COASTAL PROTECTION VESSELS – RECENT DEVELOPMENTS

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This paper describes the development of a new class of Coastal Protection Vessels derived from a well-proven range of offshore standby vessels. These ships are flexible multi-role ships capable of providing emergency towing, firefighting and pollution control as well as general law enforcement, task-force co-ordination and survivor facilities. Sustained speed and long endurance in rough weather combined with a low crew-size, aviation facilities and fast rescue boats all contribute to a flexible government response capability complementary to the current classes of Customs Cutters, Research Vessels and Offshore Patrol Vessels. A range of Coastal Protection Vessels have now been delivered to a number of customers worldwide with more ships currently under construction. This paper provides an update to that given at Pacific 2008.

KEY WORDS

Coastal; Protection; Vessel; Ice; Towing; Fire-fighting; Accident

INTRODUCTION

In 1967 a Nation's jurisdiction over its adjacent sea was increased from a 3-mile limit to a 12-mile limit (measured from the low waterline). The water lying within this limit is considered the sovereign territory of the controlling nation who then has rights over national security and customs affairs. Foreign ships however have 'rights of innocent passage' provided they are flying their nation's flags and are 'exposed' i.e. submarines are not allowed.

The Exclusive Economic Zone, or EEZ, is an area beyond and adjacent to the territorial sea under which the rights and jurisdiction of the coastal state and the rights and freedoms of other states are governed. The EEZ is regulated by the 1982 United Nations Convention on the Law of the Sea **[1]** that came into effect in 1994. Part V of this convention describes the rights of the coastal state in the EEZ as 'sovereign rights for exploring and exploiting, and conserving and managing the natural resource of the waters superjacent to the seabed and of the seabed and its subsoil'. Jurisdiction is provided for the establishment and use of artificial islands, installations and structures; marine scientific research; and for the protection and preservation of the marine environment. The EEZ extends up to 200 nautical miles from the low-water line or to the continental shelf, whichever is nearer.

Part VI of the UN Convention concerns the Continental Shelf where it extends beyond 200 nautical miles. The rules and requirements to be met by Part VI are complex but once a state achieves agreement from the UN Commission it has the rights to exploit its natural resources located on or under the seabed, including oil, gas and minerals. Under UNCLOS PtVI, nations have the possibility to claim the continental shelf up to 350 nautical miles from their low water mark, or up to 100 nautical miles from the 2,500 m isobath, whichever is the greater. To date, claims have been lodged by Australia, Barbados, Brazil, France, Indonesia, Ireland, Mexico, New Zealand, Norway, Russian Federation, Spain, and the UK (ref Commission on the Limits of the Continental Shelf CLCS – 17th June 2008). All claims are required to be submitted by May 2009. Ireland, in 2007, became the first nation to receive from the 'UN Commission on the Limits of the Continental Shelf' confirmation that it could extend its jurisdiction to its South West beyond the 200 miles of its EEZ **[2].** In Ireland's case the additional territory amounts to some 39,000 square kilometres.

The 12-mile 'sovereign territory', the 200-mile EEZ and now the continental shelf have led governments to respond by procuring assets capable of performing customs, coastguard and general policing and constabulary activities. Nations carry out their responsibilities through a wide and often diverse range of organisations including fisheries protection services, customs services and navies using a wide range of assets, both air and sea based, to do it. With an view on the current global terrorist threat, the security of coastal populations, and marine pollution, some nations are restricting access to their EEZ. In many cases this is approved by IMO or other regional or global organisations **[3**]. To successfully implement EEZ management and coastal security many nations are consolidating their various authorities under one co-ordinating command or integrating them into a single Authority. The Australian Joint Offshore Protection Command, established in 2005, is an example**.**

Four types of sea-based assets are normally used. They are:

- Customs Cutter – this vessel has to implement a nation's sovereign territory responsibilities within the 12-mile limit - they tend to be relatively small 10-40m with limited range and no organic aviation.

- Research/surveillance vessel - these vessels conduct the marine scientific research defined by the convention – they are larger than customs vessels (generally over 40m), are quiet in operation with good seakeeping and long endurance for patrol in the 200nm zone. They are not required to intervene where disputes occur or laws are being broken and hence are unarmed. Because they have no pursuit role they have a relatively low maximum speed and again no organic aviation.

