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ESCAPE AND SURVIVAL

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ESCAPE AND SURVIVAL SYSTEMS

Assessment of the Means for Escape and Survival in Offshore Exploration Drilling Operations
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Semisubmersible drilling units may have to be abandoned as a consequence of: structural failure resulting from design faults; collision; stability loss as a result of incorrect ballasting or loading; and fire or unignited gases caused by a blow-out. Jack-up rigs may be evacuated for similar reasons or as a result of punch-through. Drill ships face the same hazards as semisubmersibles except that they are normally manned by seamen who may be better able to handle marine emergencies than are other rig workers. Supply vessels face the normal problems of any seagoing vessel plus added stability problems because much of their cargo is transferred at sea. In addition, their frequent proximity to drilling units and other offshore structures increases the danger of collision, and their low freeboard aft makes them prone to damage from breaking seas. Helicopters can either crash in an uncontrolled manner with little chance of survival for those on board, or ditch under some control and with some chance of survival.

■ *ABANDONMENT CRITERIA* The most important factors affecting the success of abandonment systems off the East Coast of Canada are environmental and mechanical; therefore criteria have been developed based on historical data to define conditions under which abandonment systems must operate.

Severe storms off the East Coast of Canada typically include: icing conditions; maximum wind speeds of 70 knots; maximum wave heights of 17 metres; minimum air temperatures of −20°C; sea temperatures of −1.8°C; and visibility of less than 1 kilometre up to 45 percent of the time. Gales could last for up to 48 hours and storms for up to 15 hours. Burning oil or gas and unignited gas from blow-outs can introduce additional hazards.

From a mechanical point of view, abandonment may occur from a MODU with a list of up to 40° and from the following deck heights: supply ships, 5 metres; drill ships, 7 metres; jack-ups, 3 metres in transit and 20 metres on site; and semisubmersibles, 35 metres in transit and 15 metres in the drilling mode. For helicopter abandonment, the exit doors may be as much as 1 metre above or below the sea surface during evacuation.

When considering the type, number, and distribution of abandonment systems, it should be assumed that certain areas of the unit will be unavailable for use because of damage or angle of inclination. Successful abandonment should, therefore, be possible without use of two adjacent sides of a semisubmersible or jack-up; one side or the complete forward, aft or midships section of a drill ship; and one side of a supply vessel or helicopter.

Abandonment systems must be capable of ensuring safe transit of survivors from the point of entry into them to a position clear of the parent unit. Precedent has shown that a number of existing systems cannot meet this criterion. The most common problems involve the survival craft striking structural members of the parent unit because of the angle of launch, high winds or seas, or incorrectly working equipment such as release gears and survival craft engines.

According to Canadian regulations, abandonment systems must allow for twice the number of people on the unit including ten percent stretcher cases in a combination of lifeboats and life rafts. The total time taken to abandon vessels, including mustering and preparing equipment should not exceed 20 minutes for MODUs; 30 seconds for supply ships providing that preparatory measures are taken early where capsize is deemed to be a threat, (20 minutes otherwise); and 3 minutes for helicopters. Abandonment must be possible without relying on the power supplies of the parent unit, and the operation of the system must be simple and reliable, with suitably trained people in control. Communication links should exist between the parent unit control room, each abandonment post, and, where applicable, each escape craft, and receiving unit.

■ *SURVIVAL CRITERIA* Once a vessel or installation has been abandoned successfully, the emphasis switches to survival. A person's chances of survival in the sea off eastern Canada is most threatened by drowning, which results from insufficient buoyancy and protection, possibly aggravated by lack of bodily control through injury or, most likely, cold. Cold causes hypothermia; as the body core temperature drops, a person's ability for self-help is gradually diminished until death occurs at around 26°C. If a person is to survive, core temperature must not be allowed to drop below 35°C or, at worst, 33°C. The actual water temperature between about 5°C and −1.8°C is not as important a factor as the person's mass to surface area ratio, the amount of subcutaneous fat, general physical fitness, and mental state. Considering feasible response times for vessels or helicopters, rescue from the water should be possible within four hours. It is necessary then for survival suits to ensure that core temperatures of survivors are prevented from falling at a rate of more than 0.5°C per hour. Other physiological effects of exposure to cold air and immersion in water are cold shock, freezing and non-freezing cold injuries, cold incapacitation, sea sicknesses, and loss of body fluid. Suffocation, heart damage, burns, and injuries from excessive acceleration may also pose risks in some abandonment situations and survival systems should take these risks into account.

There are five main types of abandonment and survival systems in current use. These include: evacuation by helicopter, dry transfer, rigid survival craft, inflatable survival craft, and individual abandonment devices (survival suits and life jackets).

■ *HELICOPTER EVACUATION* Helicopter evacuation provides the most satisfactory first line means of abandoning MODUs and offshore platforms since it keeps survivors warm and dry during transfer. This method is only possible, however, if sufficient response time is available (up to four hours); if the units are not listing beyond the limits of the helicopters involved; if wind speeds permit start-up; if fire or gas are not hazards; and, perhaps most limiting of all, if visibility is sufficient.

The rescue capabilities of helicopters vary with different machines. Range, speed, and capacity are all important characteristics. Range and capacity are currently best provided by the Chinook helicopter, and, in the more remote areas of eastern Canadian waters, this may be the only helicopter capable of providing suitable evacuation facilities. The Chinook can tolerate greater pitch and roll because of its two overlapping rotors, and its payload of at least eighty people means that evacuation of a MODU can be effected in a single trip. The capacity of the Bell 212 is eighteen; the Super Puma, twenty-four; and the Sikorsky S-61, forty-four.

There are serious environmental limitations to helicopter operation. Wind speed affects start-up and the time taken to transit against strong headwinds. Start-up for most helicopters, including the Chinook, is only possible up to a wind speed gusting to 50 knots; 70 knot winds are not unusual during storms off eastern Canada. Start-up in normally excessive conditions may be possible if a lee can be provided. Another major limitation is visibility. Cloud ceilings and horizontal visibility below the operational requirements of most helicopters occur in some areas and some months as often as 33 percent of the time. In the North Sea, equipment exists and is in use in military aircraft and commercial aircraft on search and rescue contract which allows helicopters to fly in conditions of virtually zero visibility. These new developments using infra-red imaging systems provide for greatly enhanced capabilities over those available with visual flying or standard instruments.

Helicopters cannot meet the time criteria specified for abandonment, and so can only be used if there is considerable advance warning of an impending emergency. If survivors are already in the sea when a helicopter arrives, or if they are being rescued from a supply vessel or an escape craft, the normal method of recovery is winching. A well trained helicopter crew including a winchman can winch about one person in three minutes in normal conditions, or one person in five minutes in difficult conditions. The speed and number of persons recovered can be improved considerably by using an Emergency Multiple Person Rescue Apparatus (EMPRA) basket or Bennex net. Training is important; a person who has lost body fluid could die unless he is winched in the proper foetal position.

■ *DRY TRANSFER* Dry transfer systems are methods of abandoning offshore installations without having survivors enter the sea. Several different systems have been designed, although many of them only to the conceptual stage. Some have been developed to prototype stage. None have so far been fitted commercially to offshore installations. One main type of dry transfer system is based on the idea of a rigid bridge which can be passed from an installation to a rescue vessel. In view of its size and weight and the need to have a large dedicated vessel to receive evacuees, this concept appears more attractive for fixed installations than for MODUs.

The second approach is based on "replenishment at sea" systems used by many navies. A prototype has been developed in the United Kingdom and ordered for use on board a fixed production platform in the Norwegian sector. This system employs a wire in tension which is sent to a receiving vessel by means of a pneumatic gun. Escape capsules with an eighteen-person capacity are then propelled along the line to the rescue vessel. Computer control of line tensions and potential oscillation and swing-mounted docking platforms which operate within a 150° arc are improvements over earlier dry transfer designs. Among the system's advantages are that it keeps the survivors dry and allows for stretcher cases; it uses power from the receiving vessel; it operates successfully from deck heights exceeding 35 metres and in any sea state; and it automatically propels survivors clear of the parent unit and directly onto a safe haven. The total time to set up the equipment is about 25 minutes and the time taken to transfer 1 capsule is 4 minutes. Thus a MODU containing 90 people could be evacuated in about 1 hour, assuming that the receiving vessel was in close proximity to the MODU when the decision to abandon was made. Although 1 hour exceeds the criteria, it would prove a satisfactory response time in many instances.

The main disadvantage of this system is the cost of providing a dedicated receiving vessel outfitted with sophisticated electronic components and maintaining it within close range of the MODU or offshore structure. For this reason dry transfer systems will probably be limited to permanent installations or clustered groups of MODUs. Another limitation of the system is visibility; those firing the line must be able to see the receiving vessel without that vessel coming dangerously close to the installation. This situation could be improved with the further development of positioning systems. Dry transfer would also be inoperable in areas of burning oil, although this should not be a problem since transmitting stations would normally be fitted on all four corners of a platform and the line could be sent from any one. This distribution also means that the system could operate even when the unit in distress is listing severely. Overall assessments suggest that dry transfer systems offer good potential for providing a safe evacuation system for use offshore.

■ *RIGID SURVIVAL CRAFT* Rigid survival craft derive from traditional ships' lifeboats. The type fitted in MODUs are generally Totally Enclosed Motor-Propelled Survival Craft (TEMPSC) which are either boat-shaped and launched from twin fall davits or disk-shaped and launched from single fall davits. A third type, currently in very limited use, is the free fall lifeboat which is dropped into the sea. Conceptual designs also exist for several types of underwater-launched survival craft.

Twin fall gravity davits mounted on MODUs either follow conventional ship design or, more often, utilize rigid davit outriggers anchored to the structure of the unit. The escape craft is lowered by gravity with speed controlled from inside the TEMPSC by a brake. This type of launching mechanism can accommodate any deck height and is quick and easy to operate; maximum escape time for 44 people in a 50-person craft ranges from 2 to 10 minutes. High winds can affect the launching and model tests have shown that a nearly empty TEMPSC can swing as much as 4.4 metres from the perpendicular during launch from davits at a 20 metre deck height. High seas can also prove problematic as they can carry the craft under the decks of column supported MODUs, and exert considerable slam forces on the hull of the TEMPSC at the moment of impact during launch. Although no quantitative information exists to predict maximum wind speeds and wave heights that can be tolerated by TEMPSC launched by twin fall davits, estimates are that a boat could be set back 12 metres on release in a force 7 wind and over, and capsized if beam on to breaking seas of over 8.1 metres. Even if the TEMPSC does land in the water safely, it must be immediately propelled away from the structure, and experience has shown that the motors do not always work. Precedents also exist for mechanical failures in brake operating mechanisms and release gears, particularly during icing conditions. It is possible to minimize icing problems by heating winch motors and brakes and using low temperature steel on all main structural members of the launching system, but these precautions have not been built into the design of existing MODUs.

Single fall gravity davits have the advantage of a simpler mechanism with only one place for disengagement and thus fewer chances of failure. The disc-shaped TEMPSC that are generally used with this type of launching mechanism can head in any direction after entering the water, so the problem of a boat-shaped craft entering the sea beam on and possibly capsizing are lessened. The main disadvantage is that the single fall allows greater movement, particularly rotation of the TEMPSC while it is being lowered which can lead to problems both during launch and in clearing the parent structure.

Research into methods of ensuring that TEMPSC launched by conventional single and twin fall davits are not swept into the structure of MODUs in high sea and wind states has led to the development of the PROD (Preferred Orientation and Displacement) concept. This system uses a tag-line under tension attached to the bow of the craft to pull it clear of the structure during launch. The craft then continues to move forward under its own power and the tag-line connection automatically disengages. This system is still under development but appears to offer a possible modification to existing systems which will improve their performance.

Some existing twin fall launching systems use guide wires running from the davits to either submerged parts of the parent unit or to points on the seabed to steady the TEMPSC during launch and to ensure that it clears obstructions whatever the attitude of the parent unit. It is understood that on several units the use of guide-wires has been discontinued because of the difficulty of reattaching the TEMPSC to the wires after evacuation drills.

Most boat-shaped TEMPSC are currently fitted with off-load disengaging gear; before the boat gear can be operated, the load must be off the falls. This gear has been proven in practice to be unreliable in rough sea states. On-load disengaging gear is fitted in most disc-shaped TEMPSC. Although it does not suffer from the same releasing problems as off-load gear, and is generally considered more reliable, the fact that it is designed to be operated on-load means that it is possible to operate the release mechanism when the craft is still well above the water, a circumstance which led to fatalities in at least one evacuation attempt.

Free fall systems have been under development in Norway since 1973, where two main concepts have been considered. The first involves a skid system where the craft is released down an inclined chute or skid, whereas the second is a true vertical free fall device. Both systems can launch a 13-metre, 60-man craft from a deck height of 26 to 39 metres. The skid system has been fitted in a number of vessels, whereas the vertical fall system has been installed on one MODU and is on order for a North Sea production platform.

