arrive at a final short list of the most deserving R&D items. Initially this study started with over 60 ideas and research concepts. These were whittled down to the list shown here through a series of iterations and reviews. The ideas listed here will be further pruned (or added to as new ideas and comments come forward) over the next three months.

Even a focused workplan or agenda containing only the highest priority projects is still beyond the capabilities of any one organization to fund in whole (or often in part). International cooperation involving a mix of government and industry participants is needed to tackle the most important issues. This project has an international focus, considering activities in all countries where oil spills in ice are an ongoing concern. Given the specialized nature and limited number of researchers actively working in the area of oil-in-ice spills, it is essential to involve different center of expertise regardless of their location.

A relatively simple approach was taken here to create an initial priority list of important concepts and research ideas. A gauge of expected R & D effectiveness was used to create a subset of ideas, which (if successful) offered the highest potential to improve response capabilities. A subjective, hypothetical question was posed to assess the expected effectiveness of different ideas:

> Question *Would research and development in this idea or topic lead to (1) no or slight, (2) moderate or (3) substantial improvement in the existing state of the art, either in terms of recovering/removing the oil from the marine environment, or in reducing the impact of a spill in ice?*

Following this initial elimination process, the remaining ideas, projects, concepts and recommendations were distributed for a worldwide review by experienced oil spill researchers, and response agencies. Further editing based on their comments led the list shown here.

Ongoing or recent work is noted. Idea numbers maintain a cross link to the original idea list contained in Dickins (2002). A number of R&D avenues may require completely new technologies to achieve any significant chance of success in the future. Examples are mechanical recovery and/or cleaning of oiled ice, and remote sensing to detect oil trapped under or in ice (technical constraints or uncertainties are identified where possible).

The order of ideas at this stage has no particular significance. The final document will attempt to identify linkages and timelines where the decision to pursue certain ideas may be contingent on the outcome of another project. For example, the application of Net Environmental Benefit Analysis (NEBA) to the expected recovery effectiveness of particular strategies could lead to a shift in subsequent research priorities.

Although not tied to a specific ice environment, the list assumes that the highest priority in most areas of the world is to develop a credible and effective response to oil spilled in mobile (pack) ice. Some ongoing issues such as the inability to readily detect oil trapped in ice apply to stable (fast) ice as well as pack ice.

Ideas listed here are intended as the basis for future engineering and scientific research projects. Biological studies or presentations may also be required as additional input in some cases (e.g., NEBA, public education, risk analysis). These types of studies are not covered specifically in this workplan and would require a very different approach and rationale.

The intent is to further debate the ideas contained here along with comments received over the next two months (September to October, 2003) in order to arrive at final set of recommendations. The end product will only contain those ideas likely to provide the greatest advancement in knowledge and capability for a given expenditure of scarce research dollars. Keep in mind that this is still a work in progress.

Table

Possible Ideas Leading to an R&D Agenda for

Oil Spill Response in Ice Covered Waters

Title	Idea No.	Idea in Brief	Comments	Work Ongoing (Where known)
Overall Response Issues				
Rationalize Response Strategies between Different Areas	P10/ R60 & 61	Develop an international set of standards for spill response in ice e.g., ISO.	Very difficult to achieve given the different jurisdictions and national interests. Benefit would be consistent standards in spill response practices. Such standards could lead to more effective use of limited development funds to improve certain widely accepted technologies and their applications.	Baltic states are working to integrate response resources and strategies across borders. Discussions are also under way in the N. Caspian to rationalize response.
Net Environmental Benefit Analysis **NEBA**	P11/ R62/ R64	Apply Net Environmental Benefit Analysis for strategies in ice for specific scenarios - use as a tool in R64 - see below	Results could provide valuable perspective on relative merits of different approaches (e.g., burning vs. mechanical)	
Realistic Scenarios	R19	Develop realistic scenarios to evaluate and compare response options in a wide range of ice conditions.	"Real world" comparisons of response tools could help to modify regulatory approach to recommended strategies and identify the most effective strategies in a given situation.	Industry projects on the North Slope and in Cook Inlet. (Not all public)
Risk Analysis	R21	Risk analysis of spill scenarios	In theory, this type of analysis can help focus on most important oil in ice scenarios. In reality, the prevailing philosophy of always preparing for the worst-case event prevents the practical application of risk-based decision making (for spills).	Numerous worldwide examples of risk analysis during the development phase (EA process).
Past Lessons from Accidental Spills	R25	Revisit past spills in ice - worldwide in terms of response operations (has already been done in terms of oil fate and behavior)	Opportunity to consolidate lessons learned - has not been done in any comprehensive fashion. Drawback is that much of the documentation of past spills in ice is sparse and incomplete.	Individual authors have conducted individual reviews.