- Offshore Patrol Vessel (OPV) – these vessels are normally operated by the country's navy or its Coastguard and because it delivers law enforcement (of the Convention's rights) within the EEZ the vessels tend to be (lightly) armed and more warlike in appearance. OPVs will tend to be larger than research vessels due to the requirement for inorganic aviation (i.e. land a helicopter but no other facilities such as a hangar). Sometimes there is a need to provide organic aviation. The flight deck length can be a significant ship size driver and as ship motions can be a limiting factor for air operations, OPVs tend to be relatively large. OPVs are also required to pursue ships in order to enforce the law within the EEZ, and therefore normally have higher speeds than the types of ships that are likely to be transgressing the law. In the case of the EEZ this is usually fishing vessels. Sustained speeds of 15 or 16 knots in high-sea states with sprint speeds of 20 or 21 knots are generally considered sufficient. Damage to the OPV can be expected particularly during boarding or in worst cases being rammed. So these vessels are designed to meet naval stability standards and are more robust in collision than a naval combatant.

- Ocean Capable Patrol Craft (OCPC) – with security concerns having increased significantly recently and the rights to engage in naval activities in other countries EEZ remaining a controversial topic: different interpretations of the use of weapons, surveillance and hydrographic activities are held by different countries. This had led to a new class of Patrol Craft more closely resembling a naval corvette with significantly greater armament and higher pursuit speeds.

- Patrol, surveillance and policing the EEZ even in the ice, as well as the continental shelf where it extends beyond the 200 nm zone, is about exerting 'sovereign rights'. The Canadian Prime Minister Stephen Harper in relation to the Canadian Arctic put it as 'use it, or lose it' and to this end Canada is following Norway, Iceland, and Denmark with a new class of Ice-Capable sovereignty enforcement patrol vessels. Similar interest is being shown by nations in respect of the Southern Oceans and the Antarctic.

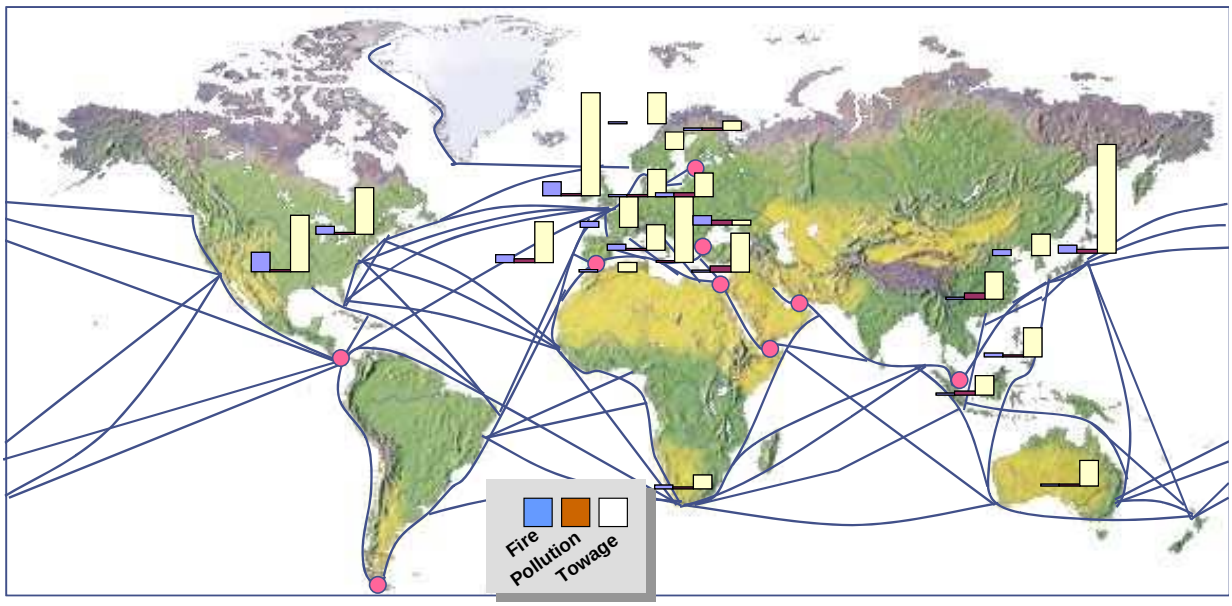

Figure 1 Principal trade routes and maritime accidents by type shown by country or region (Data is IMO published data for 2001 to 2003 inclusive)