One of the principal objectives of the free fall concept is to use the kinetic energy of the craft, built up during its fall, to carry it clear of the structure. Model tests have shown that using the worst angle of impact with 9 metre waves, the TEMPSC cleared the drop point by about 2 boat lengths. The response time for free fall systems is very short; embarkation by 69 people has been achieved in less than 3 minutes. The system is extremely simple to operate and should not be affected by wind speed. Operating success has not been determined in waves of over 9 metres or in icing conditions, but these circumstances are not expected to pose serious problems.

A combined gravity/free fall launch system is under development using the approach employed in many warship applications where the boat is lowered to just above the crest of the waves and then dropped onto a crest. This technique is used in the "Lifescape" system, a capsule designed to provide a safe haven for survivors on the deck of the parent unit and to be launched only as a last resort. The boat is suspended in a gravity release davit, carried 10 to 12 metres clear of the parent structure, and lowered until initial contact is made with the water. It can then be released from within the craft to fall into the water. This system can be used from any deck height and test analyses have given favourable results in terms of design characteristics. The rigid construction of the launch system, for example, makes it resistent to high winds. However, the system may not be capable of accommodating lists of greater than 17 degrees or wave heights in excess of 12 metres and may need modifications to operate in very low temperatures and icing conditions. Despite these possible limitations, the "Lifescape" system shows promise.

Several versions of a system similar to that designed for launching the "Lifescape" but without the final free fall have been devised using rigid booms. One such system was found in model tests to launch a TEMPSC clear of the parent structure in 17 metre waves, but the design is considered of limited applicability because of the weight and cost of components.

A TEMPSC may capsize in waves higher than eight metres, but is designed to be self-righting providing survivors are properly strapped in and there is no damage to the craft. The new *SOLAS Convention* which does not apply to MODUs requires any lifeboats which do not right themselves to have an above water escape route for those inside to climb out. Craft which meet this regulation will marginally improve chances of survival if they are flooded internally though only if rescue is close at hand. Present TEMPSC are warmed internally, only by the heat of the engine which would probably not be running at all times while awaiting rescue. Accordingly it is possible that the air temperature inside the TEMPSC could be low enough to cause freezing and non-freezing injuries and hypothermia in survivors within four days, if they were not protected with thermal clothing. This will be even more likely if the craft is partially flooded.

TEMPSC are generally equipped with high pressure air bottles, ventilation facilities, a route for exhaust gases from the engine, spark arrestors, and sea spray nozzles which can cover the upperworks with a film of water to protect those inside from fire. They are not normally equipped with drugs for sea sickness or loss of body fluids even though these conditions can seriously affect survival. The operation of a TEMPSC requires some navigational competence as the craft must be steered clear of the parent unit on a predetermined course. This skill is only achieved as a result of instruction and practice.

Communications during abandonment, survival, and rescue are currently provided by hand held VHF radios with duplicate sets available as back up. These secondary sets should provide back up to fitted VHF radios installed in the craft as the primary communication device. Normal TEMPSC location equipment includes a radar reflector, a distress beacon, and flashing lifebuoy light, but does not include highly reflective material, a radar transponder, or an audible signal generator. Current crafts are not fitted with a self-deploying tow-line, nor are there any other aids to transfer the survivors from the TEMPSC to rescue vessels, and stretcher cases can only be transferred in very favourable conditions. The technology is available to overcome most of these deficiencies through the supply of suitable drugs, additional radios, satellite linked emergency beacons, and appropriate towing arrangements. Suitably equipped TEMPSC of current design could therefore be expected to protect survivors in an acceptable manner if they are launched successfully.

Submerged launch systems which are still in the conceptual stage are designed to release the escape craft from below the surface of the water to avoid the problems presented by entry from above. Despite the advantages of these systems, they also introduce new hazards. Lists of 40 degrees or more could involve several design problems associated with release of the craft. The system would also have to be adaptable to a variety of water depths since drafts of offshore units vary by as much as 15 metres. Transferring people from a normal dry atmosphere to the pressurized underwater atmosphere involves complications which are similar to those which affect diving operations, particularly in deeper water. Another problem faced by designers of this system is the response time. In semisubmersibles the escape craft would probably be mounted in the pontoons. Access to these areas is only available through the columns down vertical ladders and it would take considerable time for the users to get from their normal positions in the unit to the abandonment position.

■ *INFLATABLE SURVIVAL CRAFT* Inflatable crafts are generally considered a secondary (or if helicopters are available, a tertiary) means of abandonment for MODUs and supply vessels, but a primary escape means for helicopters. They vary in size from single-person craft to those designed to accommodate up to 25 people and should be able, in extreme circumstances, to carry twice that number. Modern designs are self-inflating and contain integrated canopies.

Standard life rafts are designed to be entered from the water, and therefore do not provide a means of abandoning a unit. Inflation of life rafts in very low temperatures introduces problems, capsize during inflation is a constant threat and rafts tend to drift downwind very quickly once inflated. Life rafts must be visible to survivors in the water which would be difficult in dense fog. Considerable physical exertion is required to board them from the water. Davit-launched rafts are strengthened and equipped with built-in slings which enable them to be lifted from a central point at the top of the canopy. These rafts can be boarded before they are lowered into the sea, but because of their lighter weight they experience an even greater risk of impacting with or drifting under the parent structure than do davit-launched TEMPSC.

Survival problems on board a life raft are more severe than those encounted in a TEMPSC. In air temperatures below 0°C it is unlikely that survivors without protective thermal clothing would be able to retain a core temperature above 35°C in a life raft for more than a few hours. If ventilation flaps were kept closed to preserve warmth, the level of CO_2 could build up to dangerous proportions. Conditions in life rafts are also very conducive to sea sickness; drugs to combat this condition are not always included in inventories. Communication equipment is generally limited to simple battery-powered VHF radios and although life rafts normally contain flares, they are not equipped with audible signal devices, radio beacons, or radar transponders. Transfer from life rafts to rescue vessels relies upon the means provided by the latter such as personnel strops and winches and is very much affected by environmental conditions. Despite these limitations life rafts provide valuable back-up systems and many of the shortcomings cited could be overcome by using existing equipment and technology.

■ *INDIVIDUAL ABANDONMENT* Individual abandonment is currently a last resort and is likely to remain so unless revolutionary advances are made in individual systems. Available survival suits with life jackets, if properly worn, can provide protection against hypothermia in all eastern Canadian waters for four hours but the survivors may drown during this time as a result of spray and waves breaking over their faces. Individual survivors are vulnerable to irrespirable gases, sea sickness, burns, and loss of body fluid. Current means of communication, location, and transfer of survivors to safety are also inadequate, and many suits on the market seriously hamper the wearer's manoeuvrability and manual dexterity. Unless the parent unit sinks or lists far enough for one part of the deck to be at sea level, individual survivors must reach the sea by relying on such aids as ropes, rungs, or chutes, all of which present considerable hazards in bad weather.

Survival suits vary significantly in terms of lifesaving capability and although extensive testing has been done on various makes of suits to determine their ability to keep a person's core temperature at survival level and to keep them afloat, these tests do not give an accurate picture of how long a person would survive in cold water while being battered by wind and waves. In general, waterproof insulated suits are most successful in maintaining core temperatures; wet suits and dry suits without insulation are not as good. A rapid decrease in core temperature occurs when water enters a "dry" suit. Some survival suits having high integral buoyancy, particularly as a result of entrapped air, present difficulties to people attempting to escape from a partly flooded helicopter cabin since they can't force themselves down in the water to pass through a submerged hatch. Other survival suits permit wearers to lie face down in the water. Survival suits and life jackets are available today which do not suffer from either of these limitations, although improvements are still desirable.

No currently available survival suit properly protects the wearer from inhaling spray or water in rough sea conditions. A prototype which may overcome this limitation is modelled after the submarine escape suits in current use with the British Royal Navy. This version is fitted with a plastic shield which totally covers the wearer's face, and has breathing holes at the top of the hood. There are also very few, if any, existing versions which incorporate adequate communication and location devices, and provide means to ensure that survivors are retained close to one another.

Helicopter suits need to be worn throughout flight, to be non-buoyant until the survivor is clear of the machine, and to be robust enough to be used several times a day. These suits will not provide as much protection from hypothermia and drowning as regular survival suits designed for use on MODUs and supply ships and which are only worn during abandonment of the unit. Survival suits for use on supply vessels should be worn not only during abandonment but also when danger threatens or when the wearer is working on the deck during bad weather. Currently available suits do not adequately fulfill this dual function.

It is important to continue to develop survival suits which provide good protection to wearers in very cold air and water, not only for individual abandonment but also to assist in survival for long periods in TEMPSC and inflatable life rafts. Secondary suits should also be developed for storage at convenient points on the rig for personnel who do not have time to don primary suits. Since individual abandonment is very much a last resort, improvements to these suits could be of use but are not considered as important as developments in dry transfer systems.

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RESCUE

RESCUE

SEARCH AND RESCUE OPERATIONS

An Assessment of Search and Rescue for East Coast Offshore Exploration Drilling Operations
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Personnel who work offshore may have to be evacuated or rescued from mobile offshore drilling units (MODUs), supply vessels, and helicopters. A MODU evacuation can either be planned or may be initiated with limited or no warning. In each case 50 to 100 persons would have to be removed from the MODU. In a planned evacuation, a 12- to 18-hour time frame would be available for evacuation via helicopters or transfer to a supply vessel. In a limited warning evacuation, a period of one to two hours should be available for evacuation by lifeboat or life raft. Persons ending up in the water should be wearing abandonment suits, and rescue must take place within less than six hours if they are to survive. The rescue of persons from life rafts and lifeboats could, however, be safely delayed until conditions improve. In an immediate evacuation, a large number of persons could end up in the water, and some of these could be without abandonment suits. Persons in the water who are not wearing abandonment suits must be rescued within 15 to 30 minutes. As with a limited warning evacuation, the rescue of persons who managed to escape in life rafts and lifeboats could safely be delayed until conditions have improved.

The evacuation or rescue of persons from a supply vessel normally involves from 12 to 16 persons. The majority of these will most likely be in lifeboats or life rafts although it is possible that some could be in the water. Persons in the water should be wearing abandonment suits. Again, the rescue of persons from life rafts or lifeboats could safely be delayed until conditions improve.

The rescue of persons from a downed helicopter is judged to be the most difficult in terms of rescue response time. Up to 20 persons may have to be rescued and although some may, at the time of rescue, be in a life raft, all survivors will have been immersed in the water. There is also a possibility that all survivors will be in the water, but all should be wearing helicopter immersion suits. During the winter months survivors must be rescued within one hour to ensure a reasonable chance of survival, and it would seem reasonable that helicopter immersion suits providing three to four hours of protection from hypothermia should be made available.

■ *CANADIAN GOVERNMENT SAR* Canada's national Search and Rescue (SAR) system encompasses several government departments, but principally the Department of National Defence, which operates all primary SAR aircraft, and the Department of Transport, Canadian Coast Guard (CCG), which operates all primary SAR vessels. Other departments provide secondary SAR resources and have departmental SAR objectives which, although developed by an interdepartmental working group, have not all received approval from their respective ministers. The SAR system is organized into four Search and Rescue Regions, each of which contains a Rescue Co-ordination Centre (RCC): Victoria, British Columbia; Edmonton, Alberta; Trenton, Ontario; and Halifax, Nova Scotia.

Canada's responsibilities for search and rescue are determined partly by international agreements and partly by cabinet direction. The stated objective of the national SAR program is:

> to prevent the loss of life and injury through search and rescue alerting, responding and aiding activities which use public and private resources; including where possible and directly related thereto, reasonable efforts to minimize damage to or loss of property, and by ensuring appropriate priority to aviation and marine safety measures focussed on owners and operators most commonly involved in SAR incidents.

This objective should be further developed, not only to define the areas of responsibility, but also to indicate where lifesaving is possible and where SAR activities will be limited to coordination. These responsibilities should not include the provision of salvage services. There should also be criteria against which the effectiveness of the system can be measured. On an international basis, the areas for which the national SAR system is responsible are stated to be:

> for air search and rescue . . . as provided under International Civil Aviation Organization (ICAO) agreements . . . and for marine search and rescue as provided for under International Maritime Organization (IMO) agreements, and in Canadian waters of the Great Lakes and the St. Lawrence system.

Within these areas of responsibility, the SAR system is concerned primarily with resolving distress incidents which involve civilian vessels or aircraft, but it will also assist local authorities in the resolution of humanitarian (medical evacuations) and civilian (missing person searches, small craft in inland waters) incidents when requested.

The national SAR program is administered by a lead minister for search and rescue (currently the Minister of the Department of National Defence [DND]) who is supported by the Interdepartmental Committee on Search and Rescue (ICSAR). ICSAR is comprised of representatives of the various departments concerned with the SAR program, and is led by a chairman who is currently from DND. ICSAR is designed to provide a focus so that departments involved in SAR operations can consolidate their planning, and although it is felt that this management structure should be maintained, the ICSAR Secretariat itself should be strengthened. The appointment of DND personnel to the position of chairman represents a potential conflict of interest when seeking funding for improvements to the SAR system. A similar conflict exists in the appointment of the Minister of either National Defence or Transport as lead minister for SAR. Consequently, the Chairman of ICSAR should not be appointed from a SAR line department, and neither the Minister of DND nor the Minister of Transport should be appointed the lead minister for SAR.

