Oil Spills: Lessons from Alaska for Sakhalin

Rick Steiner

Introduction

This paper will present concerns regarding the potential for serious environmental impacts to result from offshore oil and gas developments currently underway off the northeast coast of Sakhalin Island, focusing on the Sakhalin II project. The environmental impacts expected from normal operation of the field and the very real threat of catastrophic accidents will be discussed. To understand and fully appreciate the potential severity of damage that could be caused by this development, the Exxon Valdez Oil Spill in Alaska is discussed.

The principal intent of this discussion is to help policy makers, industry, and the public fully appreciate the potentially disastrous ecological, economic, and social consequences of a major oil spill off Sakhalin, and to inspire the incorporation of extraordinary safety precautions in the design and operation of offshore oil development. This discussion then, is both a warning and a challenge to improve the safety of the offshore oil projects.

A Note about Environmental Activism in Democracies

A brief note regarding the importance of public involvement in Democratic government seems to be in order here. The very essence of participatory, democratic forms of governance is that citizens have not just the right to vote, but also have an obligation to become informed on issues affecting them and to express those concerns broadly and openly. Even if public opinion seems critical of particular aspects of society, it is incumbent upon government and industry to pay attention to it, and to adjust policies accordingly. Experience has shown that critical public opinion can have a very positive effect on proposed development projects. It is widely acknowledged that environmental concern in the United States in the early 1970s regarding the proposed construction of the Trans-Alaska Pipeline, while vigorously demeaned by government and the oil industry at the time, ultimately lead to the construction of a better, safer system.

It is in this context that environmental activism in Sakhalin should be fully embraced, supported, and listened to by government, industry, and the public. It is in everyone's interest to do so. Certainly, a catastrophic spill on the Sakhalin shelf would not only cause extreme environmental, economic, and social damage, it would also foreclose further oil and gas development options now planned in the area. The political and financial repercussions to future economic development on Sakhalin would be enormous.

That Sakhalin Energy officials were present at and actively participated in the SRC Symposium in Sapporo is a hopeful sign. They should be applauded for their apparent openness and willingness to discuss critical public review of their operation. Collective problem solving is often a much more productive approach than the traditional adversarial approach.

Environmental Impacts of Sakhalin Offshore Oil Development

Description of Sakhalin II Project:

Sakhalin Energy Investment Company states in their EIA for the Sakhalin II project that phase I of the Piltun-Astokhskoe (PA) Field development will involve the drilling unit "Molikpaq" positioned on the sea bed in about 30 meters of water, approximately 17 km offshore the northeast coast of Sakhalin. The Molikpaq measures 111 meters square at its base tapering to deck dimensions measuring 73 meters square, and has accommodation for 104 people onboard. The sea level of the platform is reinforced for ice-resistance with a 8 meter high, 8 mm thick steel plating. Its core is stabilized with 190,000 cubic meters of locally dredged sand compacted by about 24 explosive blasts. Scour protection for the rig consists of a 20 meter wide sand and gravel collar along with a wall of hundreds of large boulders.

Phase I of the project will include 12 production wells ranging in depth from 2,700 meters - 5,000 meters, and 2 gas injection wells (to maintain reservoir pressure), designed to produce 90,000 barrels of oil/day and 65 million cubic feet of gas/day during the ice-free, summer season lasting approximately 6 months. In early July, 1999, the first oil production began at the site. Produced oil is transported from the Molikpaq through a 2-km long, 324 mm diameter pipeline on the sea bed to a Floating Storage and Offloading (FSO) unit. The FSO, the "Okha," is a newly built 158,000 Dead Weight Tons (DWT) double-hulled tanker with a low ice-class rating, with a loaded draft of 14 - 16 meters. The "Okha" is owned by SBM, Inc. based in Monaco, and it and the SALM are leased to SEIC. The FSO is anchored to a Single Anchor Leg Mooring (SALM) system, consisting of 4 steel pilings of 40 meters in length driven through the base of the mooring into the sea bed, a 250 mm loading hose and a mooring hawser connected to a swivel apparatus so the FSO can pivot around the mooring with the wind and current. This complex - the Molikpaq, undersea pipeline, SALM, and FSO - is collectively referred to as the "Vitiaz' Production Complex."

Transport tankers will load from the Okha. The SEIC terminal operation plan states that transport tankers in the size range of 25,000 - 250,000 DWT will be accepted at the Vitiaz' marine terminal, with cargo capacity up to about 2 million barrels. Tankers over 160,000 DWT are known in the maritime industry as "Very Large Crude Carriers," or VLCCs. Thus, some of the largest oil tankers in the world will be allowed to load at the Vitiaz' facility. SEIC states, however, that most transport tankers they expect to deal with will be in the size range of 80,000 - 90,000 DWT with cargo capacity of approximately 500,000 barrels. These vessels will load from the FSO approximately every 6 days during the operating season, and then transit off the east coast of Sakhalin to market, generally south to Japan, Korea, etc. If sufficient quantities of oil are found, it is expected that Phase II of the project would remove the FSO/SALM offshore terminal, and pipe the oil ashore and south to a marine terminal at the port of Korsakov on the southern tip of Sakhalin for loading onto transport tankers.

Summary of Potential Impacts

A general overview of potential environmental impacts of offshore oil and gas development off Sakhalin is useful in order to understand the full scope of effects on the environment. The Environmental Protection section of the EIA for the Sakhalin II Project contains an overview of some potential impacts off Sakhalin. The environmental impacts can be either those chronic impacts expected from normal operations, or those acute impacts from serious accidents.

<u>Chronic Impacts Expected from Normal Operations</u>

In general, Sakhalin Energy suggests that direct environmental impacts associated with project implementation include withdrawal of oil, gas, and condensate; introduction of chemicals, noise and vibration; solid and liquid sanitary and production waste; and habitat effects. Pollution introduced into surrounding waters will come mostly from drilling wastes, which include spent mud and cuttings, cementing waste, produced fluids, process water, drainage wastewater, etc.