The four ship types are about ensuring sovereign rights are maintained but an area which can significantly affect the value of the coastal territory is the containment or prevention of marine accidents and minimising the after effects of any incident. These accidents have no respect for national boundaries. In order to prevent these incidents or to contain any after affects a different class of vessel is required - one which has capabilities such as high bollard-pull for towing of stricken vessels, fire-fighting, and pollution control as well as disaster relief, in the case of a significant number of casualties. Such vessels are, as a secondary capability, often capable of delivering other roles including general law-enforcement and fisheries patrol as well as exhibiting presence, particularly in rough seas, as a means of enforcing sovereignty. This paper describes a range of Coastal Protection Vessels (CPV) developed to meet this growing requirement.

MARITIME ACCIDENTS

Marine accidents within, and outside of a country's EEZ have the potential to cause considerable damage to the marine life and to the coastal eco-system as well as to passengers and crew aboard any stricken vessels. Constant vigilance coupled with the ability to respond rapidly, ideally before such an emergency becomes a disaster, requires a new class of vessels designed specifically for the task and sufficiently multi-capable to be able to deal with a variety of potential disasters. Figure 1 shows the principal trade routes of marine traffic around the world and it is little surprise that accidents are concentrated off the coasts of particular countries.

Analysis of these accidents shows that most require emergency towage. Of course timely intervention by a suitably equipped towing vessel can prevent an emergency becoming a crisis but fire on the stricken vessel and any pollution from that vessel can have a quite disproportionate impact on the local marine ecosystem and any dependant industries. Both fire and pollution incidents identified in the figure leave little doubt that this is an issue that needs addressing.

The traffic in figure 1 however shows the routes used currently. Increasingly, however, it is expected that more trade will cross the Arctic – Figure 2. It is interesting to note that in the early nineties, ice-class tankers made up only about 3% of the global tanker fleet, today that figure exceeds 10%. Short voyage ice-class tonnage trade is predominantly Baltic to Western Europe but long voyage trade will involve North America and the Pacific regions including Sakhalin, Japan, Korea and India. **[4]**

CHARACTERISTICS OF A COASTAL PROTECTION VESSEL

The characteristics required of such emergency response vessels are those developed following recent marine accidents. These include: emergency towing capability (bollard pull); fire-fighting; pollution control – oil spill containment, skimming and processing capability; and survivor facilities for people recovered from the sea or from the stricken ship.

Ship speed is important for timely response to the emergency but the required hull characteristics for a fast vessel are not always in line with the characteristics required for high bollard pull or for pollution control. Vessels speeds of 18 to about 20 knots are seen as achievable. As mentioned earlier, with trade routes changing due to global temperature changes, ice capability is becoming increasingly important.

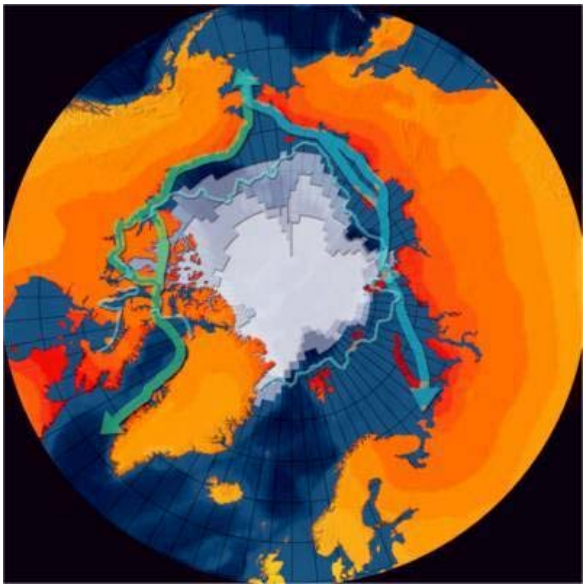

Figure 2 Arctic ice melt will open up new trade routes (Picture is from ACIA)

Environmental issues are also to the forefront of the CPV. This includes: Clean Design - No liquids to hull / No waste and grey water emission to sea, Low NOx emissions, and the right environment for the crew onboard in general

Emergency Towing

Most Offshore Patrol Vessels are specified as being required to tow a vessel of similar size in a moderate sea state. This requirement has little impact on the vessel's propeller characteristics required for maximum speed but equally will make little impact on a stricken oil tanker which is likely to be many times greater in displacement. High bollard pull,

required by Coastal Protection Vessels, is the delivery of thrust at low speed and influences both the propeller diameter, any nozzle and the hull-lines aft in order to achieve good water inflow conditions. Figure 3 shows emergency towing of the stricken containership Napoli by two French UT515 CPVs.

