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KOMMUNENES INTERNASJONALE MILJØORGANISASJON

LOCAL AUTHORITIES INTERNATIONAL ENVIRONMENTAL ORGANISATION

Report on the Transport of Mixed Oxide Fuel and other Radioactive Cargoes by Ship in Europe (Revised 2006)

In Bergen in 2002 North Sea Ministers clearly recognised the concern about the potential for an accident during the transport of radioactive material by sea.

Paragraph 67 in Chapter 8 of the Bergen Declaration stated that Ministers;

> ***iii) call*** *for further efforts, at the international, regional, sub-regional and bilateral levels, to examine and further improve measures and international regulations relevant to the international maritime transport of radioactive materials consistent with international law recalling maritime rights and freedoms as provided for in the United Nations Convention on the law of the sea (UNCLOS), and;*
>
> ***iv) agree*** *to consider the issue of maritime transport of radioactive material at the ministerial meeting on the environmental impacts of shipping to be held in Sweden in 2006 at the latest.*

Although the international community has taken some positive steps to address the risks created by the movements of ultra hazardous radioactive cargoes important gaps still exist in the regimes that govern these activities. The nuclear reprocessing industry is responsible for some of the most hazardous transport undertaken in Europe today.

It is becoming increasingly likely that in the future, increased quantities of ultra hazardous radioactive cargoes will be shipped within Europe and through the North Sea not in the form of oxide powder but in the form of finished mixed-oxide (MOX) fuel assemblies. The recent announcement by the Swedish Government to allow the Swedish company Studsvik-SVAFO, for first time in more than 20 years, to ship spent nuclear fuel to the British Sellafield plant for reprocessing will further increase the frequency of these shipments through the North Sea. In addition, to the material that was shipped to Sellafield over twenty years ago and which will be returned as MOX, these plans involve shipping a load of 4.7 tonnes of metallic uranium to Sellafield. The reprocessing will generate a total volume of 1600 litres of highly active waste, which will be shipped back to Sweden for final storage. The fuel also contains 1.1 kilograms of plutonium, which will be converted into Mixed Oxide Fuel (MOX), and sent back to Sweden.

There are many issues surrounding these shipments; the current debate over reprocessing at Sellafield, the international regulation of transport, the standard of flasks and ships involved in the transports to name just a few.

The transportation of nuclear and toxic waste by sea is an issue of great concern to members of KIMO as the communities they represent all depend on a clean environment and perhaps more importantly a perception of a pristine marine environment that produces fresh, clean and healthy resources. This is, in many cases, the basis of survival for many small remote rural and island communities. The irreparable damage to this image that could arise as a result of an accident involving a ship carrying nuclear waste could have disastrous consequences on local economies not withstanding the environmental and health hazards that could occur.

The lack of emergency planning in the event of a marine accident involving nuclear material; the questionable integrity of the flasks used to transport nuclear fuel; and evidence that ship borne fires last longer on average and at a more intense heat than the safety criteria used in flask stress tests are major issues for the organisation who have been campaigning for higher standards for many years. The question of liability and compensation in the event of a nuclear accident at sea continues to also be a major concern. KIMO remains convinced that the transport of nuclear materials should be halted and that such materials should be stored above ground at the point of production.

Traditionally MOX has been transported to and from Japan using purpose built vessels that are of the best available technology currently in service. However shipments of MOX to Switzerland have already occurred using the Atlantic Osprey, an ex-roll on roll off ferry, for MOX shipments.

British Nuclear Group delivered the first four mixed-oxide (MOX) assemblies it has fabricated in the Sellafield MOX Plant (SMP) to Swiss utility Nordostschweizerische Kraftwerke (NOK) in the spring of 2005, marking the start of a series of MOX and plutonium dioxide transports from the U.K. to mainland Europe.[1] In a statement issued to a UK local newspaper by BNFL it is likely that a second shipment of MOX will take place in 2006.

Current proposals to ship ultra hazardous radioactive cargoes within Europe on the ex roll on roll off vessel Atlantic Osprey or as recently announced the Swedish ship m/s Sigyn raises serious issues about safety, security and whether Best Available Technology (BAT) is being applied.

[1] Nuclear Fuel / Volume 30 / Issue 12 / June 6, 2005
First SMP-made MOX assemblies delivered to NOK

With significantly reduced safety & security features, how does the Atlantic Osprey compare to other PNTL plutonium fuel carriers? How will the ship meet the tougher standards required under today's increased threat of terrorist action and, given the increased threat, how can the international trade in prime nuclear-bomb material be justified any longer?

