PATRAM 2013
Transport of Nuclear Material by Sea: Challenges for a Coastal State

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Key words:
Transport of nuclear material, MOX, irradiated nuclear fuel, high level waste, confidentiality, communication, emergency preparedness, physical protection.

Abstract
Transports of nuclear material have taken place for a long time along different routes and for different purposes. Although there has not been a major accident during the transport of nuclear material, some routes have proven too onerous as a result of security concerns, requiring longer less-direct routes to be used. The result has been that transport operations are often not optimized from a coastal states perspective.

The expectations from a coastal state for information about nuclear shipments are discussed in relation to the need for confidentiality and for contingency planning. Relevant examples from both Norway and New Zealand are given, showing the need for further development of routines and procedures for information sharing and emergency preparedness. This also extends to the transport of other types of dangerous goods, as shown by the examples given.

Introduction
Norway and New Zealand are both coastal states without nuclear power plants, relatively small populations, long coastlines and pristine environments. Tourism and fisheries are important industries. As such, both Norway and New Zealand are particularly concerned to ensure that transports of nuclear material are safe and secure, and that stakeholders are able to respond appropriately to any accidents or incidents. Both countries consider communication to be an essential component of safe and secure nuclear transports and note that the pressure from political leaders, the public and the media for timely information is also relevant. New Zealand and Norway acknowledge the inherent conflict between confidentiality for security purposes and transparency for safety and emergency preparedness purposes. At the same time, however, they note the very real concerns of the public with respect to nuclear transports and the legitimate interest of coastal state Governments in receiving timely information about them. They also note that confidentiality alone is not sufficient to ensure the security of a nuclear transport and should not be used to justify inadequate communication with coastal state Governments.

International and national laws, regulations and agreements between states
The international law relating to the transport of nuclear material is complex and involves a balancing of the rights of the shipping states (for example freedom of navigation), the rights of coastal states (for example the right to notification) and the duties of all states (for example to protect the marine

environment and to engage in search and rescue). The safety of the transport is governed by the International Maritime Dangerous Goods Code (IMDG Code) and the INF Code for irradiated nuclear fuel. However, these Codes do not contain a specific requirement to inform the coastal state about the transport, as long as the transport is outside the territorial waters of the coastal state. The Convention on the Physical Protection of Nuclear Material prescribes confidentiality and discretion as means to enhance the security of the transports.

To enhance the trust and openness between shippers of nuclear material and concerned coastal states, there are agreements between some of the shipping states and some of the coastal states to give information about the transports and when they will pass in proximity to coastal state waters. These agreements are not fully comprehensive and sometimes overlooked.

There have been a number of attempts to resolve outstanding differences between shipping and coastal states. For example, in 2012 a working group was established under the auspices of the International Atomic Energy Agency to develop best practice guidelines for voluntary and confidential Government to Government communications on the transport of spent fuel, MOX fuel, High Level Radioactive Waste and Irradiated Nuclear Fuel by sea. This group is still working on draft guidelines and is taking into account a range of views on the appropriate timing and level of detail of any Government to Government communication. The report of the Working Group will be presented to the informal dialogue meeting between coastal- and shipping states in the margins of the IAEA General Conference in September 2013.

Material of interest
Materials at both the front and back end of the nuclear fuel cycle are transported, and all transports have the potential of being subject to public concern. However, the transports related to the back end of the cycle pose the largest risk to the environment and the public. These are the transports of irradiated fuel, spent nuclear fuel, mixed oxide fuel (MOX), or high level waste, all of which are subject to regulation by the INF Code in addition to the IMDG Code.

In addition to the transport of nuclear material, there are numerous shipments of radioactive materials for medical and industrial use. The risks posed by these shipments are considerably less than for the INF classed material and raise less public concern.

Experience
Although there have been a number of incidents during the transport of nuclear material there have been no major accidents so far. While acknowledging this safety record, Norway and New Zealand remain concerned that accidents or incidents may affect future transports of nuclear material. As a result of selected transport routes proving too onerous, some shipments follow an extraordinary long route, or land transport has been substituted by much longer sea transport, often in treacherous sea conditions. Transport operations are not optimized.

A coastal state is often unaware of nuclear material shipments, even if they are passing close to its territorial waters. However, the stakeholders expect that all the states involved should be able to act promptly if the vessel gets into trouble, even without prior knowledge about the risks posed by the cargo or about the emergency response capabilities of the vessel itself.

Some relevant examples from Norway and New Zealand are given:

- A ship transporting spent nuclear fuel to Murmansk requested a license to call at the port of Stavanger (Norway) to bunker fuel oil. The request came in on a Friday afternoon requesting to call at the port on the Saturday morning. To issue a license for this type of request at such short notice is extremely challenging. If the Norwegian authorities had been given reasonable notice in advance, it could have expedited the request. As the ship had a Danish flag, it called at a port in Denmark to bunker fuel.