Each of the four Search and Rescue Regions has an overall commander (appointed by DND) who assisted by staff officers, maintains a liaison with the Regional Directors of the Coast Guard and is responsible for operating the region's Rescue Co-ordination Centre (RCC).

Funding for the national SAR program is provided entirely by the federal government. Requests for funds required to operate and maintain existing levels of SAR service, including the replacement of existing resources, are presented separately to Treasury Board for approval by each participating department as part of its overall budget. ICSAR has no input into the formulation of these requests. This does not appear to be compatible with the existing management structure and it would seem more appropriate that the line departments submit the SAR portion of their budgets to ICSAR for presentation to Treasury Board as a single SAR budget. On the other hand, requests for funds for the improvement of the SAR system, such as for the purchase of new resources, are prepared by each line department and submitted to ICSAR where they are consolidated and submitted to the Foreign and Defence Policy Committee under the Defence Envelope. So that such funding requests as part of the Defence Envelope are not overwhelmed by defence-related items, funding requests for improvements to the SAR system should be presented to the Foreign and Defence Policy Committee as a separate SAR envelope. This action was recommended in the *Report on an Evaluation of Search and Rescue* in 1982 – the "Cross Report".

■ *EQUIPMENT AND PROCEDURES* The SAR system under the Department of National Defence has a total of nine primary aircraft stationed in the Halifax Search and Rescue Region: three Buffalo fixed-wing aircraft; three SARCUP helicopters (a recently upgraded version of the Boeing Vertol CH113/CH113A Labrador/Voyageur) stationed at Summerside, Prince Edward Island; and three SARCUP helicopters at Gander, Newfoundland. In addition, RCC Halifax has available a number of CP140 Aurora fixed-wing aircraft at Greenwood, Nova Scotia, and a number of CH124 Sea King helicopters at Shearwater, Nova Scotia, which are designated as secondary SAR resources.

The SARCUP helicopter is a twin-turbine, tandem-rotor helicopter with a normal speed of 115 knots and a radius of action, for planning purposes, of 225 nautical miles. It carries a full array of communications and navigation equipment and is fitted with a hoist. It does not, however, have auto-hover capability, which is scheduled to be installed within three to four years.

The CH124 Sea King helicopter, with a range of 170 nautical miles, carries much of the same equipment as the SARCUP helicopter. It is also fitted with auto-hover capability, making it better equipped to handle the rescue function.

Primary SAR aircraft, the SARCUP helicopters, and Buffalo fixed-wing aircraft, are on 30-minute standby during working hours (8 hours a day, 5 days a week) and a 2-hour standby at all other times. To increase the potential for rescuing persons from the water, the non-working hours standby posture for the SARCUP helicopters in Gander and Summerside should be reduced to one hour. An analysis of the time required for SARCUP helicopters to reach various locations on the Scotian Shelf and the Grand Banks indicates that they can reach the Hibernia area and most locations along the Scotian Shelf within 2 to 3 hours flying time. Locations on the southern Scotian Shelf and on the Grand Banks east and south of Hibernia may take as long as 4 hours flying time to reach. These travel times are in addition to the 30 minute and 2-hour standby times, and are inadequate to assist in the rescue of persons involved in a helicopter ditching. The analysis also indicates that the southern and northeastern Grand Banks are beyond the range of these helicopters.

There are four techniques currently being used by the SAR system to rescue or assist persons in distress: dropping a survival kit, landing a helicopter on the water or on a deck, hoisting using a net, and hoisting using a rescue technician (SARTECH). Survival kits usually consist of two inflatable life rafts joined by a line and can be dropped from helicopters or fixed-wing aircraft. This equipment, while potentially useful, only brings the survivors into a less hostile environment while awaiting rescue and requires that they be capable of helping themselves. Landing a helicopter on a deck or in the water is the quickest and most effective means of rescuing large numbers of survivors. This technique is severely limited, however, by the degree of list and motion of the deck or, in the case of an amphibious landing, by sea state. Hoisting by net is rarely utilized by SAR personnel because the net has only a two-man capacity and is, therefore, ineffective for recovering more than two survivors. Use of the net is also restricted to those survivors capable of climbing into the net as it can only be entered from one point. Hoisting using a SARTECH makes the rescue of an incapacitated person possible even under adverse conditions since the SARTECH descends the hoist line to assist the survivor.

The Canadian Coast Guard (CCG), as a part of the national SAR program, operates a number of small rescue boats which are based at various locations along the coasts of Canada and which are used for rescues close to shore. A number of large ocean-going Coast Guard vessels, four of which patrol the East Coast, are also assigned to search and rescue duties. Of these four vessels, one is scheduled to be replaced by a vessel currently under construction. Two of the four vessels (the *Grenfell* and the *Jackman*) are former offshore supply vessels, one (the new vessel) is a supply vessel hull and the remaining one (the *Alert*) was designed and built for search and rescue duties. All four vessels have twin screws and a bow thruster; the new vessel will be equipped with joystick control while the remaining three have full bridge control of propulsion machinery. The vessels are equipped with firefighting equipment, portable pumps, first aid equipment, diving equipment, line throwing apparatus, scramble nets, and life rafts.

The *Jackman* and the *Grenfell* are equipped with crane-launched rigid rescue boats and inflatable boats, while the new vessel will have a davit launched rigid inflatable fast rescue craft (FRC). The *Alert* is equipped with two inflatable rescue boats, but will not be equipped with an FRC until its 1985-86 refit. All four vessels have facilities for helicopter winching and the *Alert* has a helipad. The *Grenfell* is equipped with a rescue basket while the other three vessels are not. The presence of bulwarks in the rescue zones of all four vessels makes it difficult for survivors to climb on board during a rescue directly from the water.

■ *POTENTIAL SAR CLIENTS* The potential users of the SAR system are the passengers and crew of aircraft and marine vessels which operate within the defined SAR areas of responsibility. This report [*see page 141*] is primarily concerned with marine related incidents, including those incidents involving the ditching of a helicopter serving the offshore industry. The potential marine client population can be defined as all those who earn their living on the sea or who use the water for recreation.

From a national viewpoint, pleasure craft constitute the single largest potential client group, particularly in the Victoria and Trenton regions where they exceed the number of licences issued to small fishing vessels. Fishermen do represent the second largest potential client group nationally and the largest in the Halifax region. Commercial vessels represent a relatively small potential client group and offshore drilling units, even smaller.

SAR statistics kept by Canada are categorized into four types of distress incidents: air, marine, humanitarian, and civil assistance. The analysis of historical data on SAR incidents in Canada revealed that the majority (74 percent) which occurred between 1975 and 1983 were categorized as marine[1] rather than air incidents[2]. Pleasure craft and fishing vessels were involved in the majority of these, with pleasure craft representing the largest number of incidents in the Victoria and Trenton regions, and fishing vessels representing the largest number in the Halifax region. Only five percent of the national marine distress incidents during this time period involved commercial vessels, with offshore drilling accounting for only a fraction of this percentage.

[1]Marine incidents are defined as those incidents where the original vehicle of transport was a surface or subsurface marine vehicle, including air cushioned vehicles when operating over water.
[2]Air incidents are defined as those incidents where the original vehicle of transport was an airborne vehicle regardless of whether the vehicle came to rest on land or on water.

■ *SAR RESOURCE DEPLOYMENT* The SAR system currently operates 42 vessels and 24 aircraft as dedicated, primary SAR resources. These resources are deployed as follows to the four Search and Rescue Regions:

	Aircraft		Vessels	
	Helicopters	Fixed Wing	Over 20 m	Under 20 m
Halifax	6	3	4	11
Trenton	3	1	6	6
Edmonton	0	4	–	–
Victoria	4	3	5	10

It should be noted that while Trenton lists only one fixed-wing Buffalo aircraft, it actually has several, but designates only one aircraft at a time as the SAR aircraft. A similar situation exists in Edmonton.

The deployment of SAR resources, nationally, is dominated by the following factors:

- Their proximity to previously-recorded SAR distress incidents is a major consideration in the planning of resource deployment.
- The potential user population is not a major factor in the national planning of SAR resource deployment because of the uncertainty in verifying numbers of people on board prior to an incident. On a regional basis, however, population shifts are more easily identified and, therefore, are taken into account in SAR resource planning.
- Weather and operating limits are prime considerations in the siting of SAR aircraft to ensure a high percentage of response.
- The availability of a support infrastructure for the resources and the personnel operating them is a major factor in resource deployment.
- The presence of alternate sources of SAR support is important in the planning of marine resources. For example, the presence of groups such as the Canadian Marine Rescue Auxiliary has reduced the need for SAR vessels in certain areas.

An analysis of these factors reveals that the deployment of primary air resources in the Halifax region represents a level of service which is at least equal to that provided in the Trenton region and exceeds that provided in the Victoria region. A further analysis of SAR air resources within the Halifax region reveals that the current deployment of resources (three helicopters and three fixed-wing aircraft at Summerside, Prince Edward Island and three helicopters at Gander, Newfoundland) represents the optimum locations for these resources to provide coverage for the majority of marine distress incidents. These locations do not, however, optimize the provision of service to the offshore oil industry. Relocating resources to accommodate this particular need would result, in the case of helicopters, in a downgrading of service provided to locations now covered. Therefore, the present level of SAR air resources deployed in the Halifax region should be maintained. To provide adequate SAR service to the oil industry, a dedicated standby helicopter (on 30-minute standby when helicopters are flying) is necessary for St. John's year-round, Sable Island during the winter months, and Labrador during the summer months. Because this need is peculiar to the oil industry, these air resources should be obtained from outside the government SAR system.

■ *TRAINING OF SAR PERSONNEL* In addition to their basic training, pilots of helicopters used for search and rescue must undergo a 35-day specialist course. The pilot then becomes productive as a SAR pilot and enters a phase of upgrading to

Aircraft Commander, a process which can take from one to three years. All pilots subsequently undergo continual training and regular proficiency checks are required.

Search and Rescue Technicians (SARTECHs) are selected from other Armed Forces trades and two are assigned to each aircraft. Applicants for SARTECH training attend a 35-day preselection course on survival and diving, followed by a 120-day SARTECH course which trains candidates in survival techniques, medical treatment of survivors, mountain climbing, water techniques, parachuting, and helicopter hoisting. Upon completion of training, the graduate works with a senior SARTECH for 21 months before being declared operational for both fixed-wing aircraft and helicopters. As with helicopter pilots, SARTECHs are subject to continual training with monthly requirements and proficiency checks.

Personnel on board the large Canadian Coast Guard SAR ships in the Halifax region are trained in accordance with requirements in the *Canada Shipping Act*, and the officers and some of the crew have taken the Marine Emergency Duties course (MED II) which includes some limited training in search and rescue. It is evident that MED II training, as well as basic first aid training, and training in rescue techniques used in the United Kingdom and Norway should be required of all crew members of the primary SAR vessels. Drills and shipboard exercises are conducted according to CCG standing orders and instructions. There appears to be no specific training for any of these crews in the operation of fast rescue craft, and it is imperative that CCG develop and provide such training for the appropriate number of crew members on each primary SAR vessel. Most masters and mates of these vessels have also taken the National Marine SAR course at the Transport Canada Training Institution. Indications are that CCG should, in consultation with industry, initiate the development of an appropriate course in rescue techniques.

Marine controllers in the Rescue Co-ordination Centres are Canadian Coast Guard personnel, and a CCG Watchkeeping Mate Certificate of Competency is required for this position. To qualify for this certificate, individuals must have completed MED II and have at least two years sea service although there is no assurance that they have experience with SAR equipment. Consequently, it would seem advisable to require marine controllers to have a higher standard than a Watchkeeping Mate Certificate of Competency. Air controllers in RCCs are Department of National Defence personnel who are recruited from the air crews of SAR squadrons, and who will, therefore, be pilots or navigators with experience in search and rescue operations. Since it is highly desirable to have competent personnel with experience in search and rescue operations, this practice of air controller recruitment should continue. Both air and marine controllers are sent to the National SAR course at the Transport Canada Training Institution to undergo on-the-job training before being considered fully qualified.

■ *GOVERNMENT SAR – NORTH SEA* The potential client population in the production fields in all sectors totals approximately 40,000. The maximum distance between an oil field and a designated airfield on shore is approximately 120 nautical miles, but there are numerous alternative airfields available in the countries surrounding the North Sea: Norway, Denmark, West Germany, the Netherlands, and the United Kingdom. In addition, commercial vessel and fishery patrol traffic makes SAR assistance more readily available at the site of a North Sea emergency than in the North Atlantic.