Information supplied by the PNTL illustrate some significant differences in the levels of protection (safety and security) applied to the 1999 MOX shipment from the UK (Barrow) to Japan on the Pacific Pintail and Pacific Teal with those intended for MOX shipments from the UK (Workington) to Europe – despite 9/11 and its aftermath.

The Cargo

" because of its nature (it contains significant amount of fissile materials), MOX fuel is classified in the category requiring stringent measures. Extensive physical measures have been incorporated in the transportation plan for shipping MOX fuel from Europe to Japan to ensure that the ships and their cargo are protected against threats of theft or sabotage "[2]

The Atlantic Osprey will carry the same fissile materials.

The Ship

" *the proposed physical protection system for the MOX transport includes two armed escort vessels* (which) *will sail together each providing an armed escort service for the other* " [3]

No plans for an escort have been confirmed for the Atlantic Osprey. No response times for reacting to a terrorist attack have been provided and in any case any assistance would likely be too late if the attack involved a missile or similar devise.

" the ships will have a broad range of protection systems to deal with any potential threats including naval guns "[4]

In reference to shipments to and from the UK and Japan, military experts say there is a real possibility that the vessels could be targeted by terrorist groups or rogue states intent on acquiring nuclear weapons. They say the guns mounted on the ships are inadequate to fend off a well-orchestrated attack by pirates with superior weapons. In reference to Janes, the internationally renowned arms and naval authority, agrees. *"It would not take much fire-*

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[2] [BNFL information file June 1999]

[3] [BNFL information file June 1999]

[4] [BNFL information file June 1999]

power to knock them out," it said. The ships were "capable of repelling only a lightly armed attack" and should be protected by "at least one well-armed frigate".[5]

The Atlantic Osprey has not been armed with naval guns.

"there are, of course, differences in the detail of the security arrangements between the two types of shipment (to Japan and to Europe), *one of nearly 2 months duration covering many thousands of miles, and one of a few days; but there are no differences in the standards we require BNFL to maintain"* [6]

" because of its nature (it contains significant amount of fissile materials), MOX fuel is classified in the category requiring stringent measures". [7]

The requirement for 'stringent measures' is dictated by the category of the material and not the length or duration of the shipment

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" *the final* (protection) *barrier is the ship itself … classified as an INF3 vessel, the highest safety category of the International Maritime Organisation ..* " [8]

The Atlantic Osprey is classified only as INF2.

" *PNTL's vessels have a number of advanced safety features* (including) *a double hull to withstand damage and remain afloat. These are designed to withstand a severe collision with a much larger vessel without penetrating the inner hull* "[9]

In submissions to the International Maritime Organisation, the PNTL ownership has failed to provide precise details of the double hulling features incorporated into the vessel design and construction. However, despite PNTL claims that the vessels have "double hulls", it is evident that they should properly be described as "only partially double hulled" because the double hulling feature only extends around the cargo hold, leaving the fore and aft sections of the vessels with only a single skin.

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[5] *Independent on Sunday*, 4 July 1999

[6] [OCNS letter to CORE 4.11.02]

[7] [BNFL information file June 1999]

[8] [briefing 2002, BNFL website]

[9] [BNFL information file June 1999]

In this respect the PNTL vessels are not among the top rank of double hulled vessels in the world fleet of hazardous materials carriers which are fully double hulled. They are, in fact, inferior to many.

b. The PNTL ownership have made a number of claims that, because the double hulled design of their vessels provides the ability to "withstand damage and remain afloat", they are therefore effectively "a ship within a ship" and that they have "high reliability and accident survivability".

c. However, evidence from government agencies and other major shippers of hazardous materials makes it quite plain that the double hull design is intended specifically, and only, to protect the cargo and that this task can only be guaranteed in the event of low impact collision or grounding events.

d. Thus the PNTL statements are mistaken and misleading in two respects. Firstly, the double hull design is only intended to protect the cargo space, not prevent the sinking of the vessel. Secondly, the double hull design will not protect the cargo space in anything other than a low energy impact event.

Identified weaknesses of double hull features

a. Since the design programme for the PNTL vessels (1970s) industrial bodies and government agencies have concluded that there have been a number of weaknesses inherent to the first generation of double hull vessels.

These include the potential for gas and moisture build up between the hulls, difficulty in venting that gas and moisture, difficulty inspecting the double hull void space, an enhanced potential for corrosion in the hull space, potential difficulties with repair in the double hull void space and the fact that double hull features are thought to only offer protection in low impact scenarios.

b. In response to these problems at least one major hazardous materials carrier (BP Tanker Fleet) has set about a re-design exercise and commenced the construction of a series of "enhanced" double-hulled tankers in the mid 1990's.