Figure 3 – The stricken container ship MV Napoli under tow by two UT515s off the coast of Devon, UK.

Fire-Fighting

A significant number of marine accidents are due to fire. In order to address fire at sea the Coastal Protection Vessel will need to deliver water onto the stricken vessel from alongside or from standing-off some distance. Figure 4 shows a UT 512 with fire monitors in action.

Figure 4 – A UT 512 CPV deploying significant fire-fighting assets

Three standards of Firefighting capabilities are defined by Class Societies which are:

'FiFi I' - vessels are equipped with at least two monitors that in total have a discharge rate of 2400 m^3/hr. The monitors are able to throw water to a height of 45 metres and to a minimum of 120 metres distance.

'FiFi II' - vessels are equipped with three or four monitors that in total are able to deliver 7200 m^3/hr a distance of 150m and to a height of 70m.

'FiFi III' - vessels have three or four monitors capable of delivering 9600 m^3/hr a distance of 150m and to a height of 70m.

Pollution Control Operations

Figure 5 – Deploying pollution control booms around the stricken MV Napoli

In the case of stricken vessels the oil spill source will be known. But often oil spills will arise either before the vessel is known to be in danger or from some other cause. In these cases the detection of the pollution from airborne assets becomes important. Once oil is spilled, mechanical containment by booms, usually deployed by small boats, and mechanical recovery or skimming provides the means of containment and recovery. Effective coordination of the pollution incident means that any Coastal Protection Vessel will need to be equipped with extensive command, control and communications capability. Figure 5 shows the deployment of pollution booms around the MV Napoli.

COASTAL PROTECTION VESSELS

Coastal Protection Vessels have been delivered into a number of key geographical areas. These are owned and operated on a country-by-country basis. Ownership of the assets vary with some privately owned and operated on behalf of a coastguard agency and others owned and operated directly by coastguard agencies and even by navies.

Emergency Towing Vessels

The United Kingdom's Emergency Towing Vessel (ETV) scheme aims to protect the country from marine pollution arising from drifting disabled ships. *Anglian Princess* and *Anglian Prince*, operated by Klyne Tugs are UT 719-T designs with a bollard pull of about 180 tonnes. Built at the Yantai Raffles yard in China, they are now on long-term charter to the UK's Maritime and Coastguard Agency. *Anglian Princess* is based in Dover and is shown in figure 6.

Figure 06 – *Anglian Princess* UT 719T

The design is a development of the basic UT 719 platform. To date, seven vessels have been built as multi-functional tug supply vessels, with a further three on order. Two more have been built under the UT 719-R label as field safety standby vessels for the North Sea.

The Klyne Tugs UT 719-T is optimised for towing and anchor handling but also has a substantial supply capacity and a FiFi 1 firefighting outfit. It is 67.4m long, has a beam of 15.5m and a design draught of 5.2m. Built to Lloyd's Register class +100A1+LMC, UMS, FiFi-1, it is powered by two medium speed engines providing 6,000kW. Maneuverability is high with two independent high lift rudders and two 600kW tunnel thrusters at the bow and a single 900kW unit at the stern.

The Australia government finalised in August 2006 a long term charter of Swire Pacific's UT738 'Pacific Responder'. The ship is to be based in Cairns and will provide emergency towing services covering the Northern Great Barrier Reef and the Torres Straight region. It is 64.3m loa with an 80t bollard pull and has been modified for its new ETV role. The R class is shown in figure 7.

Figure 07 – UT 738 'R' Class *Pacific Responder*

Pollution Control Vessels

Two powerful towing and pollution prevention vessels have been built at the Zamakona shipyard for the Spanish marine safety agency SASEMAR (see figure 8). These vessels are a derivative of the UT 722L offshore design and have a main engine power of 16,000kW giving a bollard pull in excess of 220t. Several types of oil skimmer system are fitted, in conjunction with a very large capacity for recovered oil - 1,700m^3. In addition to a large towing winch there is a foredeck winch and fenders for escort work.

