INTERNATIONAL NUCLEAR SERVICES

Recent experience in the shipment of sensitive nuclear materials using INF3 class vessels

Paul HARDING, General Manager, INS France

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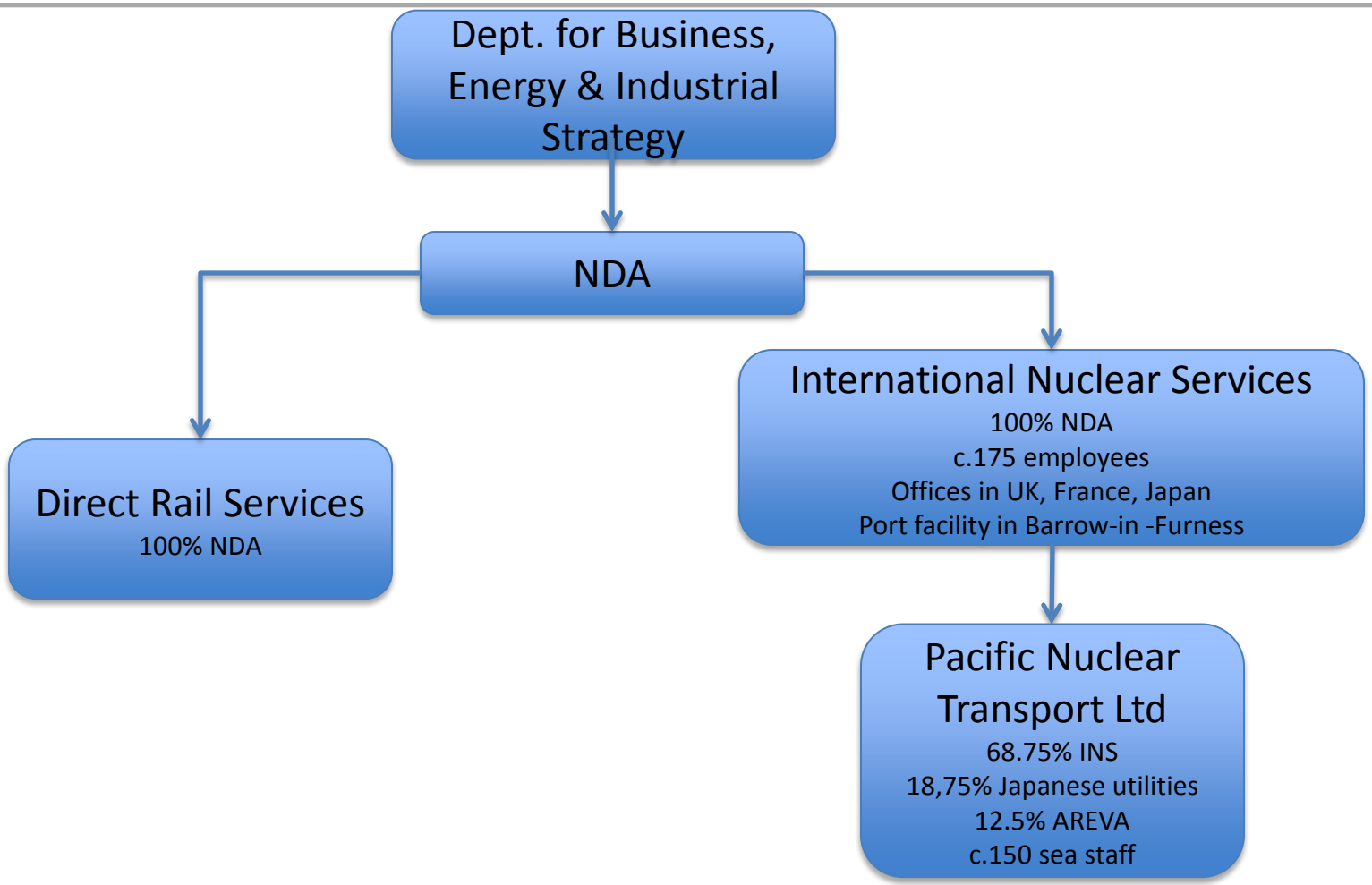
Design • Licensing • Transport

International Nuclear Services: ownership



International Nuclear Services

- UK based, Tokyo office, Paris office for European liaison.
- Design and engineer bespoke transport packages, & access to existing UK/NDA packages,
- Manage all commercial contracts obo NDA.
- Manage the utilisation of all Intellectual Property and nuclear knowledge from 60 years of fuel cycle challenges across 17 UK sites obo NDA.
- Manage and operate 4 x INF-3 ocean vessels.
- Global Emergency Response capability.
- Global Acceptance Program (PR/Coastal States)