Search and rescue services in the United Kingdom are provided by Her Majesty's Coastguard, the Royal National Lifeboat Institute (RNLI) and the Armed Forces (Royal Air Force and Royal Navy). Although each agency operates independently, HM Coastguard, through an organization of six Rescue Co-ordination Centres, and volunteer watchkeeping stations, coordinates civil maritime SAR response. The Ministry of Defence, through two Maritime Headquarters/Rescue

Co-ordination Centres, coordinates Armed Forces and civil air SAR response. RNLI is a voluntary organization with 133 offshore lifeboat stations and 67 inshore lifeboat stations. The RAF provides one Nimrod long-range patrol aircraft on standby (with a second available if required), and a number of Wessex and Sea King helicopters equipped with hoists and SARTECHs. HM Coastguard provides only one air resource for SAR duties: an S-61 helicopter under contract. The total United Kingdom search and rescue services provide no additional or special equipment for response to oil industry incidents, since companies are required to provide their own rescue facilities.

Norwegian SAR services are the cooperative effort of several government agencies, volunteer organizations, and private companies, all under the coordination of the Police Force through two Rescue Co-ordination Centres, 54 Rescue Sub-centres, and 16 Air Rescue Sub-centres. The Royal Ministry of Justice and Police provides 10 Westland Sea King helicopters equipped with hoists and SARTECHs. These helicopters are manned, operated, and maintained by the Royal Norwegian Air Force. The Norwegian Society for Sea Rescue operates 29 ocean-going lifesaving vessels and eight smaller inshore vessels, all fully outfitted with rescue equipment. As in the United Kingdom, no special SAR equipment or facilities are provided for the oil industry who are deemed to be responsible for their own search and rescue needs.

■ *CANADIAN OIL INDUSTRY SAR* Oil and gas exploration off the East Coast of Canada takes place primarily on the Grand Banks and Scotian Shelf where driling takes place year round, and off the Labrador Coast and Davis Strait where drilling takes place during the summer months.

While the offshore oil industry recognizes that it has a responsibility to provide a degree of self-help in an emergency, the government SAR system is regarded as the major resource. Nevertheless, the responsibilities for responses to distress incidents involving MODUs, supply vessels, and helicopters must be clarified and agreed to by both government and industry. The industry provides an initial marine SAR response through standby vessels which are assigned to all rigs. The industry is, however, reluctant to provide helicopter rescue services with a capability fully equivalent to that provided by government SAR. The regulatory agencies require the industry, at least in Newfoundland, to provide a helicopter dedicated to search and rescue. They also require that this helicopter be equipped with a hoist and that its crew be trained in passive rescue techniques.

All operators on the Grand Banks and Scotian Shelf are required to develop joint Alert Plans which coordinate their emergency responses in the area. An alert is declared by authorized personnel when certain specified environmental conditions exist which could result in an emergency. When a Multi-Operator Alert is declared, all operators in the area are required to provide available resources according to procedures outlined in the Operators' Emergency Resources Sharing Plan. Responses to Multi-Operator Alerts are coordinated through an Operators' Management Committee consisting of one representative from each operator, with each representative relating the Committee's decisions to his respective company. This system appears to be an effective approach towards providing mutual assistance during emergencies, although the SAR system should be represented on the Operators' Management Committee when SAR resources are utilized.

The procedures taken following the declaration of an alert are outlined in each company's Alert Response Plan. Although the plans differ slightly, they include the formation of an Alert Organization and outline the responsibilities of management to bring the company to an advanced state of readiness. The Alert Organization will notify the national SAR system (an early alerting is considered vital to receiving successful SAR assistance) and the appropriate regulatory agencies that an alert has been declared. These agencies will remain on continuous standby until the alert is terminated. Should the alert situation become more serious and develop into an emergency situation, the affected operator's Contingency Plan, required of all operators by regulation, is put into effect. Contingency Plans are intended to assist in dealing with specifically-identified emergencies by defining the responsibilities of key personnel and by outlining basic procedures to be followed. Additional procedures and manuals such as lifeboat boarding and launching procedures and well-control manuals provide more detail on certain aspects of emergencies. It appears that these Contingency Plans and their supplementary material are adequate in scope and detail. The operators on the Grand Banks and Scotian Shelf have also developed joint plans for ice management and for monitoring vessel and aircraft movements.

Standby and supply vessels report to the appropriate oil company when they arrive at or depart from a location (either offshore or on shore) and at four-hour intervals. If a vessel fails to report within 15 minutes of its scheduled time, attempts are made to contact it. When these attempts are unsuccessful, the Contingency Plan of the affected company is put into effect. These measures appear adequate for achieving a safe vessel watch, given the current level of activity.

Twice each day, supply vessel positions for each company are forwarded to Central Flight Following, a common flight watch service which has been established in St. John's and Halifax which provides a radio watch at all times when industry aircraft are flying. Aircraft report their positions along their flight paths at 15-minute intervals, and if one fails to report in within 3 minutes of the designated check-in time, attempts are made to contact it. If the aircraft is overdue by 10 minutes or if the pilots declare an emergency, Central Flight Following alerts SAR, the helicopter operator, the oil company, and the supply vessels in the area. If the aircraft is 30 minutes overdue, the emergency is confirmed with SAR and supply vessels and any available hoist-equipped industry helicopters are dispatched to the scene. Because of the transit time involved, it seems sensible that Central Flight Following dispatch supply vessels nearest the emergency at the 10-minute-overdue alert. The facilities, equipment, and procedures at Central Flight Following are, with minor exceptions, adequate to meet current needs.

■ *EQUIPMENT AND PROCEDURES* The helicopters most commonly used by the oil industry on the East Coast are the Sikorsky S-61 and the Aerospatiale Super Puma AS 332 C/L. Both helicopters are twin-turbine, single-rotor aircraft. The S-61 has a cruising speed of 115 knots and a normal Instrument Flight Rules (IFR) radius of action of about 215 nautical miles. The Super Puma has a cruising speed of 135 knots and a normal IFR radius of action of about 285 nautical miles, making it the superior helicopter among those used by government and industry SAR operations, from a logistical point of view. Communications, navigation, and other flight equipment is similar for each type of helicopter and both the S-61 and the Super Puma are equipped with an automatic flight control system. Their rescue capability, however, could be improved through the addition of an auto-hover system, direction-finding and homing equipment, and a continuous duty hoist.

The oil industry in St. John's is required to provide, on standby for rescue purposes, a helicopter equipped with a hoist. This helicopter is provided by operators on a rotational basis and can, therefore, be either a Super Puma or an S-61. This appears to be an inadequate arrangement and therefore, in each area a single helicopter should be contracted for and dedicated to this task with funding coming from the industry. The Government of Canada, however, should have the responsibility for contracting each helicopter and administering its service. This would ensure a level of training consistent with that already provided to government SAR personnel and a consistent policy on rescue techniques. In addition, industry concerns over liability and personal risk would be eliminated, and the resources could be deployed to react to changing patterns of activity. For example, the helicopter contracted to provide services for the Sable Island area in winter could move to the Labrador Coast area in summer. This rescue helicopter may not be used for crew transport and should have permanently assigned crews of at least four persons (pilot, co-pilot, hoist operator, rescue technician). When the helicopter is on standby at the shore base in St. John's, it can be airborne in 30 minutes during daylight hours and in 1 hour during non-working hours. While this arrangement indicates a certain level of air response by industry resources, the industry must come to a consensus as to the level of responsibility it will accept for the provision of this response.

An examination of the capabilities of these helicopters reveals that Super Pumas can reach all points along the Scotian Shelf, except the southern tip, in less than two hours flying time, whereas the extreme southern tip of the Scotian Shelf is beyond the range of S-61s. Neither S-61s nor Super Pumas, as they are currently equipped, can conduct rescue missions in the extreme eastern and southern portions of the Grand Banks. Although flying times to the Hibernia area are approximately one and one-half hours, points east of Hibernia are as high as three hours flying time, a range beyond even the Super Puma. These response times are adequate for most marine incidents; however, they are inadequate for the rescue of persons following a helicopter ditching.

Industry helicopters use four techniques to rescue or assist persons in distress: dropping a survival kit; landing on the water or a deck; using an EMPRA basket hung from the cargo hook; and hoisting using a net or basket. The survival kit used in industry helicopters is similar to that used by the SAR helicopter and is subject to the same limitations, as are the deck and on-water landings by industry helicopters. The Emergency Multiple Person Rescue Apparatus (EMPRA) basket used by the industry helicopters is suspended from an external hook and is large enough to accommodate 15 to 20 persons. The EMPRA basket can be used to rescue persons from a vessel or MODU deck by simply lowering it and allowing the survivors to enter it. To rescue persons from the water, it may be trawled at the surface in an attempt to scoop up survivors. Because the EMPRA basket is suspended externally, the aircraft's speed is restricted to about 90 knots when empty and to about 50 knots when carrying survivors. These helicopters are also capable of hoisting survivors using a small, one- or two-man basket. The basket can be stored inside the helicopter while in transit and survivors can be transferred from it to the interior of the helicopter. The duty cycle of the hoist used on the S-61 is very limited, while the hoist on the Super Puma is essentially capable of continuous duty.

Government regulations require that each drilling unit must have a standby vessel in close attendance to:

- Assist in the rescue of personnel from the MODU;
- Accommodate all evacuated personnel who may be endangered due to operations on or in the immediate vicinity of the MODU;
- Assist the MODU in avoiding collisions with other vessels;
- Act as a reserve communications centre in times of emergency;
- Act as a command centre in times of emergency.

One of the prime functions of a standby vessel is to provide a site to which personnel from a MODU can be evacuated by either crane or helicopter transfer. Both methods require that the standby vessel have an open dry area, free from obstructions, where the crane or helicopter basket can be landed. The standby vessel must have the ability to maintain position while the basket is being landed, particularly in the case of a crane transfer where a position very near the rig must be maintained for a considerable period of time. Both of these techniques are limited by wind conditions which may make it difficult to land the baskets on the vessel deck.

The recovery of survivors from a lifeboat or life raft to a standby vessel is difficult and under many conditions it may be advisable not to attempt to rescue persons if there is no immediate danger to the survival craft or its occupants. There are, however, a number of avenues of assistance which the standby vessel could provide if necessary. For example, the standby vessel can assist by towing or providing a lee for the lifeboat or life raft. Survivors can be rescued using the standby vessel's crane to pick up survivors individually or in groups using a basket. Direct transfer of survivors from the craft to the standby vessel may be possible. The recovery of survivors from the water directly to the standby vessel is sometimes possible using several methods but is always very difficult as the survivor will likely be suffering from the effects of cold. A fast rescue craft (FRC) can be launched from the standby vessel to provide rapid assistance to persons in the water with greater precision and control than is possible by the standby vessel itself. Regardless of the rescue methods used, the question of survivor accommodations, medical facilities, and survivor reception areas on standby vessels should be examined and standards developed.

It is general practice in eastern Canada to use supply vessels as standby vessels. Those vessels currently in use as standby vessels should be inspected to ensure that cargo rails do not restrict access to the rescue zone and that bulwarks in the rescue zone do not result in survivors having to climb a height in excess of 2.5 metres. Where the bulwarks do create a problem, either bulwark openings or removable cargo rail sections should be installed. When these vessel characteristics and rescue equipment requirements are met, the use of supply vessels as standby vessels should be allowed to continue, even if purpose-built, dedicated rescue vessels become the norm in eastern Canada.

There are, however, some supply vessels which are inappropriate to fulfill a rescue role. Those which do not possess adequate physical characteristics to maintain proper standby position are not employed as standby vessels. When a standby vessel is used for other duties while on standby, its rescue capability is seriously compromised. Canadian regulations do not specify appropriate physical characteristics for standby vessels, the equipment they should carry, or how it should be used. It is evident that regulations or guidelines should be developed which outline the characteristics necessary for standby vessels. These requirements should include the need for rescue equipment such as a rescue basket, line throwing apparatus, safety harnesses for the crew members, and fast rescue craft with engines which can be run and warmed up while out of the water and which have launching systems capable of use in most conditions.

■ *TRAINING FOR INDUSTRY PERSONNEL* Rescue training for industry helicopter crews has been conducted by the helicopter companies in-house. Training in the use of hoists was developed after consultation with national SAR personnel, while training in the use of the EMPRA basket was developed by the companies. Training is conducted mainly in flight and includes practice of hoisting persons from the water using a one- or two-man net and using an EMPRA basket. This training is generally carried out in calm water conditions. While these helicopters and crews are primarily involved in personnel transportation, the training they receive in the use of the EMPRA baskets is useful and should be continued.

Although the original government requirement to have industry provide a standby helicopter indicated that the companies' SAR programs would be regularly reviewed and that SAR training would be provided by the Department of National Defence (DND), neither of these has occurred even though there have been several meetings on search and rescue between industry and DND. There are indications that training of crews on the dedicated standby/rescue helicopters should be provided by SAR personnel.

Standby vessels usually have an 11- or 12-man crew of which about 50 percent will have completed the MED II course as part of the training for their marine certification. The majority of the uncertificated personnel on standby vessels have also taken MED II or a similar survival course and will, therefore, have had instruction in basic first aid. The government should, nevertheless, require all standby vessel crew members to have completed MED II training, as well as some additional formal training in the rescue techniques in use in the United Kingdom and Norway. Three members of each standby vessel crew are designated to man the fast rescue craft and they attend a course which provides adequate instruction on handling, launching, and recovery of these craft, as well as survivor recovery and care. Senior officers of supply and standby vessels also attend a two-day course called the Senior Officer-Emergency Management Forum. This course, recently introduced by the Petroleum Industry Training Service, is designed to ensure that senior vessel officers are trained to respond to emergency situations and to familiarize them with the resources available. Not all vessel officers have yet attended this course.