Impacts from the <u>construction & installation phase</u> of the project can include increased water column turbidity from dredging; disturbance of sea bed areas in preparing platform foundation; avoidance of the area by marine wildlife, including fish and marine mammals, arising from construction noise, vibration and the presence of erected facilities; exclusion of commercial fishing and shipping operations from the immediate area; air emissions associated with vessel and construction equipment; wastewater discharges; habitat alteration; and accidents and upset conditions such as fuel spills and vessel collisions.

Impacts from <u>the drilling & production phase</u> - include discharges from the Molikpaq, the Floating Storage & Offloading (FSO) Unit and vessels including crude oil, discharge of 5,000 barrels/day (675 tons) of drilling fluids and produced water; operation and maintenance activities such as pipe cleaning and equipment washing; drilling activities such as shipment of drilling mud constituents, mud preparation, cuttings handling, etc.; air emissions from Molikpaq, the FSO, and vessels; and marine habitat loss due to placement of the pipeline and Molikpaq, and from noise, vibration and physical presence of structures offshore; and accidental spills from Molikpaq and the subsea pipelines, operational accidents, and vessel collisions.

The largest intentional discharges are expected to be the large volume discharge of produced water and drilling fluids and cuttings. Produced water consists primarily of relatively warm water (60 degrees F) from the oil reservoir, containing dissolved and dispersed oils, high salt concentrations, heavy metals, and no oxygen. The project is expected to discharge the 5,000 barrels/day of wastewater at a depth of 5 meters, which SEIC states should be sufficiently diluted within the 500 meter mixing zone around the platform to meet Russian water quality standards - 29 mg/L oil with a daily maximum of 42 mg/L. It should be pointed out, however, that these levels are toxic to a number of marine organisms. And, as the industry is fond of pointing out, many marine organisms are actually attracted to offshore rigs, thus putting them inside the mixing zone within which they are exposed to much higher, toxic levels of various pollutants. That SEIC will be monitoring the sediment throughout the project is good, but a realistic picture of ecosystem effects would require the monitoring of toxicant levels in marine organisms as well.

Of greater concern is disposal of drilling fluids and cuttings. The drilling muds are chemically complex, formulated fluids circulated into the bore hole to control temperatures and pressures, to cool and lubricate the drill bit, and to remove drill cuttings from the bore hole. The cuttings are small fragments of subsurface rock that break and are incorporated into the drilling mud. The muds consist of various chemicals, including weighting agents (barites), gelling and deflocculating agents (bentonite clays), deflocculants and filtration control agents, pH and ion-control substances, bactericides, corrosion inhibitors, lubricants, and defoaming agents.

Of the four disposal methods possible - overboard marine discharge, shore disposal, injection, disposal in Molikpaq's core - SEIC has chosen the easiest, cheapest, and unfortunately the most environmentally damaging method - overboard marine discharge. They state that overboard discharge will result in "limited, short-term environmental impact in the immediate vicinity of the platform...due to physical smothering and short-term oxygen demand." They assert that "there is not a suitable receiving formation into which Molikpaq's wastes could be injected." This assertion should be independently verified.

The only area in the U.S. where the oil industry is allowed to discharge drilling muds and cuttings into the marine environment is in Cook Inlet, Alaska, where some of the strongest tidal flushing in the world is found (10 meter tides). Just this month however, environmental groups filed a lawsuit seeking to close the marine discharge option in Cook Inlet based on concerns of toxic contamination. A recent study by the U.S. Environmental Protection Agency found cadmium, which is one of the heavy metals found in drilling muds and cuttings, in several marine invertebrates used for subsistence foods.

While drilling muds from the Molikpaq will be reused to some extent, normal drilling operations are expected to intermittently discharge into the marine environment from 80 - 160 cubic meters of drilling muds/hr., in 1 - 2 hour periods. Ultimately, about half (2,000 cubic meters) of all the drilling mud and all (5,300 cubic meters) of the drill cuttings from the project will be discharged into the sea. SEIC states that this will cause turbidity from sediment load suspension and increased heavy metal pollution from weighting agents and clays. Heavy metals known to be elevated by drilling mud disposal include mercury, lead, zinc, cadmium, arsenic, and chromium, many of which are known to bio-accumulate to toxic levels in the food chain. Also, there is evidently little consideration given to the potential introduction of exotic marine species from shuttle tankers deballasting before loading at the FSO.

The company suggests that most of the operational impacts discussed would be short-lived, very localized and thus of little environmental consequence. This is doubtful and should be confirmed or refuted in independent analysis. Furthermore, Sakhalin Energy has not conducted a cumulative impact assessment, which is required in the United States. Federal law in the U.S. requires that environmental impact analyses for Outer Continental Shelf oil development include all "past, present, and reasonably foreseeable future actions or activities." This is to include not only past, present, and potential future oil and gas activities in the area, but also all "non-OCS" activities. Non-OCS activities include such things as dredging and marine disposal of dredge wastes, municipal wastes, radioactive wastes, obsolete munitions, industrial and municipal wastes; coastal and community development which alter coastal hydrology, reduce wetlands, logging of coastal forests; commercial fisheries; other non-energy mineral development; and other transportation of oil and gas through the region. Such an analysis for Sakhalin and the Sea of Okhotsk should be conducted to get a complete, synoptic picture of how impacts of the oil and gas projects will add to other overall ecosystem impacts. The impacts of the Sakhalin-II project cannot be adequately assessed in isolation from the other offshore oil and gas projects (Sakhalin I - VI), and other human activities in and around the Sea of Okhotsk. SEIC representatives stated publicly (at the SRC Symposium) their agreement with the need for a cumulative impact assessment in the region.