The fleet

- INS manages PNTL, plus 3 PNTL and 1 NDA/INS vessel.
- INS operates dedicated Marine(vessel) terminal at Barrow.
- Seafarers employed by PNTL (160+).
- PNTL shareholders – -INS (68.75%), Japanese (18.75%), Areva (12.5%),
- Four INF 3 Class Vessels : 3 Category 1 security capability vessels

Background

- Requirement to transport nuclear materials has existed since beginning of nuclear programmes,
- Operators & CAs have strived to continuously improve safety, and more recently security standards,
- Events such as Chernobyl and Fukushima: further pressure to improve safety throughout industry,
- Global terrorism has increased focus on security / physical protection of nuclear shipments,
- Pressure on consignors and shipping companies to guarantee security of material in transport is unlikely to reduce in foreseeable future,

History – 1969
Leven Fisher - Panama

The first specially designed vessels

- As early as the 1970s BNFL identified the need to develop purpose-built ships for the transport of nuclear material, to enhance safety for ships & crews and to improve safety and reliability of transport operations,

- 1979 saw the commissioning of the very first specially designed PNTL ship - the Pacific Swan, to be followed by a unique fleet of specially designed vessels

Precursors to the INF Code

- The ships were to have two fundamental features:
  - the hull would be divided into many compartments to form a double hull, ensuring the vessel would remain afloat, stable and manoeuvrable even after sustaining significant damage,
  - all essential systems & equipment would be duplicated

- In fact, a host of additional features were incorporated and the PNTL ships already exceeded the requirements of what would later become the INF Code,

INF Code

- The INF Code was introduced as a voluntary code in 1993 and became compulsory in 2001.
- The Code is divided into three categories, INF1, INF2 & INF3, each determined by a maximum level of radioactivity that can be carried by the ship, unlimited in the case of INF3,

Defense in depth: flask design ensures safety of transport…

Designed and licensed to IAEA Transport Regulations for type B package

- 9m drop test, and 1m puncture drop test
- 30 minute all engulfing fire test at 800C
- 8 hr immersion test under 0.9m of water

INF Code; a further level

- The INF Code was developed by IAEA & IMO to define additional requirement for ships carrying irradiated nuclear fuel, plutonium and high level waste, specifically in relation to:
  - Damage stability
  - Fire protection
  - Temperature control in cargo spaces
  - Structural considerations
  - Cargo securing arrangements
  - Electrical supplies
  - Radiological protection
  - Ship management, training & emergency arrangements

INF Code

- BNFL - and INS as we are today - have operated ships in excess of the INF Code requirements since 1979, i.e. some 13 years before the Code was introduced,
- It is with these ships that we have transported spent fuel from Japan to La Hague & Sellafield, MOX fuel and high level waste from Europe to Japan for more than 30 years,

Latest PNTL Vessels
2008 - 2009

INS Experience - Over 40 years of safe transports

5 million nautical miles

(~44 years of time at sea)