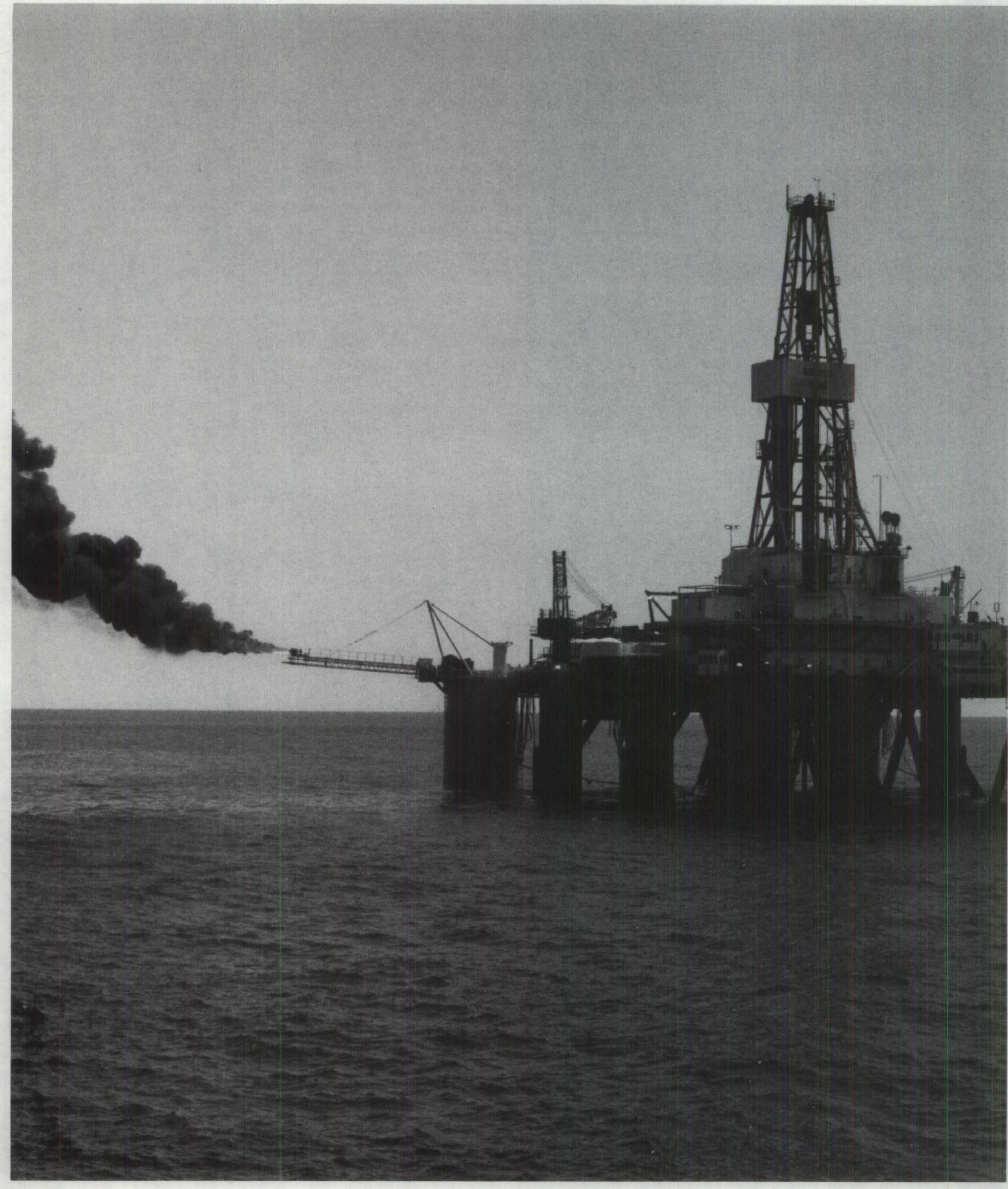
■ *OIL INDUSTRY SAR – NORTH SEA* The oil industry in the North Sea has developed six Sector Clubs which ignore national boundaries and which supply mutual SAR resources and aid to all operators within their sector. Helicopters are considered the primary means of evacuation, and a large number are available to assist in a SAR incident even though not all have full SAR capabilities. Standby vessels also perform SAR duties, although because of limited station-keeping and manoeuvring abilities, these vessels are primarily used to rescue persons either from a lifeboat or from the water rather than from a platform. Standby vessel crews are partly, if not all, trained in first aid and use of the FRC.

■ *GENERAL CONSIDERATIONS* A number of issues related to equipment and techniques affecting both air and marine operations require detailed examination:

- Because good visual contact by day or night is crucial to a successful rescue, consideration should be given to incorporating strobe lights on survival suits and life jackets.
- Where visual contact is inadequate or not possible, the use of an emergency position indicating radio beacon (EPIRB) would provide electronic means of locating the object of a SAR operation.
- The use of passive infra-red detection is another means of location. Forward-Looking Infra-Red (FLIR) is currently in use on some SAR helicopters in the North Sea and has been found to be very effective. This North Sea experience should be examined for possible application in Canada.
- All motorized craft, including lifeboats and life rafts should be required to have ELTs or EPIRBs, since rescue often involves survival craft in addition to individual survivors.
- Survival suits and life jackets should incorporate hand holds for rescuers.
- The recommendations made by official enquiries into search and rescue should be monitored in accordance with a formal system to ensure that appropriate actions or responses are made.

9

REGULATIONS



REGULATIONS

OFFSHORE REGULATORY SYSTEMS

Safety in the Design, Construction, and Operation of Offshore Oil and Gas Installations: A Comparative Analysis of the Regulatory Structures of Norway, Canada, United States and the United Kingdom
Dalhousie Ocean Studies Programme
Halifax, Nova Scotia
September 1984

An analysis of four different regulatory regimes which govern the design, construction, and operation of offshore installations reveals a diversity both in the structure and scope of the regulations and in enforcement practices. The regulatory spectrum varies from self-regulation by operators in the United Kingdom sector of the North Sea to the detailed regulation and enforcement policies in Norway. The offshore industry constantly tests the bounds of known technology in an effort to improve both the efficiency of its industrial operations and the safety of those employed in the industry. For regulators, the challenge is to adopt appropriate regulatory mechanisms which reflect both the innovative nature of the industry and the safety demands of the state.

■ *NORWAY* The scope of the Norwegian regulatory system is extensive compared to that of other jurisdictions. Individual regulations, however, have been designed to incorporate flexibility and to ensure that changes in technology and procedures can be adopted in individual cases reflecting the conditions specific to each operator.

The *Continental Shelf Law* provides the legal basis for control of activities on the continental shelf. It delegates authority to the King to give approval for and to regulate the exploration and exploitation of petroleum resources. Royal Decrees on the authority of that and other statutes provide the framework for issuing regulations and delegating authority for the control of these operations. Primary responsibility for the safety of offshore installations is vested in the Department of Local Government and Labour although in practice authority has been delegated to nine institutions for mobile platforms (primarily the Maritime Directorate), and to five institutions for fixed platforms (primarily the Petroleum Directorate). Five classification societies have been approved to undertake inspection and other tasks on behalf of the Maritime Directorate.

The basis of the Norwegian approach to regulating offshore safety is that the operators are responsible for ensuring that prevailing regulations are observed and that the Government's requirements are regarded as the minimum acceptable standard. An operator is required to present to the Petroleum Directorate a main plan for the exploration and/or development of a field. The plan must involve the safety policy of the operator, a safety evaluation of the conceptual design of the platform in accordance with guidelines issued by the Petroleum Directorate, and details of the operator's internal control system for ensuring its offshore activities are conducted in accordance with prevailing safety regulations.

It is a basic principle of the Norwegian system that responsibility lies with the operator to pursue applicable safety requirements. Guidelines have been issued regarding the planning, design, construction, and operation of installations. A comprehensive statute regarding offshore oil and gas activities is under study and safety regulations are under review. Measures to coordinate the systems governing mobile and fixed platforms are already in place. In particular, the Maritime Directorate has moved to implement an internal control system for mobile platforms based on the principles and procedures already in place for fixed installations. These measures are all designed to provide a more functional regulatory system, in terms of both the number of authorities involved and the style of regulation. Most importantly, the responsibility for meeting safety standards is being placed in the hands of the licensee through the internal control system, with the authorities maintaining an overriding control position.

There are extensive regulations covering the design and construction of fixed installations and their equipment. Evaluation takes place during the planning and construction phases, although the installation is not approved until it is completed. Similiarly, the design and construction of mobile rigs are extensively regulated, particularly with respect to safety and technical standards.

Well control is exercised through specific regulations, accepted oil field practices, detailed requirements contained in Royal Decrees, and result-oriented stipulations placed upon the operator. The general framework of requirements for a safe working environment is established by statute. Regulations issued by the Maritime Directorate covering workplace safety apply to both Norwegian and foreign-registered mobile drilling units. Royal Decrees provide that the operator must ensure that persons employed on the installations have qualifications adequate to work in "a safe and reliable manner." Regulations set forth manning requirements, responsibilities of personnel, and the qualification and certification required. The Maritime Directorate has issued regulations regarding standby vessels, their physical requirements, their equipment, and the requirement that they must remain within one mile of the drilling unit.

■ UNITED STATES *The Outer Continental Shelf Lands Act* and the *Submerged Lands Act* provide the legal basis for control of the resources on the continental shelf adjacent to the United States. The actual regulatory regime is a mixture of four distinct approaches. The first consists of general statements of policy that provide direction to the offshore safety program. The second is equipment-specific in that it designates design criteria, construction tolerances or specific maxima or minima (for example, producing wells shall be equipped with a surface-activated downhole safety device). The third philosophy generates performance-oriented requirements describing the result that must be achieved to comply with the regulation (for example, the requirement for shutdown of pipeline pumps when abnormally high or low pressures occur). The fourth calls for the preparation and submission of equipment and operating plans by the operator, followed by government review and approval.

The implementation of these approaches is carried out through a number of instruments including statutes, regulations, executive orders, notices, circulars, permits, and standards incorporated by reference. Regulations are developed through a process prescribed by the *Administrative Procedures Act*. Proposed regulations must be published in the *Federal Register* to give the public an opportunity to comment. Executive orders are not subject to this procedure. The four agencies whose statutory authority requires them to be involved in the day-to-day regulations affecting offshore are: Department of the Interior (Bureau of Land Management and Geological Survey); Department of Transportation (Coast Guard and Materials Transportation Bureau); Environmental Protection Agency (EPA); and Department of Defense (U.S. Army Corps of Engineers).

There are many areas of potential or actual overlap in authority. Recognizing this, the agencies have attempted to negotiate memoranda of understanding to resolve conflicts of authority, and thereby improve efficiency. These instruments are published in the *Federal Register* and are subject to public scrutiny.

There are many mechanisms employed by the regulatory agencies in fulfilling their mandates. These range from broad-brush enunciations of general policy to the imposition of extremely detailed design, equipment, and procedural requirements. In some areas, such as training and certification of personnel, the U.S. approach has favoured leaving the details up to the companies themselves. In other areas, such as the design, certification, and installation of equipment for fire prevention, well control, and workplace safety, the U.S. regulations are extremely detailed and often incorporate industry standards and guidelines. Increased demand on Coast Guard inspection personnel, increasingly complex technologies, and a current desire to minimize government involvement in the private sector have resulted in widespread use of voluntary standards and the increased involvement of classification and professional societies in the regulatory process.

An interesting development in the area of regulation in this context has been the development of what has become known as the Best Available and Safest Technology (BAST) requirement pursuant to Section 21(b) of the *Outer Continental Shelf Lands Act Amendments*. This requirement provides a general statutory mechanism whereby the Department of the Interior and the Department of Transportation ensure the adequacy of technologies and regulations dealing with offshore safety.

The responsibility for regulation of the design, construction, and survey of various drilling units is divided. In the United States the structural integrity of fixed offshore platforms is the responsibility of the Geological Survey whereas the Coast Guard has primary regulatory authority for mobile offshore drilling units. MODUs are designated as vessels and their seaworthiness (structural strength and stability) is under the jurisdiction of the Coast Guard which is empowered to carry out inspections to ensure that each U.S. registered MODU complies with the American Bureau of Shipping's *Rules for Classification of Mobile Offshore Drilling Units*. Similarly, MODUs of foreign registry are not permitted to operate in U.S. waters unless they meet the same Coast Guard requirements as U.S. registered units. Although the Coast Guard is the primary regulatory authority in this area, the Geological Survey indirectly exercises jurisdiction over the design and construction of MODUs insofar as it requires evidence of the fitness of a mobile drilling unit, including its capability to withstand oceanographical and meteorological conditions and to conduct its operations in a specific area.