Acute Impacts from Serious Accidents

Of far greater concern than the chronic, operational impacts of the project as discussed above is the real threat of a catastrophic accident - structural failure; blowouts; and process system "upsets" such as fires and explosions. History shows that catastrophic failure of complex human-machine systems can result from relatively small system anomalies. Structural failure of the Molikpaq, the offshore pipeline, the FSO or the Single Anchor Leg Mooring (SALM) buoy could be caused by seismic events, extreme seas, sea ice, corrosion, steel failure, etc. Well blowouts can occur as a result of overpressurization, and could release significant quantities of oil into the marine environment, as could explosions/fires in the system. While the company suggests that several design criteria will be incorporated into the system to prevent such catastrophic failures, they give little specificity regarding such criteria. For instance, they suggest that hazard analyses "will be conducted" and other criteria "will be developed," but do not further elucidate the details of such important components as the emergency shutdown system, the design criteria for the emergency depressurization system, the criteria for the fire suppression system on Molikpaq and the FSO, the structural integrity of Molikpaq, etc. Such emergency systems should be examined independently, and the company must strive to satisfy government and people of Sakhalin that the most stringent safeguards have been incorporated. These are all very real threats, and should be of great concern in Russia and downstream in Japan.

Oil Spill Risk from Transport Tankers

Perhaps the most significant potential environmental threat from Sakhalin offshore oil and gas development is that of a major oil spill from one of the transport tankers. It is well established that the greatest risk for catastrophic oil spills is that of transportation via tanker. Given that VLCCs with 2 million barrel capacity will be calling at the offshore terminal and then sailing south along the island, the potential for a loss of an entire cargo needs to be considered. At projected production levels of 90,000 barrels/day, they expect one tanker transit every 5 - 6 days, or about 36 each operating season. In the EIA, Sakhalin Energy suggests that "the potential of a transport tanker release is classified as unlikely," and goes into little additional detail regarding risk from these shipping operations. They simply say that the transport tankers are not their responsibility. For such a serious threat as a catastrophic tanker spill along the east coast of Sakhalin or further south off Hokkaido, this is an entirely unacceptable assessment.

There are any number of scenarios for catastrophic oil spills from tankers off Sakhalin, including grounding or collisions caused by power or steering loss, navigational error, hull failure, fire/explosion, etc. Shuttle tankers can be blown off the FSO while loading, an incoming tanker can collide with a fully loaded FSO, a fully loaded tanker can lose power or steerage in an easterly gale and be blown onto shore at Sakhalin, a tanker can collide with a fishing vessel, a tanker can ground due to navigational errors, and so forth. All such scenarios need to be carefully examined and planned for in order to minimize the risk of occurring.

Although SEIC presents the image that they have conducted "risk analyses," they clearly haven't addressed all potential problems. It is clear that a thorough risk assessment should be conducted that, at a minimum, would (1) identify, evaluate, and rank the risks of oil transportation off Sakhalin and Hokkaido, (2) identify, evaluate, and rank potential risk reduction measures for the tankers, (3) develop a risk management plan for oil transport off Sakhalin and Hokkaido. The three principal components of the oil transport system that should be carefully evaluated regarding spill risk are the vessels, vessel traffic/shoreside monitoring, and the crews.

Vessels: In order to adequately evaluate and manage the risk of these operations, it will be necessary to fully characterize the fleet that will be used to haul oil from the Vitiaz' terminal: name of vessels, age, hull design, classification society, owner and operator, previous owners, insurer, status of class reports, flag and changes in flag, complete casualty history, pollution history, company vetting policies and maintenance schedules, major repairs completed, history of any and all deficiencies and violations found by classification society or flag state or port state, history of detentions and/or refusals to enter port in vessel's history, etc. SEIC has now developed a vetting procedure by which they intend to screen the quality of vessels that may load at the terminal, and they have established arrival inspection procedures. These procedures need to be thoroughly evaluated by independent analysts, and the inspections should be a matter as well for Russian maritime authorities. The company suggests that they will have the "right to reject vessels on arrival which contravene their established Port Procedures and/or Vessel Conditions." The "right to reject" is not the same as "the obligation to reject." One wonders how rigorously these standards would be enforced if, for instance, the Okha is full, and no other tankers are available to load except those of lower quality that might not be accepted otherwise. Faced the choice of either stopping production from Molikpaq, or accepting a sub-standard vessel, what will the company choose absent governmental oversight and intervention?

Regarding vessel construction standards, while both the United States and subsequently the International Maritime Organization (IMO) have now mandated the phase-in of double-hulled oil tankers over the next couple of decades, this still leaves Sakhalin and Japan exposed to unnecessary risk in the interim. Double hulls provide a significant degree of reduction in risk of oil spills in the event of grounding or collisions of loaded tankers. For instance, Conoco Oil Company, which went ahead and built all double-hulled tankers far in advance of the U.S. and IMO requirement , has had two potentially serious incidents recently, neither of which resulted in an oil spill because the vessels were double-hulled. In 1996 the "Randgrid," a double-hulled Conoco tanker with 1 million barrels of oil onboard, grounded on a rock reef in France and spilled no oil. And in 1997, a barge flotilla slammed into the "Guardian," another double-hulled Conoco tanker with 550,000 barrels of oil onboard in Louisiana, and although a 120 m gash was torn in its hull, again not one drop of oil spilled. A statement by Conoco said "in both incidents, the ships' outer hulls absorbed the brunt of the impact and, although penetrated and heavily damaged, protected the inner hulls and prevented any loss of cargo."