Enhanced double hull tankers include innovations such as: extra structural members to provide greater strength in areas of the hulls where fatigue loads are highest, strengthening of key areas to give a greater margin of resistance against corrosion of the hull void space, use of "Grade D" steel instead of the more usually used "Grade A" steel, gas detection points fitted in the hull void space, venting provisions fitted in the hull space and provision to fill the hull space with explosion/fire resistant inert gases.

In addition to the above, it is also self evident that double hulling and associated collision resistant features would potentially complicate any attempts to salvage the vessel or their cargo.

The possibility of flooding of the PNTLs

a. In it's submissions to the IMO, PNTL claims that even if holed during a collision "holds and machinery spaces could be completely flooded" while the ships could survive without sinking.

In its submission to the IMO this PNTL claim is not supported by any technical data or precise details. This means that the claim is scientifically and technically unjustified and should be regarded as an unsupported, hypothetical assumption. In fact during a visit by members of BNFL National Stakeholder Dialogue Security Working Group (SWG) information was provided that the tanks could not be remotely or automatically flooded but would need to manually flood from the deck. **The effectiveness of this procedure in the middle of a terrorist attack must be questioned.**

b. The PNTL claim fails to discuss the impact of secondary effects of flooding such as: the potential decommissioning of vital primary systems and backup systems (engines, generators, navigating equipment etc.) and the subsequent loss of manoeuvrability, sea- kindliness and the ability to ride heavy seas.

All of these are major contributory factors to many vessel losses, especially as a result of foundering and sinking.

c. No detail of any reference accident, simulation exercises, trials, tests or any hypothetical calculations are given in the PNTL submissions to the IMO. Nor are there any discussions of the performance of the PNTL vessels thus flooded, in different types of weather and sea state. This means that the PNTL claim is scientifically and technically unjustified and should be regarded as an unsupported, hypothetical assumption.[10]

Considering the concerns over double hulls surrounding only parts of the PNTL ships the risks associated with the Atlantic Osprey as a double-bottomed but only a single hull vessel are greater. .

" *conventional ships of this size are normally single engine, single rudder configurations but for the purpose of reliability all* (PNTL*) ships have twin propellers and engines which operate entirely independently* "[11]

The Atlantic Osprey only has one engine.

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[10] A review of aspects of the marine transport of Radioactive Materials. With particular reference to the activities of the Pacific Nuclear Transport Limited (PNTL) fleet (A Report to Greenpeace International) - Tim Deere-Jones BSc.Hons Maritime Studies, University of Wales, Cardiff Marine Environment & Pollution Consultant

[11] [BNFL information file June 1999]

The Transport Container

" this (MOX fuel) plutonium is inaccessible because – the fuel assemblies are enclosed in a specifically engineered 110 tonne cask " [12]

The Atlantic Osprey will use a 5 tonne lightweight box container.

The Port

" *MOX manufactured by BNFL – At the Barrow port, BNFL Transport Division operates a purpose built terminal with a team of Port Operatives experienced in the handling of radioactive materials* "[13]

The Atlantic Osprey will use the Port of Workington. Compared to Barrow (which has high security measures installed due to nuclear submarine operations as well as civilian nuclear trade), Workington Docks is significantly more open and vulnerable, and has fewer safety measures in place.

BNFL has repeatedly defended the 'seaworthiness' of all their custom-built ships on the basis that, given the nuclear cargoes they have to carry, they have all been individually maintained/serviced to the highest levels throughout their operational lives.

The Atlantic Osprey (built in 1986) did not come into BNFL ownership (third-hand – Alster Rapid, Arneb, Atlantic Osprey) until 2001 – i.e. 15 years after it was originally built in Germany as a Ro-Ro cargo ship. For three-quarters of its 20- year operational life, the Atlantic Osprey is unlikely therefore to have received from its previous owners the same level of dedicated attention.

