Emergency Response Arrangements for the Transport of Irradiated Nuclear Fuel From Japan to Europe

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INTRODUCTION

Pacific Nuclear Transport Ltd (PNTL) a subsidiary of British Nuclear Fuels plc (BNFL) was established in 1975 to transport irradiated nuclear fuel from Japanese nuclear power stations to reprocessing plants in Europe. BNFL owns 62 1/2% of the PNTL shares with the remainder being held by Japanese and French companies. PNTL owns and operates its own fleet of five purpose built ships specially designed for the transport of irradiated fuel flasks: the Pacific Swan (operational from 1979), Pacific Crane (1980), Pacific Teal (1982), Pacific Sandpiper (1985) and Pacific Pintail (1987). The 33,000 mile round trip to Japan begins and ends at BNFL's Marine Terminal at Barrow in Cumbria. The flasks are off-loaded directly from the ships to BNFL owned rail wagons and are then transported by rail to Sellafield. Whilst the probability of a serious flask incident involving the release of radioactivity is very small it is nevertheless important to plan for such an emergency. Indeed the International Atomic Energy Agency Regulations (IAEA 1979) require that such plans be established. This paper describes the BNFL/PNTL emergency response arrangements.

TRANSPORT OPERATIONS

BNFL/PNTL have been transporting irradiated nuclear fuel from Japan for 20 years. Initially specially converted ships were used but now the PNTL fleet comprises five purpose built ships. The design of the ships incorporates many safety features which include, strengthening of the hull against collision impacts, watertight subdivisions to give adequate reserve bouyancy, additional fire fighting equipment of a particularly high standard, extensive duplication of machinery, equipment for navigation, communications and ship location (including satellite navigation equipment), cargo monitoring aids and cooling systems in the holds.

The sea transport operation begins when a ship sails for Japan from the BNFL Marine Terminal at Barrow in Cumbria carrying empty irradiated fuel flasks. The ship may stop in northern France to collect French flasks. The fuel flasks are of massive construction weighing up to 110 tonnes and are designed and tested in accordance with the IAEA Regulations. On arrival in Japan the empty flasks are delivered to Japanese nuclear power stations and full flasks are collected for the return journey to Europe. The ship may stop in northern France to deliver full flasks before returning to the UK. On arrival in the UK, at the BNFL Marine Terminal, the full flasks are off-loaded directly from the ship to special BNFL owned rail wagons. The flasks are then transported by rail directly to BNFL's reprocessing plant at Sellafield. (See Figure 1 & 2).

EMERGENCY RESPONSE ARRANGEMENTS

The aim of the BNFL/PNTL emergency response arrangements is to achieve a rapid and effective response to an incident involving a loaded nuclear transport flask on board a BNFL/PNTL vessel or to the vessel itself. Depending on the extent of the mishap this could be followed up by emergency teams trained and equipped to minimise any radiological consequences of the incident. To achieve this effectively Emergency Response Procedures have been written detailing lines of communication from the involved ship to the BNFL Control Centre and through to the emergency response participants. Arangements have been made to move an expert team rapidly to anywhere on the ships route. A range of equipment is available to be taken with the team depending on the nature of the incident. This includes health physics and engineering equipment, together with more specialized equipment such as acoustic equipment to provide a relocation and cargo condition monitoring system.

NOTIFICATION OF AN INCIDENT

In the event of an incident the Ship's Master will inform the BNFL Control Centre at Barrow in the UK of the situation and the ship's location. If the nature of the incident is such that the Ship's Master is unable to contact the BNFL Control Centre then they would be alerted by the non-receipt of the routine position report which is transmited at pre-determined intervals throughout the voyage. The BNFL Control Centre then notifies PNTL who are based at BNFL's Head Office at Risley, Warrington in Cheshire. A senior member of the PNTL staff then travels to Barrow by helicopter to direct the emergency response from the BNFL Control Centre. The despatch of the emergency team is organised by his deputy who remains at Risley. The team is led by a senior member of the PNTL staff and includes a further member of the PNTL staff, health physicists and flask engineers from Sellafield, a marine engineer and a press officer. Arrangements are in force to transport this expert team rapidly to anywhere on the ship's route.