The government of Japan has requested the IMO to accelerate its phase-in schedule for double-hulled tankers ,which began in 1994 for any new build, and extends to 2024 for pre-existing tankers. It is recommended here that the Japanese government move ahead unilaterally, outside the IMO process, to legally require all oil shipped in territorial waters of Japan to be hauled only in double-hulled vessels as of 2005. Similarly, the Russian government should insist that only double-hulled tankers be used to transport oil from the Sakhalin project. The double hull spacing should be sufficient - the National Research Council in the U.S. recommends that inter-hull spacing be at least the beam width of the vessel divided by 15, or 2 meters, whichever is greater. Further, these tankers should be fitted with twin engines, twin rudders, and bow thrusters. This is the sort of tanker now being built by ARCO in the U.S., called the "Millennium Class Tanker."

As the entire world tanker fleet of approximately 3,000 vessels will have to be replaced over the coming two decades or so, one wonders if this might be considered as an economic development opportunity for the Russian Far East. If Russia could develop a state-of-the-art shipbuilding capability, with the highest standards anywhere in the world, it could conceivably capture a portion of this enormous economic potential, which will run into the several hundred billion dollar range. It must be stressed that contracts for these new vessels should go to shipyards with the highest possible quality standards.

Short of requiring all shuttle tankers to be double-hulled at the outset - which clearly is the best safety precaution - the Russian government should push for a more aggressive phase-in of the new vessels and phase-out of the old, single-hulled vessels. If this is the option chosen, then there are several interim structural and operational measures that should be mandatory for all single-hulled vessels. Restrictions against carrying oil in wing tanks will provide additional protection in the event of an accident (particularly collisions), and hydrostatic balanced loading, whereby the cargo holds are not filled all the way so that in the event of a hull rupture the inward pressure of seawater is greater than the outward pressure of oil, would greatly reduce oil outflow in grounding situations. Industry representatives have stated that the costs of implementing both hydrostatic balanced loading and the use of empty wing tanks would only be about two cents per gallon of cargo hauled. Another interim possibility is to fit single-hulled cargo holds with a horizontal mid-deck, essentially resulting in a hydrostatically balanced load. Extensive testing has confirmed the validity of the mid-deck design. Such minimum interim measures should be mandatory until the entire Sakhalin fleet is double-hulled, with redundant engine and steering systems.

Another concern is that, if VLCCs with a loaded draft in excess of 20 meters will be accepted at the Vitiaz' terminal, which is in only 30 meters of water, might heavy swells lead to a dangerous situation where a fully loaded, single-hulled VLCC could actually bottom-out in wave troughs while moored alongside the Okha? Ten meters of clearance in large sea swells does not give much room for comfort.

Regarding the pre-loading vessel inspections at the FSO, it is important to understand just how thorough such inspections will be - will they include the tanker's inert gas system operability, the oily water separator, fire fighting systems, cargo pump emergency shut- down systems, tank level alarms, combustible gas detectors, steering gear systems and failure alarms, back up steering gear operability, emergency generator operability, vent pipes, pumproom shutdowns and explosion proofing, navigation equipment, engine room systems, and so forth?

Vessel Traffic/Shoreside Monitoring: Another concern is the vessel traffic situation off Sakhalin and Hokkaido. As the EIA for the project states that northeast Sakhalin has fog about 1/2 of summer days when these tankers will be navigating the area, the vessel traffic situation needs to be thoroughly analyzed and routing agreements should be established. These agreements could include at a minimum a traffic lane with a north - south traffic separation scheme that is located as far from shore as possible. This assessment should also identify what shoreside monitoring system would enhance the safety of navigation both off Sakhalin and off Japan - a vessel traffic service (VTS), an automated dependent surveillance system (ADSS), vessel transponders and shoreside tracking, and/or tug escorts in hazardous seaways. Additional navigation aids should be considered along the entire route of the transit tankers.

Of critical concern, and again not addressed at all to date by the company or apparently by the government, is how to render assistance to disabled tankers. A plan should be developed that would identify and evaluate existing tugs and emergency towing and salvage capabilities both in Russia and Japan, and include an assessment of various alternative equipment and deployments that would improve the safety of the system. Protocols should be clearly established whereby tanker masters are required to immediately notify Russian and/or Japanese authorities of any loss of power or steerage, so as to avoid potentially disastrous delays in dispatching rescue tugs to the scene. Emergency tow packages similar to those employed in Prince William Sound, Alaska should be required on all transport tankers and the FSO, and the salvage assets of Sakhalin and Hokkaido should be assessed.

Also, communication protocols should be established whereby loaded tankers are required to report positions along their transit route to both Russian and Japanese government authorities.

Crew: Finally, because over 80% of maritime disasters are caused by human error, it is incumbent upon the governments to insist on the highest possible crew standards for the shuttle tankers and the FSO. The IMO Standards for Training, Certification, and Watchkeeping (STCW) Convention of 1984 provides just the bare minimum, and Russia and Japan should insist on higher crew standards. In general, the quality of seafarers has eroded over the past few decades. Crew complements are now about 1/2 of what they were just 20 years ago, which causes increased fatigue, additional stress, reduced on-board training and maintenance time, decreased morale, and less ability to respond to emergencies. Also, many ship owners are now relying on manning agencies to supply crew, who generally supply the least expensive, least experienced, multinational crews that often have trouble simply communicating with one another in a common language.

Safety Concerns at the FSO:

There are several very important unanswered questions regarding the safety of operating procedures at the FSO Unit. These include such issues as weather operating conditions stipulating in what conditions a tanker and the FSO must secure from offloading and disconnect from the mooring, what the SALM hawser tension limits will be and how it will be monitored, pilotage to be required in the exclusion area around the site, the adequacy of the size of the exclusion area, what standby protocols will be required during loading, the pre-transfer conference, verification of Inert Gas System (IGS) operation, monitoring of loading rate and pressures, substance abuse screening, and a pre-departure conference. In response to such issues, SEIC has simply stated that "operational procedures will be developed to address the concerns listed above."