~200 shipments/2000 casks

<u>Spent fuel shipments</u>

7500t Japan to Europe

3000t Europe to UK

<u>HLW shipments</u>

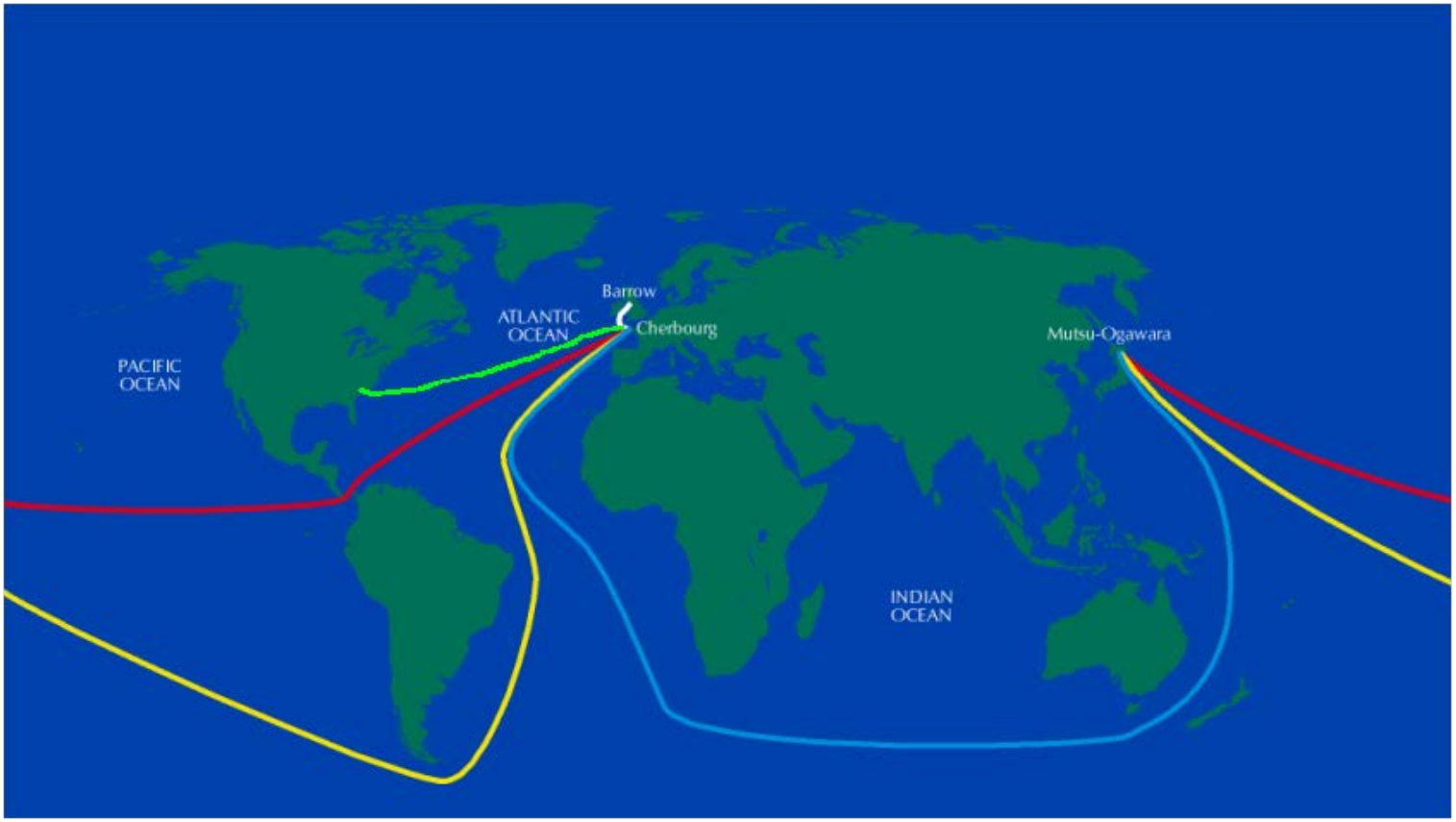
17 Europe to Japan

2 UK to Europe

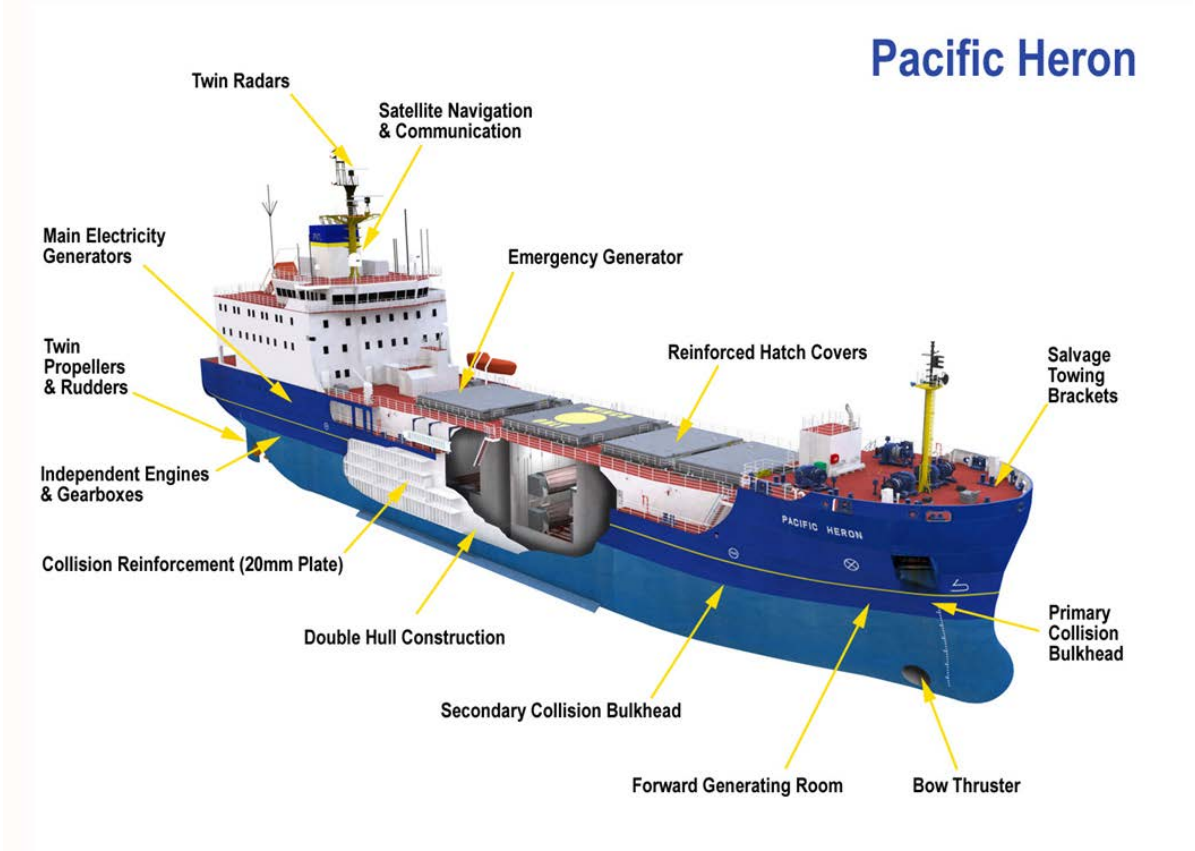
<u>MOX / Pu shipments</u>

A number of shipments between Europe and Japan, Europe and the USA and within Europe.

Transport Routes



IMO INF3 Class Ship Design



Animation: INF3 Class Ship

Security

Security requirements for transport derive from international conventions agreed at the IAEA

Convention on the Physical Protection of Nuclear Material (INFCIRC/274/ rev 1) – CPPNM

Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/ rev 5)

Level of protection depends on quantity and type of nuclear material

Cat I is highest and armed guards are recommended

Security Principles

- Minimise total time in transit
- Minimise number and duration of transfers (eg road to rail)
- Avoiding predictable schedules
- Limiting knowledge to those who need to know
- Using routes away from areas of unrest or natural disaster
- Avoiding bottlenecks
- Varying the route used

Security Cat I

Specially trained UK team of Civil Nuclear Constabulary (CNC) armed officers

High security locks

Sophisticated alarm / access control system

Dedicated encrypted communications

Surveillance systems

Personal & fixed weaponry

Recent transport experience

- The U.S. government in its drive to reduce the risk of nuclear proliferation – through the GTRI/M3 (Material Management and Minimisation) has recently supported a number of transports of sensitive nuclear materials, whilst maintaining an acute focus on the need to maintain & reinforce nuclear security,

- In response to this we have made our INF class vessels available for a number of shipments between research centres around the world and the U.S. as part of the GTRI/M3 programme,

First ever separated plutonium shipment under GTRI

- In March 2012, INS undertook the marine transport of three kilograms of separated plutonium from Sweden to the US for permanent secure storage. This was the first transport of its kind, carried out with the utmost discretion and on our INF3 vessel, Oceanic Pintail.

- This shipment was undertaken on a greatly accelerated timescale and was completed prior to the Nuclear Security Summit in Seoul, Korea. It was held up as an example of Sweden delivering on its non-proliferation commitments at the summit, which was attended by world leaders.