Figure 8 – UT 722L Emergency towing and pollution control vessel for Spain showing oil booms extended.

Multi-Purpose Coastal Protection Vessels

Multi-Purpose Coastal Protection Vessels are designed to undertake a variety of coastguard and EEZ management roles including standby and rescue, firefighting, salvage and also general law enforcement and fishery control.

Four countries have recently acquired multi-purpose Coastal Protection Vessels. France has acquired the UT 515, Norway the UT 512, Iceland the UT 512L, and India the UT 517. These vessels share similar characteristics.

Figure 9 – UT 515 CPV for France combines very high bollard-pull with a high ship speed.

France. Type-numbered UT 515, these 80m-long vessels combine towing, salvage, coastguard and safety standby capability. An installed power of 16,000kW (4 x 4,000kW diesels) provides a bollard pull of about 200 tonnes (tanker assistance up to approx 300,000 dwt) and a speed of 19.5 knots. The ship is designed to ICE C and includes Fi-Fi 2 with a 500m^3 oil recovery tank. Accommodation is provided for 25-35 with two fast rescue craft launched by heave compensated davits. The ship is shown in Figure 9.

The Les Abeilles company in Groupe Bourbon operate these ships on a long-term charter to the French Navy. The ships were built at Myklebust Verft, one of the Kleven Maritime yards in Norway.

Norway. The UT 512 design for Norway *K/V Harstad* is from the same family as the UT 515 and has been acquired by Remøy Shipping for charter to the Norwegian Coastguard for a comparable coast protection role. The vessel was built at Aker Søvikness on the West coast of Norway.

K/V Harstad (see Figure 10) is designed and fitted for emergency towing of tankers up to about 200,000dwt and has a full outfit of oil-spill control equipment with a tank capacity for recovered oil of more than 1,000m^3. It has twin 4,000kW diesels enabling a bollard pull of about 110tonnes and a ship speed of about 18.5 knots (19.5knots optional) to allow the vessel to reach the scene of an accident quickly. As its roles include patrolling, the ship has fast boarding/rescue boats, a gun on the foredeck and a comprehensive civil and military communications system. Like other Norwegian coastguard vessels the crew of 26 will be a mix of civilian and military personnel. The vessel is 83m long and is on a long-term charter to Kystvakten.

Figure 10 – *K/V Harstad* UT 512 is in service with the Norwegian Coastguard as a multi-purpose Coastguard Vessel. Ship's armament is not shown in this photo.

Operating along the full length of Norway's coastline and throughout the country's exclusive economic zone involves much time in the Barents Sea, so ice 1B class was been specified, along with anti-icing measures such as heated shelters for the two MOB/boarding boats.

Figure 11 – *K/V Harstad* UT 512 deploying the NATO Submarine Rescue System (NSRS).

For towing and emergency work this particular UT 512 design includes a towing winch, a reinforced pushbow, Fi-Fi 1 fire-fighting systems, a hospital and an extensive range of ancillary equipment including line-throwing gear, a harpoon system for attaching tow lines, oil spill booms and skimmers and a 1,000m^3 of tankage for recovered oil.

KV Harstad has also been adapted to launch and recover the NATO Submarine Rescue System (NSRS). Figure 11 shows the ship deploying the NSRS. The NSRS is a system for rescuing personnel from damaged and sunk submarines. The system is air transportable and can be mounted on a pre-prepared vessel like *Harstad* in 1 – 2 days.

Iceland: Iceland have recently ordered a UT 512L version to undertake tanker assistance (up to approximately 200,000dwt), towing/salvage, fire-fighting, oil recovery, and general law enforcement. The vessel at 93.65m is about 10m longer than the standard UT 512.

Twin 4500kW diesel engines deliver the 100t of bollard pull and a ship speed of 19.5knots. Oil recovery tanks are 640m^3 and two 1,200 m^3 monitors provide the Fi-Fi 1 capability. An artist's impression of the vessels, currently under construction at the ASMAR yard in Chile, is shown in figure 12.

Figure 12 – UT 512L Iceland Coastguard Patrol Vessel.