Spill Response Preparedness:

As presently planned, the oil spill response capability for Sakhalin is woefully inadequate.

SEIC states in the EIA simply that they will mount "an adequate response in the event of a spill," without defining exactly what they consider "an adequate response." There should be response planning standards in Sakhalin as are required in Alaska to have the equipment and personnel in place to respond to a maximum probable discharge, which off Sakhalin should be considered to be the loss of a full load from a VLCC, or 2 million barrels.

The company also states in its EIA that "response techniques for spills under ice-free conditions are well established and are generally recognized as effective worldwide." This is categorically not so, and leads to a dangerous misperception that a major spill can be effectively recovered. It must be understood that this has simply never occurred. One of the best spill response in history was the response to the "American Trader" spill off Huntington Beach, California in 1990 (when the tanker broke loose from the offshore mooring) with just 25% of the spilled oil being recovered in ideal conditions of calm seas and extensive inventories of response equipment and personnel on hand. Most responses recover less than 10% of the spilled oil, which is generally inconsequential to the amount of biological damage the spill causes.

It is apparent that SEIC is not planning on a major spill. Importantly, there still exists no pre-approved process for the use of chemical dispersants in the event of a spill. While controversial in some arenas, dispersants can sometime offer the only response tool available in a large, offshore spill. Confusion regarding dispersant-use protocols can lead to delay in their application thus rendering them ineffective. This must be clarified, and a sufficient amount of dispersant and applicator aircraft should be readily available to treat a maximum probable discharge. At a 1:20 dispersant-to-oil ratio, SEIC would need ready access to 100,000 barrels of dispersant to treat a 2 million barrel spill. Having access to some amount of dispersant through contracts with East Asian Response Limited (EARL) in Singapore and Oil Spill Response Limited (OSRL) in the U.K. may or may not be helpful, depending on how fast the dispersant can be transported to Sakhalin. In poor weather conditions, no flights would be able to transport response equipment or dispersants to the island. And, apparently SEIC only has a few hundred drums of dispersant on-island. Also, it is evident that not enough ocean boom, skimming capability, storage capacity, and trained response personnel and vessels would be on hand for a major spill. Spill response preparedness can have a very positive economic benefit to Sakhalin.

Response planning is particularly complicated in this instance in that a spill could spread across international jurisdictions. The government of Japan and the government of Russia should develop a clearly articulated agreement as to spill response and command protocols if this were to occur. While SEIC acknowledges that a spill from their facility could spread to the coast of Japan and have therefor established liaison with the Japanese Marine Disaster Prevention Center, a rigorous, cooperative response protocol and command structure must be pre-established.

Liability Standards:

Financial liability is the primary incentive for responsible conduct by industrial interests throughout the world. With adequate liability on the line, oil companies will be motivated to design, construct, and operate their projects as safely as possible. Conversely, without adequate financial liability, even the most stringent government regulation and oversight will not achieve a safe system.

It is evident that the financial liability standards for the Sakhalin operation are inadequate.

Sakhalin Energy states that they carry insurance coverage for various phases of the project as follows:

- preconstruction period: US $100,000,000 including pollution damage and cleanup
- construction period: Operator's Extra Expense (OEE) coverage of not less than US $200,000,000, to cover costs of well blowouts including property damage, personal injury, and pollution cleanup. This coverage will continue during operational phase.
- operations period: at start up of the Molikpaq, Sakhalin Energy will

have General Liability Insurance in the amount not less than US $150,000,000.

- FSO insurance: Sakhalin Energy will contractually require the owner of the FSO to provide Protection and Indemnity coverage in the amount of US $700,000,000 per incident.
-shuttle tankers: The Russian Federation requires only US $81,000,000 liability cap for tanker owners

These amounts are simply inadequate. By comparison, the cost to Exxon for the Exxon Valdez oil spill in Alaska is likely to exceed US $10 billion, including private compensatory and punitive damages, natural resource damages, criminal fines, and cleanup costs. While this may seem extreme, the $81 million liability cap for shuttle tankers in Russia is ridiculously low given that a spill of comparable magnitude and consequence could occur there. To their credit, SEIC publicly stated at the SRC Symposium in Sapporo that they agree that the $81 million liability cap for tankers is insufficient, and that Russia should consider raising this cap. Also, since a spill could spread from Sakhalin into Japanese waters, standards for liability in Japan should be considered here as well.

Similarly, the coverage for the operational phase of Sakhalin II is inadequate. Sakhalin NIPImorneft estimates that a winter well blowout off Sakhalin could spill as much as 230,000 barrels over a 20-30 day period, an amount that is comparable to the official estimates of the amount spilled by the Exxon Valdez.

Also, because there would inevitably be a drawn-out disagreement between the spiller, their insurer and the government concerning damages in a major spill, a $1 billion response and compensation fund similar to the U.S. "Oil Spill Liability Trust Fund" should be established to expedite response and supplement oil spill claims. Liability standards for this project should be assessed much more carefully, and increased. As they stand now, they do not provide adequate incentive for the safest operation possible.

Another related financial consideration for the government and people of Sakhalin is the Production Sharing Agreement. The fact that the Sakhalin government will only begin receiving royalties from the project after SEIC shows a profit seems reasonable, but as companies are quite adept at burying profits as costs with clever accounting practices, this issue should be carefully reviewed. Oil companies have become so proficient at hiding profits in the U.S. that they have avoided billions of dollars in corporate taxes, leading to concerns that the U.S. has for quite some time had a highly developed state of "corporate welfare." It is important that the companies involved off Sakhalin not be allowed to play a "shell-game" with earnings, thus delaying payment of royalties to the local government.