INS plays another key role in international non-proliferation mission

INS recently played a key role in a collaborative effort to transport approximately 20 kilograms of separated plutonium from Switzerland to the United States.

The successful transport was undertaken by our INF3 vessel the Oceanic Pintail.

In a statement the US Department of Energy's National Nuclear Security Administration (NNSA) highlighted the "significant contribution of the United Kingdom's International Nuclear Services, which provided the secure transport of the material from Europe to the United States".

We continue to support US DOE / NNSA in various worldwide initiatives to remove and transport sensitive nuclear material.

Japanese research reactor materials arrive in USA

WNN 7 June 2016:
A shipment of plutonium and highly enriched uranium from Japan Atomic Energy Agency's (JAEA) Fast Critical Assembly reactor has arrived at two US DoE sites. Japan and the USA announced their commitment to remove the material at the 2014 and 2016 nuclear security summits.

The Japan Times, 7 June 2016:
The British-flagged Pacific Egret & Pacific Heron were carrying 331 kg of weapon-usable plutonium. About 236 kg, used for nuclear-reactor testing in Japan, originated in the United Kingdom, while around 93 kg is of U.S. origin and 3 kg is of French origin, according to Savannah River Site Watch, a non-governmental organization tracking the shipment.

Conclusions

- These shipments are now a matter of public record, and have been carried out to exemplary safety and security standards. A record of which INS is very proud and constantly strives to maintain.

- The need to transport nuclear and sensitive materials is growing, as is the pressure on operators to continually reinforce safety & security,

- There is increasing sensitivity & focus of public attention, and many conventional shipping companies are becoming reluctant to carry Class 7,

Conclusions

- The availability of our specialist INF 3 vessels for a wider range of transport operations now enables INS to offer customers on a global basis the advantages of an INF class vessel in terms of maritime safety, security and the inherent positive public perception associated with the use of purpose built INF ships – helping consignors, shippers & Competent Authorities to demonstrate that we, as a transport industry, are adequately addressing safety, security & reliability, alongside the growing challenges of public perception from our stakeholders & from the media.