Experimental Spills				
Field Spills	R22 R2 R6	Field tests with real oil focusing on pack ice See also R2, R6 and potential for simulants to facilitate applications for field spills in the US (R23 below).	Lack of opportunities for realistic field-testing with oil in ice considered as key deficiency in developing improved response strategies for arctic spills. Essential to have better understanding of dynamics of interactions of oil in slush, brash and grease ice + spreading in different concentrations.	None in US. Two previous in Norway (93) and Canada (86).
Oil Simulants	R23	Develop realistic oil simulant(s)	This may be a realistic alternative for experimental spills in US waters.	University of Utah funded by Alyeska
Tank Tests	R24	Develop controlled climate, tank facility for "realistic" tests (See also R22, R2, R6)	Need to conduct reliable meso to full-scale testing with oil in ice.	Initial trials with sea ice at OHMSETT 01/02
Containment, Recovery, Removal Techniques				
Dispersants in Ice **(includes use of other additives)**	R51/ 52	Test dispersant/additive effectiveness in pack ice and identify scenarios and oils where applicable. Options: (1) using icebreakers (on hand) to add necessary mixing energy, (2) assess ability of dispersants to remain with the oil in ice as it moves from a low energy (internal pack) environment to a higher energy ice margin.	Questions surrounding dispersant use in ice include pour point/viscosity, film thickness & mixing energy in waves & ice. Studies in this area could also look at any potential for natural dispersion of oil in certain high-energy ice environments (e.g., Sakhalin and Canadian E. Coast). Limited in geographic scope and time.	Limited knowledge. Exxon/Mobil (03/02) - proprietary. See also work by Goodman and Brown in wave basin with brash ice (AMOP 88)
Vessel Ice Management	R27	Evaluate potential for icebreakers to support and influence the outcome of a response operation in ice. May include novel design concepts in future such as asymmetric hulls.	Explore the capabilities of new azimuthing drive icebreaker designs (and other available work boat) to aid in breaking down floe sizes, releasing trapped oil etc.	Finnish concept studies. Cook Inlet field trials (preliminary)
Booming Alternatives	R39/ R41	Evaluate alternatives to booms for oil containment in pack ice.	Could include concepts of (1) submerged bubble jets and (2) coherent plunging jets, among others.	Recent (02) proposals not funded by MMS. ExxonMobil (02/03) Proprietary

Containment, Recovery, Removal Techniques				
Oil Deflection or Redirection in/though Ice	New	Evaluate potential application of prop washing or other concepts to direct oil into a collection/recovery area.	Builds on experience with prop washing as a common technique for clearing oil films out from wharves and piers at terminals.	Current technique in open water (Valdez). Tried in Cook Inlet.
Skimmer Evaluations		Compare effectiveness of different skimmer systems in ice	Need to develop or use accepted protocol for testing to ensure acceptance of results by regulatory agencies (e.g., ASTM etc.)	Past work by Canadian Coast Guard and others.
Dedicated Oil in Ice Skimmers or Ice Cleaners	R32 R33	Increase rate of advance and swath width for (throughput) to allow broken ice skimmers to deal with broken ice offshore. Also, better separation of oil and ice.	Existing mechanical approaches have limited ability to accommodate larger ice pieces or to cope with larger spills (outside harbors and ship channels).	MORICE Ohmsett tests (01/02), Finnish work with vibrating concept (03)
Improve Capabilities of Conventional Equipment Mechanical Systems	New	Improve cold temperature and slush ice handling capability of existing devices (brush drums, pumps, disks).	Focus here is on redesign and engineering improvements rather than new R&D. Extend operating window of existing equipment.	Numerous past efforts tied to specific devices. No recent comprehensive work.
Direct Recovery of Oiled Ice	R36	Improve direct recovery of oiled ice for small spills (e.g. harbor)	This could still be a valid response strategy for small spills. Difficult to scale up without handling huge volumes of ice.	Used in past accidental spills Canada & Finland. No efforts to optimize.
Oil and Ice Fate & Behavior				
Nearshore Oil/Ice Interaction	R3	Evaluate likely shallow water fate/behavior in ice (Less than 2 m water)	Understand fate and behavior of oil in shallow water zones of bottom fast ice and/or spring overflood.	Little or no work in this area.
Shoreline Studies	New	Evaluate treatment options for oiled ice and ice rubble in the 'shoreline zone'	Could involve consideration of likely oil/ice interactions in this zone focusing on means to access and remove the oil without waiting for spring melt. Tank testing could include the use of a simulated shoreline ice foot to study oil adhesion and removal.	Some historical experience trying to remove oil spilled in grounded ice rubble. Little or no actual research.
Oil/Ice Mixtures	R30	Define likely range of oil/ice mixtures for response (composition, properties) in particular regions.	Would satisfy need to specify ice types as design parameter or to define limiting conditions for all strategies.	