Well-control regulation is the subject of a Memorandum of Understanding between the Coast Guard and the Geological Survey. This memorandum vests in the Geological Survey the regulation of "all mineral exploration and drilling, and production activities on leased or leasable land." Implementation of this agreement is by means of Outer Continental Shelf Orders which address equipment, procedures, training, and certification requirements. For instance, through *Outer Continental Shelf Lands Act* Order No. 2, the Geological Survey requires that all toolpushers, drillers, or owners' representatives take a basic course in well-control procedures and equipment every four years and a refresher course annually.

Workplace safety is not governed by one single set of regulations. Currently the Coast Guard is preparing regulations under the authority of the *Outer Continental Shelf Lands Act Amendments* to address identified workplace problems. As with construction and design, Coast Guard regulations generally apply to mobile offshore drilling units and those of the Geological Survey apply to fixed platforms. Although the Coast Guard's jurisdiction over workplace safety is derived from the *Outer Continental Shelf Lands Act*, there is a Memorandum of Understanding between the Coast Guard and the Occupational Health and Safety Administration which provides that the U.S. Coast Guard will be responsible for ensuring that all offshore operations will be conducted in compliance with occupational safety and health regulations and are free from recognized hazards.

Numerous regulations specify the equipment and procedures that are to be employed in emergency situations on offshore installations. The Coast Guard is primarily responsible for regulating emergency and abandonment procedures and equipment on both fixed and floating platforms. There are also procedural regulations dealing with the chain of command in emergency situations. On fixed platforms the owner, operator, or agent designates the person in charge. On mobile offshore drilling units the "master or person in charge" is responsible for ensuring that all personnel on the unit and all visitors are familiar with their stations and duties during emergencies. In response to recommendations by the National Transportation Safety Board, this section is to be amended to designate the master as the person in charge.

The regulations that deal with the inspection, certification, and design of safety equipment are extremely detailed. However, with the exception of a provision that lifeboatmen be "capable of carrying out their duties" no mention is made of specific training or qualifications. Unlike the other jurisdictions under study, the U.S. regulations do not presently require the continuous presence of standby vessels. Regulations governing design, construction, operation, manning, and equipment standards for offshore supply vessels have been proposed and released for public comment.

■ *UNITED KINGDOM* Responsibility for offshore safety of oil and gas installations in the United Kingdom rests with the operator. Regulations tend to be drafted in general terms, giving the operator wide latitude in their practical application with the assistance of non-mandatory measures such as Guidance Notes. The role of certifying authorities in inspection and survey functions is significant and is supplemented by the in-house government inspection which has developed over the years. Additionally, the U.K. system emphasizes the use of external organizations, such as United Kingdom Offshore Operators Association (UKOOA) to assess and indicate the need for technical standards and regulations in order to ensure that realistic and up-to-date technologies are utilized in the offshore.

The *Continental Shelf Act* 1964, the *Mineral Workings (Offshore Installations) Act* 1971, the *Health and Safety at Work Act* 1974, and the *Oil and Gas (Enterprise) Act* 1982, provide the statutory framework for the exploration and exploitation of oil and gas resources on the continental shelf and for the safety of the personnel, the installations, and the environment. Under the authority of these Acts of Parliament, regulations are issued detailing principles of health and safety in the design, construction, and operation of offshore installations. Guidance Notes, Continental Shelf Operating Notices, Codes of Practice, Notices to Mariners and British Standards relating to issued regulations give non-mandatory advice on methods of achieving objectives to an acceptable standard of reliability. With the exception of the safety of ships and seafarers engaged in offshore oil and gas exploration and exploitation, the Department of State for Energy has full responsibility for all related safety matters. Its Petroleum Engineering Division, strengthened with the transfer of inspectors from the Health and Safety Executive, is the main governmental inspection body.

The control of industrial health and safety is based upon the principle of self-regulation. The employer has full responsibility for ensuring that appropriate health and safety specifications are adopted in the areas under his control, and for demonstrating to the authorities that the general requirements for safe operations are being met. The inspectorate's role is one of monitoring, not giving detailed instruction on fulfilling the employer's duties. To facilitate this process, legislation is kept to a minumum and regulations are written in general terms, reducing the need for constant revisions to keep pace with technological changes. Secondary legislation and detailed technical Guidance Notes amplify the legal provisions of the system.

Under a system of self-regulation, consultation between government and industry in the drafting of regulations and guidance notes is important. Consultation is required by statute. An oil industry advisory committee has been set up but the main channel of communication with industry is the UKOOA which represents all the operators. UKOOA plays a significant role in assessing and updating Guidance Notes, preparing preliminary drafts of technical regulations for the Department of Energy and establishing non-mandatory guidelines for its members.

The Department has authorized five classification societies and one independent certification group to assess drilling units and to issue *Certificates of Fitness*. The owner of the drilling unit selects and pays the certifying authority who is responsible to the Department and applies the regulations and Guidance Notes issued by the Department. No drilling unit, mobile or fixed, can operate on the continental shelf without a *Certificate of Fitness*. The owner is responsible for sound design, proper construction, and effective maintenance of his unit.

Problems in well control require a flexible and fast response and the approach is individual treatment. The mandatory objectives are set forth in statutory instruments and advice on achieving these objectives is contained in Guidance Notes. Under the permit system the minister has wide discretion regarding the manner in which oil fields are developed and exploited. In addition to specific regulation, a wide range of instructions are issued under the regulation specifying practices to be observed to ensure the safety of the installation. Regulations make specific provisions for safety in the workplace, and for the qualifications of installation managers, helicopter landing officers, medics, and radio operators. There are also certification requirements for personnel in well control. Otherwise the onus is on the owner to provide "competent" personnel. A manager is required on all offshore installations, and is responsible for all matters affecting safety, health, and welfare. He is the person in charge and in an emergency has unrestricted control and authority.

Regulations are also issued dealing with emergency procedures, lifesaving appliances, and firefighting equipment which must be of an approved type. Emergency procedure manuals are required, and regulations specify that a standby vessel must be within five nautical miles of any manned installation at all times. UKOOA has issued guidelines to its members dealing with offshore safety training and well emergency drills and exercises. It has also arranged a coordinated plan with other countries involved in North Sea operations for mutual assistance in an emergency.

■ *CANADA* Although Canada has exclusive rights over the hydrocarbon resources on her continental shelf, she has not yet enacted legislation giving her jurisdiction over offshore oil rigs. The Criminal Code, for example, does not apply to foreign registered rigs nor does Canadian common law. Where Canada has not legislated nor issued regulations, only the requirements and standards of the Flag State apply. The statutory basis for regulating exploration on the continental shelf is the *Canada Oil and Gas Act* and the *Oil and Gas Production Act* under which the *Canada Oil and Gas Drilling Regulations* were issued. The responsible agency is the Canada Oil and Gas Lands Administration (COGLA). The federal parliament has jurisdiction under the constitution for "Navigation and Shipping", and the responsible agency is the Department of Transport. The juridical status of mobile drilling units in Canadian law is uncertain. In 1982 a Memorandum of Understanding was concluded between the Canadian Coast Guard and COGLA setting forth the terms and conditions of cooperation between the two agencies and, *inter alia*, the provision of marine services to the continental shelf and the inspection of mobile drilling units there. By virtue of this Memorandum of Understanding the Coast Guard administers the regulatory requirements which standby and support vessels must meet. In addition, the Ship Safety Branch of the Coast Guard, is responsible for ensuring compliance with the Interim Standards that have been adapted for the design, construction, and operation of MODUs.

The primary tool for regulating the design, construction, and operation of offshore installations is the application-permit system rather than detailed regulations. Information is required on each proposed drilling unit which is then inspected and evaluated. Each applicant must obtain first Drilling Program Approval and then Authorization to Drill a Well.

The federal regulatory structure does not include a set of regulations that deal exclusively with the design and construction criteria or with certification of offshore drilling installations. The Drilling Program Approval procedures establish, however, the needed information and requirements. The unit must be capable of withstanding anticipated environmental conditions. The process of approval also includes the enumeration of specific design and equipment requirements for drilling units. The Chief Conservation Officer of COGLA will have all relevant design and construction data for evaluation and may inspect the unit and its equipment at any time.

The regulation of well control is achieved through the Drilling Program Approval which requires detailed information on the geological structure and through other regulations which outline the procedures and equipment that must be employed. Regulations also specify a number of safety-related procedures and equipment to be used to ensure workplace safety. They require the operator to ensure that trained personnel are available to operate the equipment and that safe working methods are followed in all operations. The only mention of a mandatory training requirement is the stipulation that all unit supervisors, foremen, and toolpushers must, once every three years, successfully complete an approved well-control course.

Dispersed throughout the regulations are provisions for: design criteria and equipment required for emergencies; safety drills; training; and contingency plans. Requirements also exist for suitable standby vessels as a means of evacuating personnel from drill rigs and for the rescue equipment that they should carry. Each operator is required to ensure that any operation necessary for the safety of personnel employed at a drill site or on a support craft has priority, at all times, over any other operation on that drill site or craft, and that trained personnel be ready and able to operate any item of equipment.

■ *ANALYSIS* The subject matter of regulation differs widely from jurisdiction to jurisdiction as do the mode and technique of control and the degree of detail. The legal environments also differ and, hence, there are different attitudes regarding government control. Three modes of control are evident in the four jurisdictions under examination. One mode relies on the permit system to require information and enforce compliance. The Canadian Federal Government relies heavily on this mode as does the United Kingdom, relying upon "model clauses" in general regulations and upon non-mandatory measures such as guidelines to make its wishes known. The onus is on the operator to ensure that expected and recognized safety standards are met.

A second mode is the acceptance of the assessment of another organization that an offshore drilling unit, equipment or procedure is safe. This is similiar to the way many states deal with vessels and classification societies. It is a total incorporation of standards and inspection practices of others without state regulation. It removes from the hands of the state any responsibility for establishing the details of what constitutes a safe procedure. In the United Kingdom, the United States, and Canada, this authority is delegated primarily to the classification societies. In

Norway, authority is delegated, for some purposes, to the company through the "internal control system", although detailed regulations and standards are often set by the government.

The third mode recognizes that specific areas must be regulated. A number of techinques are used. Requirements may be specific with respect to the number or the type of equipment, for example, fire extinguishers, and the performance standard of the required equipment may be set. Another technique is the incorporation of external standards or setting the criteria of inspector's approval. The approach may be to require safe performance or to specify that the performance must be by competent persons.

The technique of specific regulation is used widely in the United States and Norwegian regulatory systems. The Norwegian approach is to legislate extensively regarding the nature of the equipment, procedures, and training, and to monitor the offshore unit's compliance through spot checks and evaluation of the documents required to be submitted to the government. It is the operators' responsibility to establish an "internal control system" to ensure the safety of the drilling unit and its personnel, but the government closely monitors the companies' operations. The "internal control system" places the burden on the operator to devise a system that ensures safe operations that comply with government-established standards. The U.S. approach is less detailed than the Norwegian, but there still exist multiple equipment regulations and inspection requirements that must be met in order to obtain the necessary operating certificates. The introduction of the BAST requirement vests discretion in the agencies to determine whether equipment and procedures which may affect safety conform to specified standards.

Maximum safety is achieved through a balancing of certainty of application for the operator and legislative flexibility to permit the adoption of emerging technologies and to accommodate changing conditions. Another consideration is efficiency of the drilling operations. Undue external control will increase costs. Other considerations include administrative ease and the ability to ensure enforcement of the regulation. In selecting the mode and technique of regulation, an acceptable balance of these factors must be achieved.

The five jurisdictions addressed in the report all accept the desirability of concentrating responsibility for safety on offshore petroleum installations in as few regulatory bodies as possible. In the United Kingdom, for example, responsibility has been placed with basically one entity. In the United States two major departments have responsibility for safety in the offshore. Both departments issue regulatory instruments but duplication and confusion are minimized by inter-agency agreements in areas of overlapping jurisdiction. In Norway two directorates are involved in the coordination of offshore safety, one for fixed drilling units and one for mobile drilling units. In Canada both the federal and Newfoundland governments have established agencies which are designed to play the principal role in offshore management.

Offshore petroleum operations involve the application of the expertise of two industries, the oil industry and the shipping industry. Canada has much experience with both. Canada has little experience, however, with the two combined in the shape of the offshore oil industry. The United States also has much experience in oil and gas matters, and a long history of maritime regulation. The United Kingdom and Norway have rather more maritime experience than oil and gas experience. Nevertheless, activity outside Canada has shown that the maritime nature of offshore petroleum activities cannot be safely ignored. It can be argued that safety on offshore petroleum installations can be viewed from both the maritime and oil industry perspectives.

The federal government is attempting to concentrate responsibility for offshore management (using the phrase in its widest sense) in one agency, while utilizing the expertise of other agencies where necessary. The Newfoundland Government has concentrated oil and gas management in one agency, and must perforce, leave the maritime component in offshore operations to a federal government agency. The task for Canadian administrators should be to determine whether this concentration is desirable, and if so, to ensure that it is not achieved at the expense of the legitimate role of other agencies.