Regarding federal revenues from OCS oil and gas development, it is recommended here that the Russian government consider implementing legislation similar to that in the United States. In the U.S., each year the Minerals Management Service (MMS) collects and distributes about $3.5 billion from bonuses, rents, and royalties from offshore oil and gas leases. Of this amount, $900 million/year is to go to the Land and Water Conservation Fund (LWCF) to be used to purchase protections on critical habitat areas, and $150 million/year is to go to the National Historic Preservation Fund. While this has been the law for many years, in practice much of these monies have been used for deficit reduction and not been appropriated to their mandated purpose. Presently, legislation is pending in the U.S. Congress to fully appropriate these funds as originally intended. The LWCF provides a 50/50 matching grant program with States and local governments to acquire and develop public recreation areas and facilities, and federal monies are used to purchase federal park lands. As of FY 1997, over $4.3 billion has been appropriated from the LWCF for federal park purchases and about $3.2 billion has funded over 37,000 park and recreation projects by the State governments. In this way, rents from non-renewable public resources are translated into long-lasting public benefit.

Public Oversight:

In addition to adequate financial liability, public oversight is an important factor in assuring the protection of the environment. The author has proposed to the Governor of Sakhalin that the government there establish a Regional Citizen's Advisory Council to monitor government and industry vigilance during all phases of the offshore oil operations. Such a council was established in Prince William Sound, Alaska by the pipeline owner after the Exxon Valdez spill, and funded by industry at approximately US $2 million/year. This council has been responsible for continuing improvement in the safety of the oil transportation system in the region. A Sakhalin Shelf Citizens Advisory Council (SSCAC) would greatly enhance citizen confidence in the safety of the offshore oil and gas development project. It should involve representatives of the local indigenous community, commercial fishing industry, environmental groups, scientific organizations/universities, local governments, etc. It is also recommended here that the establishment of such a citizen's council be considered in Japan.

Sakhalin Energy officials stated, correctly, at the SRC Symposium in Sapporo that the safety of the oil production and transport system is largely a matter of corporate culture.

In keeping with this reality, it is proposed here that SEIC establish, among other safeguards, a confidential reporting system whereby employees can report potential problems without fear of retribution by the company. Self-policing does have a place in ensuring safety, and employees need a corporate environment conducive to freely discussing problems without fear of losing their jobs.

Clearly, the government and oil industry have a long way to go to bring the Sakhalin offshore oil operation up to a "best available technology" standard. The potential consequences of not doing so should become evident in the following discussion.

Overview of Exxon Valdez Oil Spill in Alaska

'what could be in store for Sakhalin and Hokkaido'

The 1989 Exxon Valdez Oil Spill in Alaska provides an important lesson in what can be lost in one simple wrong turn of a loaded oil tanker. The spill became for the oil industry worldwide what Chernobyl had become for the nuclear industry and Bhopal for the chemical industry - the symbolic, defining standard against which all other such disasters are measured.

Policy decisions and assertions before the spill provide an important context in which to understand this spill, and the situation in Sakhalin. When oil was discovered on Alaska's north slope in 1968, the immediate question became how best to get the oil to market. Of the various options discussed - which included building a railway, a road to truck it, submarine tankers, ice-breaking tankers, and even huge cargo airplanes - the only two given serious consideration were to build a pipeline east from Alaska across to connect with a pre-existing pipeline system in western Canada, or a pipeline south across Alaska to the ice-free port of Valdez, for subsequent shipment by tanker through Prince William Sound.

At the time, the national environmental community and the Prince William Sound fishing industry favored the Canadian option, specifically fearing that a major oil spill into the Sound would catastrophically disrupt the productive marine ecosystem and the fishing industry. The oil industry, however, wanted to build across Alaska, saying this route would be cheaper, quicker, and they also had their eye on the potentially lucrative Asian market for exporting Alaska oil in the future. Although the Sound's fishermen won a law suit to stop the construction of the Alaska pipeline, the Nixon administration bowed to powerful domestic oil interests, went to Congress and narrowly passed the Trans-Alaska Pipeline System (TAPS) Act in 1971, clearing the way for building the line across Alaska.

To help win approval in Congress, the administration and the oil industry made three important safety promises to the people of the United States and Alaska - the tankers would be double-hulled, there would be a state-of-the-art vessel traffic system (VTS) observing each tanker navigating the Sound, and Alyeska (the pipeline owner) would have an oil spill response capability second to none. As a result of such promises, some naive politicians boldly stated that "not one drop of oil will ever enter Prince William Sound."

But in subsequent years, after pipeline construction began, all three of these promises essentially evaporated. The federal government was convinced by the oil industry that double-hulled tankers were unnecessary, and in 1974 the U.S. Coast Guard announced that Alaska tankers would have no special requirements, such as double hulls. The State of Alaska tried unsuccessfully for several years to convince the federal government to change this policy and to require TAPS tankers to be double-hulled. In 1976, the Alaska Legislature passed the Alaska Coastal Management Act requiring oil shippers with lower standards to pay more into the coastal management program. This provided a significant financial incentive for shippers to build double-bottom and double hulled tankers, and several were built for Alaska in the next few years. But the shippers filed a law suit against this act just after the oil started flowing through the pipeline in 1977. And in a profound blow to oil transportation safety, the shippers won this suit in 1979, with the court ruling that the state could not preempt federal inter-state shipping authority. This victory for the industry put the issue of additional double-hulled vessels and that of additional spill response preparedness to rest at the time.

But these short-term cost saving victories for the oil industry in the 1979 set the stage for the environmental, social, and economic tragedy of the Exxon Valdez spill ten years later.

The Spill:

On the evening of March 23, 1989, the Exxon Valdez loaded 1.3 million barrels of Alaska north slope crude oil, and headed out from Valdez. The mates and captain, having been involved either in cargo loading operations or drinking across the bay in town, were fatigued and of questionable performance capability. After disembarking the harbor pilot just outside Valdez Narrows, the master radioed Valdez Coast Guard requesting permission to cross over from the outbound traffic lane into the inbound (north-bound) lane to avoid glacial icebergs. The Coast Guard VTS had been downgraded in the early 1980s and now could not track tankers as far out as Bligh Reef.