- A ship that had transported spent nuclear fuel to Murmansk experienced problems along the Norwegian coast on its return journey without nuclear cargo. The ship had to call and go into port in Hammerfest (Norway) due to a leakage in the engine room.
- In 2011 a container ship, the *Rena*, ran aground on the Astrolabe reef off the Bay of Plenty, New Zealand. The ship was carrying 1,368 containers, eight of which contained hazardous materials, as well as 1,700 tonnes of heavy fuel oil and 200 tonnes of marine diesel. Rescue and salvage attempts were hampered by bad weather and within about a week the ship had broken up beyond recovery. Numerous containers were lost spreading debris and a 5 km oil slick resulted in the closure of beaches and threatened wildlife and the area's rich fishing waters. The loss of dangerous goods containers generated public and political concern and fuelled media speculation that yellow cake was being carried. The accident was declared New Zealand's worst ever maritime environmental disaster by the Environment Minister.

The examples show that not only severe weather conditions, but human negligence and bad planning may create problems. These are problems which are easier to handle when basic information about the cargo and the vessel's emergency response capabilities is at hand.

Contingency for emergencies
Emergencies which may affect a transport of nuclear cargo span a wide range of possible events from unpredicted extreme weather conditions to acute illness of a crew member to malicious acts concerning theft of nuclear material. The whole range of emergencies may warrant valuable assistance from the coastal state and its emergency services. The different scenarios need to be considered and the adequate measures to be taken need to be planned and exercised. To be able to provide an adequate assistance under different circumstances, the coastal state needs information about the ship and the cargo and the capacities of the carrier to handle possible unplanned situations. This information is also essential to be able to react to unplanned situations as much as practicable within the legal framework of both the flag state and the coastal state.

Some Coastal States such as Norway and New Zealand have comprehensive capabilities in terms of radiological assessment expertise, instrumentation, equipment and response commensurate with credible radiation incident scenarios for those countries. In the event of an incident involving a shipment with nuclear material on board in close proximity to that State there will be a realistic expectation from the local government and public that the local radiological safety experts will be able to provide comprehensive and authoritative advice regarding the radiological situation and how the incident will be managed. In order to achieve this the local assessors would need accurate, timely and comprehensive information on the incident response as it occurs including radiological survey equipment deployed, measurements such as dose rate, surface and airborne contamination results, inspection and test results, remedial protective measures, recovery plans and timescales.

A mechanism for effective communication of this information is critical. There is also significant benefit in developing technical relationships between Shipping and Coastal States up front. This should include a full understanding of the scenarios that are planned for and how the response is expected to operate. Ideally such plans should be exercised.

Furthermore consideration needs to be given to the reality that not all Coastal States have radiation safety infrastructures and expertise or comprehensive emergency response capabilities. Such states are likely to be even more dependent on receiving timely and accurate information from Shipping States in the event of a maritime emergency involving radioactive material, and may also look to trusted partners in the region to verify or supplement that information. This reinforces the case for the development of effective communication mechanisms in advance of an emergency.

Security during transport
All stakeholders concerned have to respect the confidentially clauses in force. However, this is an area where safety and security seem to conflict. The dissemination of information may compromise the security measures taken to protect the transport and its contents.

Publicly revealing the route and time of departure makes it easier for opponents to impede the transport. Today many ships are equipped with tracking devices, which means that the exact position of the ship can be tracked, with much of the resulting data openly available. Although the cargo is not reported in these systems, some ships are known to be more likely to carry nuclear materials than others. As a result, the security of the shipment cannot be ensured by confidentiality alone. Appropriate physical security measures such as escort vessels can provide additional security, and have the potential to enhance the safety of the operation by providing rapid emergency response capability.

To enhance the security of nuclear material and other dangerous goods during transport it is crucial to minimize the total time the material is in transport, and avoid regular movement schedules. It is also of importance to limit to designated officials the advance knowledge of transport information including the dates of the shipment, the ship, route and destination.

Preventing malicious acts during transport of radioactive material is a main concern. Theft of material or terrorist attacks has been an issue, especially since 11 September 2001. The nuclear material is subject to extensive national protection measures. Several protection measures are used during transport. These measures would involve the design of the package, the ship, security clearance of employees, satellite tracking of ship, security forces and possible co-ordination with the state security authorities.

What information would a coastal state expect?

- the name and type of the vessel
- the date and port of its departure
- the planned route with the dates and estimated timing and duration of passage through waters in proximity to the Coastal State
- assurance that such vessels would not pass through their waters
- the type of material (nuclides and activity) to be transported and type of packaging
- the safety and integrity standards of transport casks in an accident
- details of the vessel's shipboard emergency plans and details of emergency response procedures for operators following an accident;
- details of the contingency plan if the vessel fails to communicate;
- details of the salvage company which has been retained and of the operational capability which the operator has in place e.g. its response time, the equipment which it could deploy, the expertise on call and the procedures in place for the rescue, salvage or recovery of the vessel and of any dislodged casks etc;
- information on clean-up and liability for any damage arising; and
- details of reporting procedures to Coastal States following an accident.

Conclusion

It is our view that the transport operations are not completely optimized. A closer coordination between safety and security is needed, and we believe that a constructive cooperation between the shippers of INF goods and the coastal states the transport is passing will provide an enhancement of both safety and security in spite of the fact that more information about the transport will be available in the public domain.