India: A predicted 100% increase in oil demand in India over the next 20 years will radically increase tanker traffic in India's EEZ. The Indian Coastguard is building three vessels at the ABG shipyard in Surat to counteract potential marine incidents. The Rolls-Royce UT-517s (figure 13) are 94m-long vessels designed to carry out the following tasks:

- Pollution Control
- Surveillance and Law Enforcement
- Anti-Smuggling
- Fishery Protection
- Search and Rescue
- Data Collection
- Assistance with Salvage and Firefighting

The ships carry a medium-sized helicopter and are equipped with oil booms and skimmers. The recovered oil capacity on-board is 500m^3, can be provided on board or by transfer to inflatable barges that can be towed astern.

The UT 517 is capable of speeds greater than 20 knots with power provided by an innovative hybrid electric propulsion system with two 3,000kW diesels and twin 2,300kW electric motors; this system being ideally suited to the very varied operating profile of such a ship. It has an endurance of 6,000 nm at 14 knots.

The ship is arranged as a single deck vessel and designed to meet two-compartment vessel rules according to UK Naval Engineering Stability Standards for Surface Ships. Engine rooms are arranged amidships with accommodation sited in the forward part of the ship. The ship has a maximum draught of approx. 4.50m and a design / operation draught of 3.80m.

Helicopter deck and helicopter hangar is aft of the deckhouse, over the oil recovery tanks. The main deck aft is arranged as the Pollution Control deck with a free area of approx. 28.5x15 m with tanks for storing and separation of oil from water located aft of the deckhouse. Oil recovery pumps and separating capacity is based on a separation of approx. 300 m^3 oil and water in an hour. Oil recovery sweeping arms with oil skimmers are arranged port and starboard under the helicopter deck and are operated with hydraulic driven launching davits.

The vessel is capable of operation in sea states up to 6, and is capable of helicopter operations up-to sea state 5.

The ships accommodation is arranged for a total of 111 persons.

No special measures to reduce Radar Cross-section, Infra Red Radiation or Under Water Noise Signature are included.

Figure 13 – UT517 Indian Coastguard Pollution Control Vessel.

ICE-CAPABLE PATROL VESSELS

With changing climate and an increasing interest in the extended EEZ allowed by part VI of UNCLOS, northern navies have acquired or are showing considerable interest in ice-capable Patrol Craft. The Arctic Ocean ice is melting, the North-West passage will soon be navigable for substantial parts of the year, and the whole region is rich in minerals, oil and gas.

Norway has built and is operating the Svalbard ice-breaker patrol vessel and also the UT 512 KV Harstad, Iceland is acquiring two UT 512L ice-capable vessels, Greenland (Denmark) has an ice-breaker patrol vessel recently delivered, and Canada has an urgent requirement for six to eight ice-capable Arctic Patrol Vessels.

Greenland: has acquired two 71m NVC 810 ice-capable Knud Rasmussen class 1,720t Inspection Vessels or OPVs (figure 14) for the North Atlantic and Arctic waters.

The ships are capable of operating in areas of 0.5m unbroken ice and is classed to ICE-1A with ICE-1A* for hull structure. Crew is normally 18 with accommodation provided for 45 persons in a gas tight citadel.

The ships were designed by Rolls-Royce in conjunction with Karstensens Shipyard who built the ship. A high top speed of 17 – 18 knots is available, in order to cover the very significant patrol areas in Greenland waters. Two 0.5 calibre machine guns are the normal armament but as the ship has been built to 'Stan-Flex' options exist for 76mm gun, Evolved Sea Sparrow, and anti-submarine torpedoes. Medium size helicopters can land but no hangar is provided.

Figure 14 – NVC 810 Denmark/Greenland Ice-Capable Inspection/Patrol Vessel.

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REFERENCES

1 United Nations Convention on the Law at Sea, Third, 1982
2 Ireland can extend territorial waters, Irish Times, 07/04/2007
3 The battle for the next energy frontier; Yenikeyeff S M, and Krysiek, T F – Oxford Energy Comment August 2007
The disappearing right to navigational freedom in the exclusive economic zone; van Dyke, Jon M. 2005 Elsevier
4 Duggal MNI, Marine Manager, Sanko Kisen, USA). Ice Strengthened Ships and Ice-rules