Noticing heavy ice in the lanes, the master steered the vessel on across the inbound lane to avoid ice, put the vessel on autopilot, and increased to full sea speed of 14 knots. He then left orders with the third mate to turn the vessel back into the lanes when it was abeam the Busby navigational light, and went below to his quarters. At this point, there was a fully loaded, single-hulled supertanker at full sea speed, outside the designated traffic lanes, on autopilot, heading directly toward Bligh Reef, unmonitored by the Coast Guard VTS, piloted by an exhausted mate without pilotage credentials for this seaway - a recipe for disaster. Although the third mate later testified that a command was given to take the vessel off autopilot and that he gave a 10 degree right rudder command at Busby light, the voyage data recorder indicated later that the vessel didn't turn until 5 minutes (a full mile) later. It is strongly suspected that the vessel was not taken off autopilot until it was too late, and just after the bridge crew realized the error, switched off the autopilot and the right turn commenced, they slammed full ahead into Bligh Reef at 12:04 a.m., March 24.

The impact ruptured 8 of the 11 cargo tanks, and most of the oil flowed out in the next 12 hours of falling tide. The oil remaining onboard was successfully lightered onto other tankers over the next few days, and the tanker was eventually salvaged and rebuilt in California. The response and cleanup was a notorious failure, as little equipment or dispersants were on hand, much of it didn't work, and a strong northerly storm quickly scattered the oil beyond control. While a little oil was recovered from beaches, the amounts recovered were of little consequence to the coastal ecosystem - the damage was extraordinary.

Biological Impacts:

Results of several hundred million dollars of government and private scientific studies indicate that the Exxon Valdez Oil Spill, though not the largest in terms of volume spilled, was the most biologically, socially, and economically damaging spill in history. Over 40,000 tons of a relatively heavy crude oil spilled into an extremely productive, pristine, cold-water, protected nearshore environment - Prince William Sound, Alaska. The spill occurred at the time of critical biological productivity - herring were moving nearshore to spawn, migratory seabirds and whales were returning to the area, juvenile salmon were just emerging from streams into the nearshore zone, harbor seals and sea otters were pupping, and the spring plankton bloom had just begun. The spilled oil traveled with currents and wind southwest through Prince William Sound, and thus was exposed directly to hundreds of miles of relatively protected shoreline in its path. In a very real sense, a major spill couldn't have happened at a worse time and place.

The Exxon Valdez became the defining example of ecological disaster from marine oil spills. The oil eventually spread over 10,000 square miles of Alaska's coastal ocean, as far as 600 miles from the sight of grounding. Over 1,500 miles of some of the world's most extraordinary shoreline were oiled, including three national wildlife refuges, three national parks, wilderness areas, a national forest, and extensive areas that had been inhabited for millennia by Alaska Natives. Less than 7% of the spilled oil was recovered, despite a $2 billion attempt - the most massive ever - by Exxon and the federal and state governments.

The initial biological effects are well documented and understood by many throughout the world, due largely to the extensive media coverage of the disaster. The effects were devastating - virtually everything associated with the sea surface was significantly impacted. More marine mammals and seabirds were killed directly by the oil than in any man-made disaster ever. The marine mammal death toll included at least 25 killer whales out of an area population of about 180; 3,500 - 5,500 sea otters, most of the population in western Prince William Sound; and 200 or so harbor seals. Direct mortality of seabirds has been estimated at 300,000 - 645,000, with an additional loss in chick production of over 300,000 following the spill. Some colonies of murres lost 60% - 70% of breeding birds. The 1989 year class of herring, that was spawned in the nearshore zone just as the oil arrived, was essentially lost to the population. Terrestrial mammals including river otters, brown bear, deer, and mink were all affected. And, much of the intertidal zone was essentially sterilized by the toxic oil, and invertebrate communities severely altered.

Such body counts, however, leave only a relatively sterile, abstract understanding of the acute and devastating impact of the oil. Many of us watched in vain as countless sea otters shivered in oiled fur that once kept them warm, whales surfaced in oil which they then inspired, birds struggled unable to fly, river otters crawled off to die under rocks, and thousands of juvenile salmon showed up dead through oil skimming operations. The immediate, overwhelming sense of tragedy was eloquently conveyed by Walter Meganak, a regional native elder who said in June, 1989:

"...what we see now is death. Death, not of each other but of the source of life - the water...It is too shocking to understand. Never in the millennium of our tradition have we thought it possible for the water to die. But it is true."

Beyond the immediate biological damage, there were profound sub-lethal, chronic impacts. There were brain lesions in seals, reproductive failure in birds and mammals, blood chemistry problems, morphological deformities such as curved spines, reduced growth rates, altered feeding habits, liver damage in otters and seals, eye tumors and viral diseases in fish, and general overall physiological impairment.

Some of the ecological damage didn't begin to manifest until several years into the event. Herring populations collapsed for the first time on record in 1993. Of the 120,000 tons of herring expected to return to the Sound that spring, only about 20,000 tons showed up, more than 30% of which were infected by a serious viral disease (viral hemorrhagic septicemia) and a fungal disease. In the succeeding 7 years, only small harvests have been possible in just two years. And although pink salmon runs were strong in the first couple of years, they too collapsed in 1992 and 1993 seasons. Millions of outmigrant salmon were exposed to oil as juveniles in 1989, and many of the eggs of these fish that were laid in streams in 1990 were further exposed to oil. Thus, both even and odd year pink salmon were heavily exposed to oil, and the progeny of both of these year classes failed in 1992/1993. The ecosystem impact of these fish stock collapses has been profound. Herring is considered a cornerstone species in the ecosystem, being a principal prey item for over 40 other species including seabirds, seals, sea lions, whales, and fish. The extensive mortality in sea otters in western Prince William Sound precipitated an explosion of some of their prey species, notable green sea urchin, causing urchin barrens where they have denuded large areas of macroalgae which are critical habitats for certain other fish and crustaceans.