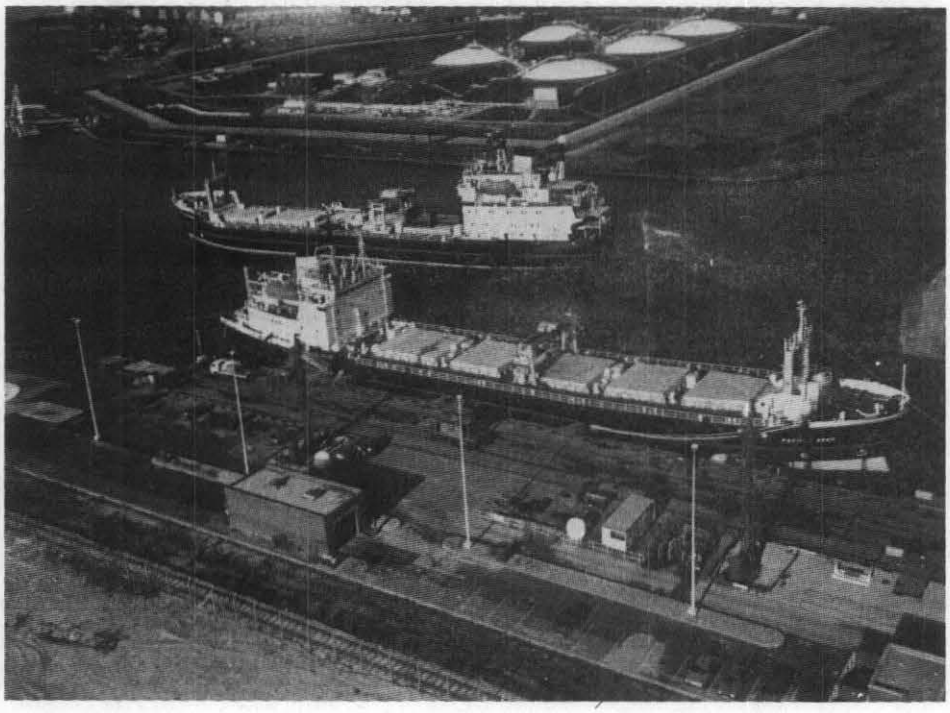


FIGURE 1

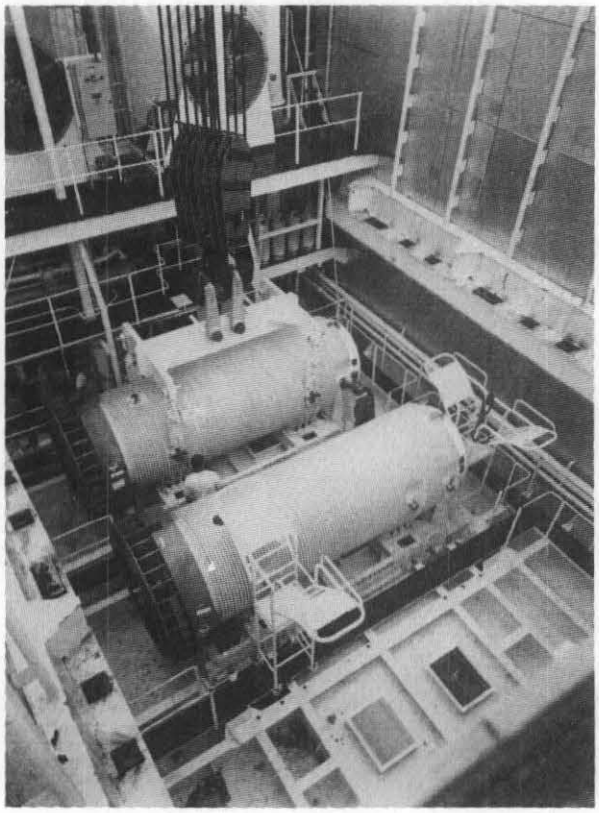


FIGURE 2

All communications to and from the ship during the emergency are routed to/from the BNFL Control Centre in Barrow. The content of all communications are copied to BNFL's Head Office. The appropriate authorities are notified of the incident and the response to it by BNFL's Head Office.

If an incident occurs in Japanese territorial waters the BNFL Control Centre at Barrow will be notified as described earlier, however the initial response will be provided by an emergency team from Nuclear Services Company who are based in Japan and are contracted to PNTL to provide a similar response to that available from the UK. If it is considered appropriate an emergency team will also be despatched from the UK. A diagrammatic representation of the communications chain is given in Figure 3.