Each of the jurisdictions examined share common problems in terms of the issues which those institutions involved in regulating offshore safety must face. Difficult questions arise, for example, in determining the need of regulation, mode of regulation, and technique of regulation. Resolving these questions requires detailed knowledge of all matters relating to offshore drilling units and technological innovations which may affect safety. Reaching decisions on these matters can be accomplished either by state institutions unilaterally or by formal or informal consultation with industry. Regulations that are created by the state without consultation with industry presuppose an enormous government knowledge of offshore operations and it is perhaps unrealistic to expect any government to be so qualified. Thus most governments in fact consult industry either formally or informally.

The major role of government in offshore safety is the creation and enforcement of regulations. Enforcement is problematic where the regulations are vague, for example, in statements of "good intentions". Enforcement is difficult where expertise is lacking to ensure compliance with detailed regulations and where no industry incentive to comply with the regulations exists. Enforcement can be accomplished through delegated power of inspection to groups like classification societies or other professional organizations. The fear of random inspection, and hence enforcement, may work when penalties are sufficiently severe.

The fact that the Canadian regulatory regime is the least developed of the jurisdictions examined is reflected in how Canada currently deals with concerns such as: the status of oil rigs, manning and training, construction and design, workplace safety, and emergency procedures and equipment.

There is an obvious need in Canada for the promulgation of legislation to ensure that national law, not foreign law, applies to all activities on board an oil rig, to the extent permissible under international law. Canada should encourage other states to accept the jurisdiction of the coastal state, thus furthering the development of the international rules. This legislation should ensure that no dichotomy in safety-related law and administrative structures exists between fixed and mobile drilling units, and production platforms. Further, the legislation should make it clear that oil rigs are not to be treated as vessels, but should have safety regulations designed specifically for them. There is a necessity as well to treat oil rigs as separate entities in regulations to avoid the problems of the dichotomy between a rig in the drilling mode and one in the non-drilling mode. Norway has taken this approach to rigs. In the United States, regulations distinguish between fixed and mobile installations. The United Kingdom has employed one set of regulations for offshore installations, whether mobile or fixed in nature. Regulations developed for ships are often not appropriate for rigs. This is particularly true in the Canadian example, since the *Canada Shipping Act* (under which shipping regulations are passed) can trace its origin to the mid-1800s, when offshore technology was virtually non-existent.

The manning and training requirements for a vessel are significantly different than those for an oil rig. In Canada, however, the only manning requirements that apply to rigs are found in the *Canada Shipping Act*. In the United Kingdom, there are no general requirements regarding training, equipment orientation, or emergency procedures. The United States is similar to Canada in its lack of regulations on manning and training. The U.S. Coast Guard has detailed certification requirements only for personnel performing traditional maritime activities on mobile offshore drilling units and separate regulations require that senior rig personnel complete well-control courses. The National Transportation Safety Board Report on the *Ocean Ranger* recommended that new regulations be passed on manning and training requirements for specific jobs and for emergency procedures. This recommendation is in the process of being implemented. An important strength of the Norwegian system is the detailed manning and training requirements that exist for individuals in key positions on a mobile offshore drilling unit. For some positions, course work and experience are important prerequisites. Senior personnel must have maritime certification as well as courses relating to particular drilling operations.

The Canadian federal jurisdiction is the only jurisdiction studied which does not have detailed standards and requirements regarding design and construction. In order to obtain a Drilling Program Approval an applicant must submit to the Canada Oil and Gas Lands Administration detailed information relating to the design and construction of the particular drilling unit to be employed. The International Maritime Organization (IMO) MODU Code, which Transport Canada uses as Interim Standards, provides a series of ready-made standards for rigs (although it should be remembered that the IMO Code is not comprehensive). Thus, there is an emphasis on quality of equipment but little with respect to qualifications of personnel. Both the United States and Norway have extensive, detailed regulations in these areas. In the United Kingdom the standards to be achieved and the equipment to be used are detailed in non-legally binding guidelines, which benefit from constant review through consultation with the interested parties.

The key to construction and design safety would appear to be monitoring and inspecting the work to ensure its quality. Ship classification societies, on behalf of owners, are usually responsible for undertaking the necessary inspections with the aid of government departments where their expertise is appropriate. It would be the role of the state, in consultation with experts, to determine the equipment to be tested, the frequency of inspections, and the standards to be achieved.

The United Kingdom and Norway have regulations regarding workplace safety. In both cases the legislation imposes certain duties on the oil rig operators and the employees. The United States is in the process of developing and implementing legislation on workplace safety in the offshore environment. While Canada has no significant legislation in this area, it is apparent that there is a need to establish responsibility for occupational safety.

All the examined jurisdictions have detailed regulations on emergency procedures and equipment. In all cases the state involvement in the inspection of such equipment and the assurance of the existence of an emergency plan is significant. In the United Kingdom, regulations exist regarding the type of emergency equipment that must be available on board an offshore installation. Emergency procedure manuals are to be created for every installation. There is a clearly designated chain of command established with the Offshore Installation Manager retaining overall responsibility on the installation. The U.S. regulations specify that there must be an identifiable chain of command in an emergency situation with the commander being the master unless the operator clearly designates otherwise. The operator is to prepare and have ready for inspection and use an operating manual which details activities to be undertaken to ensure and maintain the safety of an oil rig in emergency situations. Regulations on emergency equipment and procedures in Norway include training requirements and set out an onboard chain of command. The provisions for individual worker safety are extensive and detailed, extending the land-based system of safety delegates to the offshore. Provisions in the Canadian regulations regarding emergency equipment and procedures take several forms: design criteria and required equipment; safety drills; training of personnel; and contingency plans. Contingency plans for emergencies must be readily accessible on each unit and must be submitted upon request to government authorities. There are no training requirements, although there are emergency drill requirements. Safety of rig personnel is, by law, to have the highest priority.

In striving to determine what the proper structure and goal of an offshore safety regulatory regime should be in the Canadian context, it has been useful to examine the example set by other countries but obviously that example should not be adopted thoughtlessly. What is appropriate for the Norwegian Continental Shelf may not necessarily be appropriate on the Canadian East Coast. Nor should Canada necessarily be intimidated by the superior experience of other jurisdictions. This alone does not guarantee a systematic solution to the problems posed by conducting oil and gas operations in a hostile environment. The loss of the *Ocean Ranger* has forced Canada to consider the state of its legal regime with respect to safety on offshore drilling units operating off its coasts. The questions which must now be addressed include the desirability of concentrating regulatory authority in a single agency, the proper role of regulations bearing on safety, the extent to which each individual on an offshore installation is responsible for his or her own safety, and the best way in which the proper offshore safety environment can be created and maintained.

[Editor's Note: This report and the one following were contracted in 1983 at which time a dual regulatory system existed for operations on the Grand Banks. Subsequent court decisions resulted in the federal government receiving jurisdiction over offshore drilling operations.]

(1) *An Evaluation of the Management of the Regulatory Process in Eastern Canada Offshore Drilling*
(2) *Task and Skill Analysis of Agencies Regulating East Canada Offshore Drilling*
National Petroleum & Marine Consultants Limited
St. John's, Newfoundland
June 1984

CANADIAN REGULATORY MANAGEMENT

The Canada Oil and Gas Lands Administration (COGLA) is responsible for the management of oil and gas exploration and development in the Canada lands, that is territory that under the law is not part of any province. The principal purpose for the creation of COGLA was to concentrate, within a single body, the oil and gas management functions exercised by the Department of Indian and Northern Affairs, with respect to Canada lands situated north of the line of administrative convenience defined in Schedule IV of the *Canada Oil and Gas Land Regulations* and by the Department of Energy Mines & Resources with respect to Canada lands located south of that line.

COGLA was formed in 1981, in preparation for the passage of the *Canada Oil and Gas Act*, proclaimed in March 1982 together with amendments to the *Oil and Gas Production and Conservation Act*. With a mandate to administer oil and gas activity in the Canada lands, COGLA has been made the principal point of contact between government and the petroleum industry. It negotiates exploration agreements, authorizes all activities respecting the exploration for and production of oil and gas on Canada lands, inspects exploration and production operations, and coordinates the development of related Canada Benefits' plans and the resolution of environmental concerns.

Although a single new body combining components of two departments was created, the two ministers involved retained their respective areas of responsibility north and south of the line of administrative convenience. COGLA has an unusual organizational status: it is not a program or a branch within a particular department, nor does it have the independence of a Crown corporation. It cannot be compared to most existing federal units of organization because it is an administrative body with functional responsibility to two ministers. Its authority is derived from the ministers of both parent departments and is exercised to the extent that ministerial delegation is made. Under the Memorandum of Understanding that established COGLA, both departments turned over to COGLA their respective oil and gas resource management functions for Canada lands. Each department, however, retained a substantial number of policy and operational activities with which COGLA activities must be coordinated.

COGLA is headed by an Administrator who has authority to make all ongoing operational decisions and who bears the principal responsibility for the implementation of the *Canada Oil and Gas Act*. The Administrator is also, by joint ministerial designation under the *Oil and Gas Production and Conservation Act*, the Chief Conservation Officer (the Chief). The Administrator reports to the Deputy

Ministers of both departments and receives direction from them on how he is to relate COGLA operations to relevant activities of their departments. Policy advice is provided by the COGLA Policy Review Committee, which includes senior personnel from both departments. That Committee ensures that COGLA policy decisions are consistent with the requirements of Energy Policy and Northern Policy.

COGLA is composed of six main branches. Engineering and Control is responsible for the regulation and monitoring of exploratory drilling as well as for development and production activities on Canada lands. This branch administers and enforces the *Oil and Gas Production and Conservation Act* and ensures that the operator takes all the precautions necessary for the safety of personnel, the prevention of pollution and the conservation of resources. The Land Management Branch is responsible for negotiating, issuing, and administering exploration and production rights on Canada lands. The Resource Evaluation Branch approves geophysical and geological programs and assesses the oil and gas potential of Canada lands as a basis for resource management policy. This section is also responsible for identifying seabed, surface, and subsurface geological hazards that might affect the safety of a drilling, transportation, or production system. The Environmental Protection Branch ensures that projects are environmentally safe with respect to biological and physical regimes, and acceptable to relevant coastal communities. This branch administers the southern Environmental Studies Revolving Funds (ESRF) and evaluates and approves contingency plans covering both environmental and personnel safety in the event of an emergency. The Canada Benefits' Branch is responsible for ensuring that Canada Benefits' plans submitted by operators are satisfactory to the minister. The Policy Analysis and Coordination Division coordinates roles and responsibilities between COGLA and other federal and provincial departments and analyzes, develops, interprets, and implements policy with respect to the management of oil and gas activity in the Canada lands.

COGLA maintains two regional offices on the Canadian East Coast located in Newfoundland and Nova Scotia. The regional offices are responsible for interpretation of COGLA's safety requirements to regional operators, for liaison with representatives of industry and provincial governments on safety issues, and for the monitoring and inspection of offshore operations for compliance with COGLA safety regulations. The regional offices are also responsible for granting the Authority to Drill a Well. The role of site-specific, regional monitoring, and inspection of operations is perhaps the most important function of the regional offices. In this regard, they exercise discretion on most issues, referring to Ottawa headquarters as needed. Since COGLA has the administrative responsibility for the regulation and management of the offshore petroleum resource under the terms of the Canada/Nova Scotia Offshore Agreement, the regional office there is responsible to the joint Canada/Nova Scotia Oil and Gas Board which administers that agreement as well as to the COGLA Ottawa headquarters.

Within the federal government there are a number of other programs and agencies apart from COGLA which, either by legislation or administrative arrangement, have responsibility for certain aspects of offshore petroleum activity. The Canadian Coast Guard (CCG), largely through its Ship Safety Branch, has responsibilities associated with marine aspects of drilling units and support vessels and their related safety systems. The authority to regulate these matters derives from the *Canada Shipping Act*, in the case of Canadian flag rigs and vessels; and under the terms of the CCG/COGLA Memorandum of Understanding, in the case of foreign-registered drilling units and their support craft operating under COGLA licence in the area seaward of the territorial sea of Canada. Other departments which have secondary responsibilities for safety offshore include Fisheries and Oceans, Communications, Transport, Environment, Indian and Northern Affairs, Employment and Immigration, Health and Welfare, and Labour. COGLA maintains less formal ties with the International Maritime Organization, the Northwest European Offshore Safety Committee, the Norwegian Petroleum Directorate, the United Kingdom Department of Energy, and the United States Geological Survey.

Except in instances where they have been retained as a consultant, COGLA has no direct contact with classification societies. As far as the petroleum industry itself is concerned COGLA has no single, formal, consultative mechanism for liaison although contact is maintained through a number of informal and semi-formal means.

■ *LEGISLATION* *The Canada Oil and Gas Act* and *The Oil and Gas Production and Conservation Act* form the main legislative basis of the regulatory regime administered by COGLA. Combined, these two pieces of legislation set out the requirements for granting oil and gas exploration and production rights, for establishing a fiscal regime applicable to oil and gas activities, for providing transitional mechanisms for moving from the old to the new, and for supplying as well the framework for detailed technical and safety requirements for work and activity on the Canada lands.