During its short life with BNFL, the Atlantic Osprey has already suffered a number of mishaps including an engine-room fire that disabled the ship in the Manchester Ship Canal. [14]

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[12] [BNFL Separating Facts from Fiction August 2002]

[13] [BNFL information file June 1999]

[14] *CORE BRIEFING* No:01/04 Date: 3rd February 2004

Atlantic Osprey – **now owned by the Nuclear Decommissioning Authority (NDA), the public sector cleanup body that took over ownership of BNFL's Sellafield reprocessing complex April 1. The ship is now managed by International Transport, which is part of Spent Fuel Services, which, in turn, comes under the umbrella of British Nuclear Group.**

Atlantic Osprey (1984)

The Atlantic Osprey is an INF 2 classified multi-purpose general cargo vessel operated by the NDA, which took over ownership from BNFL in 2005. She has a lift-on/off capability through hatches together with drive on capabilities via a stern door which, when open, becomes the access ramp for vehicles. The vessel (formerly known as the Arneb) was purchased by BNFL in 2001 and extensively refurbished to meet its operational requirements. She transports used research reactor fuel and MOX fuel and, unlike the PNTL vessels and the European Shearwater, the Atlantic Osprey is also chartered to transport non-nuclear materials. [15]

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[15] PNTL website

Pacific Pintail (1987)

The Pacific Pintail is an INF 3 certified vessel under the INF Code of the International Maritime Organization (IMO). Like the Pacific Teal, she is fitted with additional security features that enable her to transport MOX fuel and plutonium dioxide. The Pacific Pintail is fitted with fixed naval guns and has other additional physical protection systems, only some of which are visible from the outside. [16]

M/S Sigyn is a specially built ocean going ship, classified for use in ice, for carrying spent nuclear fuel from the Swedish nuclear power plants, together with other nuclear waste. The ship is crewed and operated by Rederiaktiebolaget Gotland on behalf of SKB.

Since the Swedish nuclear power plants are situated on the coast and have their own harbours, the radioactive waste is transported by sea. Each year the ship makes numerous trips between these nuclear power plants, Clab and SFR. m/s Sigyn is owned by SKB, but operated by Rederiaktiebolaget Gotland. She is specially built for transporting radioactive cargoes. The ship

[16] PNTL website

has two 12-man crews, who keep constantly in touch with the tracking station on shore. The ship's position at sea can therefore always be determined.[17]

The ship was launched in:	1982
Length overall:	90.33 meters
Breadth:	18.04 meters
Deadweight tonnage:	2,044 tonnes
Gross tonnage:	4,166 tonnes
Payload:	1,400 ton
Draught fully loaded:	4 meters
Cruising speed:	12 knots
Engines:	2 x 1,170 kW

M/S Sigyn was built in 1982 and is a combined roll on/roll off- and lift on/lift off ship. The ship complies with the SOLAS IAEA regulations. 4-meter wide engine rooms and a four-meter high double bottom surround the cargo area. The walls are enforced by radiation isolating concrete. Although it appears that the m/s Sigyn has some enhanced features such as two engines, a double hull and added protection features in terms of its concrete walls. The flasks that will be used are similar in standards to the Atlantic Osprey.

An illustration that transportation of nuclear wastes even on this ship is not without risk, a Swedish National Radio broadcasting of March 3rd 2004: stated " Sigyn nearly collided" The nuclear fuel ship Sigyn, two weeks ago, nearly collided with a Panama registered tanker in the Strait of Bornholm. The website of Sydsvenska Dagbladet [a Swedish newspaper] wrote that the incident occurred when the Sigyn was going from Barsebäck to Oskarshamn with among other things two containers with high-active nuclear fuel on board. The tanker had a collision course with the Sigyn and did not respond to calls about changing the course. The collision was avoided because the Sigyn commander stopped the engines and allowed the tanker to pass. The distance between the ships were then only 200 meters. The Swedish Shipping Authority considered this to be a very serious incident. http://www.sr.se/ekot/arkiv.asp?DagensDatum=2004-03-03&Artikel=378625

The same concerns must apply to the Sigyn as to the Atlantic Osprey in terms of scuritiy as no information about the secutity arrne,ents on baord have been made avilable. The only information, which could be accessed for this report regarding the Sigyn, was from an internet search.

Transport of U-MOX by Sea

It has been pointed out by many observers on many occasions that the conditions that a radioactive active material (RAM) package may encounter in

[17] http://www.skb.se/templates/SKBPage____8857.aspx

the course of an accident at sea can be far more severe than those simulated by the Type B test.[18]

There are numerous historical examples of shipboard fires of much greater duration than that represented by the Type B test. For instance, some fires have burned for days or even weeks. It has also been noted that the combustion of hydrocarbon fuels can result in considerably higher maximum temperatures --- as high as 1300 degrees C --- than are simulated by the 800 degrees C test. [19]