And this year - ten years after the spill - only two injured species are listed by government agencies as recovered - bald eagles and just recently, river otters. Listed as still recovering are black oystercatchers, clams, murres, intertidal communities, marbled murrelets, blue mussels, herring, pink salmon, red salmon, sea otters, sediments, and subtidal communities. And those still listed as not recovering include pelagic cormorants, red-faced cormorants, double-crested cormorants, harbor seals, harlequin ducks, killer whales, and pigeon guillemots. Those listed as recovery unknown include cutthroat dolly varden trout, Kittlitz's murrelet, and rockfish. And today there is still a substantial amount of residual oil in beach sediments of the oil spill region, mostly in Prince William Sound. This oil resides under rocks and in intertidal sediments, and because it has solidified into an asphalt on the surface, the lower layers exist in a relatively unweathered, toxic condition. This residual oil has been found to exhibit toxic effects down to concentrations as low as 1 part per billion.

And beyond ecosystem impacts, humans working on the cleanup experienced an average oil-mist exposure some 12 times in excess of permissible exposure limits. A maximum overexposure of 400 times the permissible limit was reported from one beach being treated with high-pressure, hot water washing. Over 1,800 worker compensation claims were received by the government in 1989, most with respiratory complaints. In summary, the biological damage of the Exxon Valdez spill was severe, unprecedented, and in most cases ongoing ten years into the event. Many scientists expect long-term damage to continue for decades to come.

Social and Psychological Impacts:

The spill had an extraordinary destabilizing effect on human communities in the region. These communities are very dependent on commercial, subsistence, and recreational harvesting of natural resources from the nearshore area, and thus were particularly vulnerable to disruption caused by the spill. Several studies documented that the social fabric of many such communities essentially fell apart following the spill. There were well documented, often dramatic increases in post-spill anxiety disorders, post-traumatic stress, depression, alcohol and drug abuse, domestic violence, conflict among friends and within families, divorce, and even suicides tied directly to the spill. These impacts came mostly from uncertainty about the ecosystem's future, fear of food contamination, the chaos of the cleanup, and the ongoing fish stock collapses. Today, there is still a deep and profound sense of sadness in the region. Many residents have moved elsewhere to avoid the ongoing stress and memory of the spill.

Economic Impacts:

The spill forced many fishery closures in 1989, and caused a depression in salmon prices statewide out of fears of contaminated product reaching market. And with fish stock collapses in the Sound, a continuing depression in the fishing economy is apparent. While

the year before the spill, the harvest value of fisheries from the Sound was $82 million, the total has been less than half of that since stocks collapsed in 1992. In 1993 Alyeska, the pipeline owner, paid $98 million to private claimants and about $31 million to the governments to settle their liability for the spill. A 1994 federal jury set Exxon's liability for compensatory damages (lost income) to 30,000 plaintiffs at about $280 million. Further, punitive damages of an unprecedented $5 billion were awarded by the jury, but Exxon continues to resist paying any of this amount, and ten years later the case remains on appeal in the 9th Circuit Court of Appeals. Exxon spent over $2.1 on their attempted cleanup, and another $1 billion for natural resource damages to the governments. Depending on how the appeals in the private civil suit unfold, the spill could ultimately cost Exxon well over $10 billion. Other damage estimates for the spill were much higher, including almost $3 billion in lost income by fishing industry and coastal businesses, and at least $3 billion in non-economic, or natural resource damages. The economic damage from this spill is, so far, without precedent.

Restoration:

The spill also initiated the most extensive attempt in history to mitigate damage from an environmental disaster. The $1 billion Exxon payment to the government was intended to be used specifically for the purposes of "restoring, rehabilitating, replacing, or acquiring the equivalent of natural resources injured by the oil spill." But even with all of this money and all the scientific attention given the injured ecosystem, it has become painfully obvious that little can be done to actually repair the biological damage from the spill. This has indeed been a bitter pill to swallow.

While little in the way of direct restoration was possible, most realized quickly that the coastal ecosystem faced other serious threats, predominantly clear-cut logging of the old-growth, coastal forest. Because these forests are critical habitat for many of the bird and fish species injured by the spill, their removal only further compromised recovery. Thus, the single most significant accomplishment for the government restoration program has been to acquire protections on over 700,000 acres of coastal habitat along the shores of the region, costing over $400 million. Altogether, some 1,300 miles of shoreline, including several hundred salmon streams, have been permanently protected with these monies.

Many feel that this habitat protection was the most important positive legacy of the Exxon Valdez spill.

But despite this achievement, it is clear that no amount of human intervention after a major oil spill will significantly repair or replace lost natural resources.

Conclusion

In summary, using the Exxon Valdez spill as an example, several important lessons for Sakhalin regarding major marine spills should be clearly understood:

- catastrophic spills can occur from a series of simple human errors
- in general, large spills cannot be contained - seldom is 10% recovered
- oil cannot be recovered effectively from water or shorelines
- ecological damage can be extreme and long-lasting
- social and economic damage can be extreme and long-lasting
- damage is generally not correctable

The inescapable conclusion from this is that once you've spilled it, you've lost. The damage is done and there will be little anyone can do about it. Most of our efforts then, should be focused on prevention of catastrophic spills.

Thus, if government and industry are really serious about wanting to prevent environmental damage to the marine ecosystem off Sakhalin and Japan, it is critical that many of the improvements suggested above be implemented soon so that the offshore oil and gas projects are operated in as safe a manner as possible.