Response Support				
Unstable Ice Logistics	R56/ 58	Develop logistics options within the landfast zone during freeze-up and break-up	Focus on need for access to offshore sites when the ice is too thin, deteriorated, flooded or unstable to allow safe surface access.	
Oil Transfer	R59	Oily waste transfer during freezing conditions.	Continues to be a priority issue with DEC and others.	SL Ross (02) with ACS Prudhoe Bay for USCG. Viscous Oil Pumping Wkshp. sched. for Nov. 03.
Remote Sensing	R15/ R17	Test new technologies with potential for detecting oil-in/on/among ice. Past testing in Canada incl. Laser Flurosensor, acoustic prototypes etc. Cook Inlet uses IR sensor to help identify thinner ice (could apply to oil in ice).	Very limited choice of existing technologies with any potential. Past work in this area has shown disappointing results. Still an urgent need for this detection capability.	Alyeska technology review (02). MMS review (01). Various papers by Fingas, Brown, Goodman
Monitoring and Tracking	R18	Develop tools to account for a range of ice conditions in new oil spill fate, behavior and tracking models	Needs new analytical models to deal with oil and ice input data on a real-time basis. Prerequisite would be reliable ice drift models as a starting point (lacking).	Little or no new work in past decade. Some recent MMS interest.
Other Non R&D Issues				
Regulations and Standards	R60	Review state and federal policies to allow more effective use of all available strategies in ice and to take into account unique aspects of oil in ice response.	Work towards a more flexible policy on implementing non-mechanical strategies from the outset. Need to consider aspects such as natural containment offered by the ice, reduced spreading in ice, natural shoreline protection during winter.	Recent changes in US to increase credits for additional response options.
Pre-Approvals	R63	Continue to develop and expand pre-approval process for additional response options such as ISB and dispersants.	Complicated by differences in local jurisdictions and sensitivities.	Extensive efforts in some areas including parts of Alaska
Education	R64	Develop continuing long-term public outreach programs.	Required to explain the trade-offs of alternative response strategies and to dispel existing fears and myths related to spill response.	Tends to be project or incident specific, with no sustained programs.

CONCLUSIONS

There is a need for new funding to support the continued development and improvement of all available response options to deal with oil spilled in ice-covered waters. At the same time, attention needs to be paid to the regulatory framework at national and regional levels to ensure that the unique aspects of responding to spills in ice are reflected in future standards and statutes. Advances in technology and equipment will gradually improve our ability to deal effectively with spills in certain types of ice.

There is also a need to make sure that responders have access to all of the available tools in a timely manner. Improvements in this area will require honest and open communication between industry, the public and government agencies. Sustained, long-term education and public outreach programs are needed to ensure that everybody with an interest in the outcome of an accidental spill is well informed as to the trade offs inherent in making the most effective response decisions.

Spill response operations in ice and open water are fundamentally different. These differences must be recognized in assessing and recommending the most appropriate strategies to deal with oil in a wide variety of ice conditions and seasons, including freeze-up, winter and break-up. Over-reliance on any single response strategy for oil and ice is bound to fail, given the infinite variety in ice environments and oil in ice situations that may be encountered in a real-life spill.

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