There are a number of international agreements and conventions that cover marine aspects affecting the safety of ocean-going vessels and drilling units. One such accord is the *International Convention for the Safety of Life at Sea* (SOLAS) to which Canada is a signatory. Similarly, the International Maritime Organization (IMO) Code for Mobile Offshore Drilling Units specifies minimum requirements for the design, construction, and outfitting of these units. Member states such as Canada generally recognize the provisions of these conventions by promulgating regulations but may specify more stringent and detailed requirements. The MODU Interim Standards developed by the Coast Guard and COGLA used this code as a starting point although currently the Interim Standards do not have the legal force of regulations.

■ *APPLICATIONS AND PERMITS* The process of government approval to drill a well involves two stages, the Drilling Program Approval and the Authority to Drill a Well. In the first stage, an approval granted under the *Canada Oil and Gas Drilling Regulations* permits an operator to drill in a particular geographical region for a specified period of time not exceeding three years, using the drilling unit, associated support craft, techniques, and contingency plans as described in the operator's application and approved by the Chief Conservation Officer ("the Chief"). The second stage, the Authority to Drill a Well, is also granted under the *Canada Oil and Gas Drilling Regulations* and is essentially a licence to drill a particular well within an approved drilling program using the drilling procedures, blowout preventers, and the casing and evaluation programs described in the operator's application and approved by the Chief or by the relevant COGLA Regional Manager. An application for Authority to Drill a Well must include all the technical information required by the Drilling Regulations plus such other information as the Chief may require.

■ *INSPECTIONS AND MONITORING* In addition to conducting an inspection of the proposed drilling unit before the drilling program is approved, COGLA also conducts regular on-site drilling and safety inspections which are usually carried out by engineers and technologists from the regional COGLA office. COGLA also relies on the Coast Guard to control and approve the design and construction aspects of drilling units and support vessels and their related safety systems, as well as the operating, equipping, and manning of such vessels. Written reports on all inspections are prepared and circulated in the regional office and sent to the Engineering Branch in Ottawa with a copy provided to the operator. In addition the operator is required to report regularly to COGLA and other government agencies. These reports include a great deal of information: drilling data, weather information, logs or physical environment factors, summaries of significant events, lithology reports, hydrocarbon shows, and accident data involving personal injury or death. COGLA monitors these activities and ensures compliance. Deficiencies or problems encountered as a result of this inspection and monitoring activity are brought to the attention of the operator as soon as possible, often a formal statement of requirement is issued as a "directive". Whatever response is adopted, an attempt is made to maintain a continuing dialogue with the operator.

The steps taken in the enforcement process are straightforward. The initial step is for the inspector who has observed the deficiency to give notice to the operator's representative on the rig. Notice is then telexed to the operator's management. In general these steps have been sufficient to elicit a prompt and cooperative response on the part of the operator. Occasionally, when it becomes obvious that a noted deficiency is not being addressed, a warning letter setting a deadline for compliance and action is forwarded to the operator. Monetary penalties are generally provided for in the legislation but the usual enforcement mechanism is the authority to withdraw drilling permits and shut down a drilling unit.

■ *ANALYSIS* Perhaps the most important question emerging from a review of the regulatory process is the overall question of structural organization and jurisdiction. Identified as the key weakness in the offshore regulatory system of the United Kingdom by the Burgoyne Report, this controversial area has also been cited as problematic by a number of other countries. The specific safety problems created by overlapping or unclear division of responsibility are hard to predict, but it appears evident that such confusion may lead to conflicting patterns of enforcement, delays in preparing or amending legislation, and non-cooperation on the part of frustrated industry representatives.

The mere fact that this same problem crops up in discussions of regulatory effectiveness in many different countries and systems, speaks of the inherent difficulty involved in setting up a smooth and effective structure to regulate offshore exploration. The reasons for this difficulty are directly related to the special status of offshore drilling as an occupational endeavour. There are natural divisions and overlaps between marine and stationary operating guidelines; between provincial, national and international jurisdiction; and between the often conflicting but equally pressing goals of vigorous and rapid development of much-needed resources and carefully reasoned rules to protect people and property in an environment that is far more dangerous than any encountered on shore. The day-to-day problems created by overlapping or inconsistent regulatory responsibility are magnified in times of crises when the heightened risk factor and unpredictability require a speed of response and flexibility of approach that are impossible in a structure that is made up of many loosely related parts.

Offshore operations in eastern Canada have had their share of problems arising from this source. In the federal system, COGLA claims to be the window on the industry and the coordinating body for the other government departments. This is not always the case, and perhaps should not always be the case. There is evidence of confusion in the federal system regarding the allocation of responsibilities, and, even when the lead agency role of COGLA was recognized in principle, in reality it is apparent that many of the secondary agencies deal directly with industry independently of COGLA and sometimes without COGLA's knowledge. This generally occurs in areas where other government departments have traditionally exercised and continue to exercise jurisdiction, such as Coast Guard with respect to regulation of coastal and marine operations and Employment and Immigration with respect to national employment requirements.

The main source of problems may not be the particular assignment of responsibility to COGLA or elsewhere, but rather the confusion about where that responsibility lies. The same elements of confusion exist in industry, particularly among companies that are new to East Coast drilling, when it comes to determining the routines which must be followed in getting approvals and in complying with regulations in general. The present regulatory organization and structure are of recent vintage, and there seems to be little general knowledge in the industry about the organization and responsibilities of the various regulatory groups and the regulations themselves. There is no widely circulated source of updated information clearly delineating these lines of responsibility, or explaining current regulations, directives, and guidelines. This lack of systematic information is seen as an important gap in the smooth operation of the system.

A second area of concern, closely related to the first, is the danger of overlap and occasional competition between agencies which share jurisdictional control. There seems to be some feeling within industry, for example, that competition and communication break-downs exist between COGLA and Coast Guard. This situation is not, however, perceived to be a serious problem. Where there may be some difficulty, according to past experience, is liaison with respect to initial inspection and survey of drilling units. On some occasions this process has been poorly coordinated with departmental representatives acting independent of each other and with no central coordination.

A third major problem in the broad area of general organization and policy concerns the inherent conflict between the goals of industry and those of government. Regulatory agencies are sometimes seen as ruling without considering adequately the cost, efficiency, or practicality of their requirements from an industry point of view, or as ruling on the basis of political contingency rather than fundamental safety considerations.

On a local level there appears to be little justification for these statements. Although they are widely held beliefs, it is difficult to identify concrete examples where safety was actually or potentially, adversely affected by political compromise, and government regulatory agencies appear to give considerable thought to cost, efficiency, and practicality in their deliberations and decision making. A further area of policy concern among some representatives of industry is the adherence of regulatory agencies to Canadian content quotas in equipment and manpower. Although some people felt that this policy could have detrimental effects on safety standards, little evidence was found to support this claim.

A problem does exist with the degree of input by industry in the regulatory process. One symptom of this problem is the lack of industry experience within the senior ranks of COGLA and other government departments. Mitigating against the ability of these regulatory agencies to build strong, highly skilled teams are such factors as ever-changing technology which requires a constant updating of knowledge, and competition for good people arising from within industry itself. The situation in eastern Canada is exacerbated by pressures on the agencies to pursue an aggressive development strategy and to absorb the series of organizational modifications that are inevitable in a new, high-growth enterprise, while maintaining high standards of regulatory activity.

In general terms the regulatory agencies under consideration have coped well with the task of upgrading skills and general competence of their units. There is a serious need for more industry experience on regulatory staffs, particularly at senior levels. One possible suggestion for securing industry input without incurring the prohibitive costs of full-time senior personnel might be by hiring retired industry executives to provide valuable skills and knowledge on a part-time or consultant basis.

No formal mechanism is in place for industry to make their views known to regulatory agencies, or to have their concerns systematically and consistently addressed. One area where lack of input is particularly important is in the development of regulations. Regulatory groups have made it a practice to circulate proposed regulations and to solicit views from industry. The objective of these groups is to consult with industry and to utilize their advice. Consultations, however, are informal and there is no system for industry involvement in the early stage of development of particular regulations. It is unclear to what extent industry comments are analyzed and incorporated into actual decision making.

A second, closely related concern is the lack of a formal mechanism for workers' safety committees to have discussions with regulatory authorities and to make recommendations concerning safety regulations. As the workers themselves are highly aware of occupational safety hazards, their input is seen as a significant asset.

The approval to drill procedure is an important one in the functioning of any petroleum regulatory agency. When this approval to drill is granted, it is assumed that all necessary government requirements have been met. There appears to be a problem in this area within the eastern Canadian system. There is no formal "sign off" procedure to ensure that assessments and evaluations carried out prior to approvals are all performed to the same level of effort. Without such a system, the agencies' approvals are not as clear-cut as they could be and operators have had to comply with new requirements after being given approval to drill.

Another instance of uncertainty within the local regulatory approval system is the absence of formal procedure for approval of lifesaving equipment. Occasionally, there are doubts about compliance of equipment brought into Canadian waters on foreign flag units, this doubt may exist for significant periods before a decision is made.

Regulatory agencies issue directives, guidelines, and standards and it is often unclear how mandatory they are. The understanding within the federal regulatory agencies themselves is that directives are specific to particular safety problems, and must be adhered to in order to remain in full compliance with regulations; that guidelines are compilations of directives and safety notices and that standards are non-mandatory. The main problem comes in the lack of understanding within industry of the degree of rigour of some of these requirements. On the whole, there is no definition that sets out the legal authority of each of the elements.

It is also important in any regulatory system that these directives and guidelines (as well as actual regulations) are administered fairly and consistently. There have been occasions when regulatory personnel have contacted industry personnel to inquire about actions taken or planned to be taken although the limits specified in a guideline had not yet been reached. This type of premature intervention may not have significant adverse effects on safety conditions. Nevertheless, the premature involvement of regulatory agencies potentially creates an atmosphere in which the industry feels that the agencies do not have confidence in either the limits they have set or the ability of industry to respond adequately if these limits are exceeded.

Fairness and consistency should extend to all inspection activities carried out by the regulatory agencies. One area of concern identified, related to the inspection of pressure vessels and elevating devices which appear to be the subject of overlapping and conflicting regulation. Traditionally, the inspection of these devices is carried out by trained inspectors representing provincial Labour and Manpower departments. In the case of ships, these items of equipment are also the subject of inspection by classification societies and the Canadian Coast Guard. There is often a difference in requirements and methods of inspection in a marine environment.

A general review of safety regulation activities carried out by the agencies under consideration identified some specific areas of concern. Although there are practical reasons for combining environmental safety and personnel safety under one jurisdiction, care must be taken in the review and execution of contingency plans to ensure that there are no conflicting priorities between these two domains in the proposed sequence of events.

Although most aspects of helicopter operations are adequately regulated, there seems to be some confusion concerning helicopter landing facilities and the division of responsibility between Transport Canada and COGLA. The degree of regulatory control over drilling rigs varies depending on the country of registry. Canadian flag rigs come under tighter control than do foreign flag rigs which are monitored by the Coast Guard. Consequently, two rigs could be operating side by side and not be subject to the same scrutiny of safety features. While this situation does not mean that foreign flag rigs are less safe than Canadian ones, it does point to a fundamental flaw in the present regulatory system.

The general approach of having the Coast Guard inspect drill units was reviewed. The strength of CCG is primarily derived from its long history of regulating the marine industry, therefore treating semisubmersible drill rigs as another form of ship is natural for the CCG and, in the main, is a sensible approach. Nevertheless, there are enough significant differences between the design, construction, and operation of semis and ships to warrant very special attention. Like COGLA, CCG could benefit from incorporating more industry expertise into its work force, particularly at the inspector level.

■ *CONCLUSIONS* There is an acknowledged need for government agencies to regulate the safety of drilling operations under legislative mandate. It is of paramount importance that every operator and his operations plan be closely scrutinized by a regulatory authority to ensure that the operator has the capability to carry out the plan in a safe manner and is fully aware of any potential problems.

In general, the drilling activities themselves appear to be reasonably well regulated. The significant organization and management problems seem to arise for the non-drilling activities, that is, the operation of the drilling unit and air and marine support services. Until recently, little emphasis has been placed on these non-drilling activities.

Improvements in the overall administration of the regulatory process should result from a clarification of the responsibility of the lead agency (COGLA) for the performance of other agencies, and the provision of a clear description of exactly how the federal regulatory system works. A systematic effort should be made to educate industry on the routines involved in securing approvals and complying with regulations, and formal "sign off" systems should be established to ensure that assessments and evaluations done prior to approvals are consistent and complete. The legal authority of directives, guidelines, and standards should be defined and publicized and the methodology for designing, promulgating, reviewing, and amending regulations should be established and the information made available to relevant parties.

Improvements should also result from increased participation by industry in the regulatory process. Industry should be invited to provide input at an early stage in the development of regulations, and formal mechanisms should be established for input of workers' safety committees into safety regulatory matters.

COGLA should recognize the importance of offshore petroleum industry knowledge as a prerequisite for decision making at the senior management level, and encourage senior management personnel to augment the existing quota of expertise with input from technically knowledgeable peers and subordinates, and to increase their own exposure in this area whenever possible, particularly with regard to new petroleum-related technologies. COGLA and CCG should also place emphasis on industry-related and technical expertise when choosing and training personnel for inspectors' positions.