It is worth noting that the international marine transport of RAM is essentially an unregulated practice. RAM transport was intentionally excluded (as a result of IAEA intervention) from the Safety of Life at Sea (SOLAS) convention, which is a binding international agreement mandating design specifications for ships carrying dangerous goods. The "Irradiated Nuclear Fuel" (INF) Code[20], which was adopted by the International Maritime Organization (IMO) in an attempt to narrow this RAM loophole, is now mandatory. Even under this code, it is acceptable to transport as much as about one tonne of reactor-grade plutonium (e.g. about 40 U-MOX assemblies) on non-purpose-built passenger (INF 2 class) vessels.[21]

In the event that a MOX transport vessel experiences an accident of greater severity than a Type B package is designed to withstand, the amount of material released will be determined by the "graceful failure" behavior of the package. U-MOX packages that use ablative materials for fire protection will not be able to withstand a prolonged fire (greater than a few hours). Of special concern is an accident which first causes the rupture of many fuel rods and is then followed by a long-duration fire. Even if the fire smolders at a low temperature, substantial oxidation of the fuel rods can take place if the package is ruptured or the seals fail. The amount of fuel oxidized would be limited only by the duration of the fire and the availability of oxygen.[22]

Conclusions

It is therefore highly likely that security issues being currently highlighted by a number of concerned organisations need to be considered by North Sea Ministers in relation to a potential terrorist incident involving the Atlantic

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[18] Safety Aspects of Unirradiated MOX Fuel Transport - Edwin S. Lyman

[19] ECO Engineering Inc (Annapolis, Maryland, USA), "A Review of the Proposed Marine Transport of Reprocessed Plutonium from Europe to Japan, March *1992;* E. Lyman, "Safety Issues in the Sea Transport of Vitrified High-Level Radioactive Wastes to Japan," Centre for Energy and Environmental Studies, Princeton University, prepared for the Nuclear Control Institute, Greenpeace International and CNIC Tokyo, December 1994.

[20] The May 1999 amendments were adopted on 27 May 1999 and entered into force on 1 January 2001 (Under tacit acceptance) Amendments to Chapter VII make the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code) mandatory.

[21] Safety Aspects of Unirradiated MOX Fuel Transport - Edwin S. Lyman

[22] Safety Aspects of Unirradiated MOX Fuel Transport - Edwin S. Lyman

Osprey or other vessels carrying ultra hazardous radioactive cargoes through European waters. The reason is straightforward: If there were a successful attack on a maritime transport carrying these cargoes, the consequences would be comparable to those from a severe accident. This is especially relevant in evaluating the critique by BNFL that the consequences projected by many genuine concerns could apply only to highly improbable accidents.

Since September 11 there can be no justification that any scenario should be excluded from assessing the risk to radioactive shipments near coastal zones and through busy and confined shipping lanes. KIMO stresses that if an attack by terrorists succeeds in an incident involving a severe long-term fire, breaching shipping casks and/or sinking a nuclear transport vessel, the consequences would be comparable to the most severe accident that authorities insist is too improbable to be considered. It should also be noted that there are five countries, including Sweden, who have registered carriers of ultra hazardous radioactive cargoes who may operate in Europe. Data obtained from the Lloyd's Register of Shipping shows that, to date, 14 vessels have been built and registered as dedicated Irradiated Nuclear Fuel Carriers, and flagged to five different sovereign states. [Ref 2] [23]

Based on the weight of information from the sources contained in this report and other reports it is clear that in the cases of the Atlantic Osprey and the Sigyn Best Available Techniques (BAT) is not being applied and is a matter that should be of concern for Ministers in May 2006.

In addition under the OSPAR Strategy with Regard to Radioactive Substances Objective I 1.1 states *"In accordance with the general objective, the objective of the Commission with regard to radioactive substances, including waste, is to prevent pollution of the maritime area from ionising radiation through progressive and substantial reductions of discharges, emissions and losses of radioactive substances, with the ultimate aim of concentrations in the environment near background values for naturally occurring radioactive substances and close to zero for artificial radioactive substances"*

Article 2 2.1 under the OSPAR Guiding Principles states *"Assessments made, and the programmes and measures adopted, to achieve this objective will be in accordance with the general obligations as set out in Article 2 of the OSPAR Convention and consequently will involve the application of:*

a. the precautionary principle; (IMO)

b. the polluter pays principle;

c. best available techniques and best environmental practice, including, where appropriate, clean technology.

[23] A review of aspects of the marine transport of Radioactive Materials. With particular reference to the activities of the Pacific Nuclear Transport Limited (PNTL) fleet (A Report to Greenpeace International) - Tim Deere-Jones BSc.Hons Maritime Studies, University of Wales, Cardiff Marine Environment & Pollution Consultant

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PNTL website

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BNFL information file June 1999

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