ACTION BY THE EMERGENCY RESPONSE TEAM

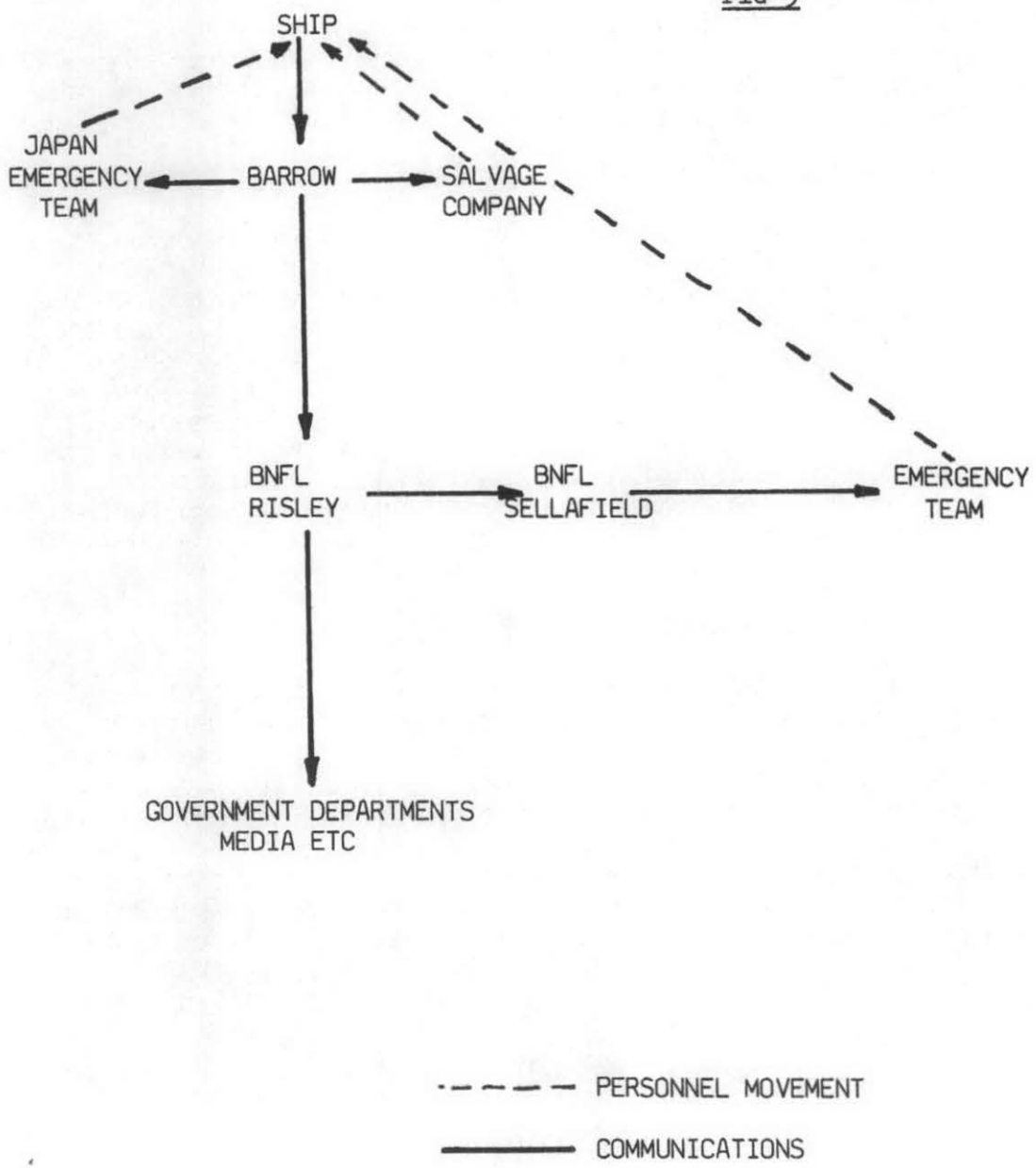
The emergency response team are trained to board a PNTL vessel at sea, the press officer will normally remain on land near to the scene of the incident to answer local enquiries, having boarded the ship the team leader will consult the Ship's Master and advise the BNFL Control Centre at Barrow of their arrival. He then remains on the ship's bridge to direct the team's actions and to maintain contact with the BNFL Control Centre. The other team members proceed to the hold. They are equipped and trained to monitor the condition of the irradiated fuel flasks and to carry out such remedial operations (in consultation with the BNFL Control Centre) as are necessary to ensure flask containment and to enable the safe onward passage of the ship.

EMERGENCY RESPONSE EQUIPMENT

Engineering and health physics equipment (including protective clothing) adequate to satisfy the requirements of the emergency team is kept fully maintained and ready to travel with the team at any time. In addition specialised equipment is available to be taken with the team at the discretion of the team leader depending on the nature of the incident. This includes acoustic equipment to provide a relocation and cargo monitoring system, a computer database and a satellite communications system. A diagrammatic representation of the acoustic relocation system fitted to the vessels is given in Figure 4.

SIMPLIFIED EMERGENCY RESPONSE COMMUNICATIONS DIAGRAM
SEA TRANSPORT EMERGENCY
PNTL/BNFL SHIPS

FIG 3



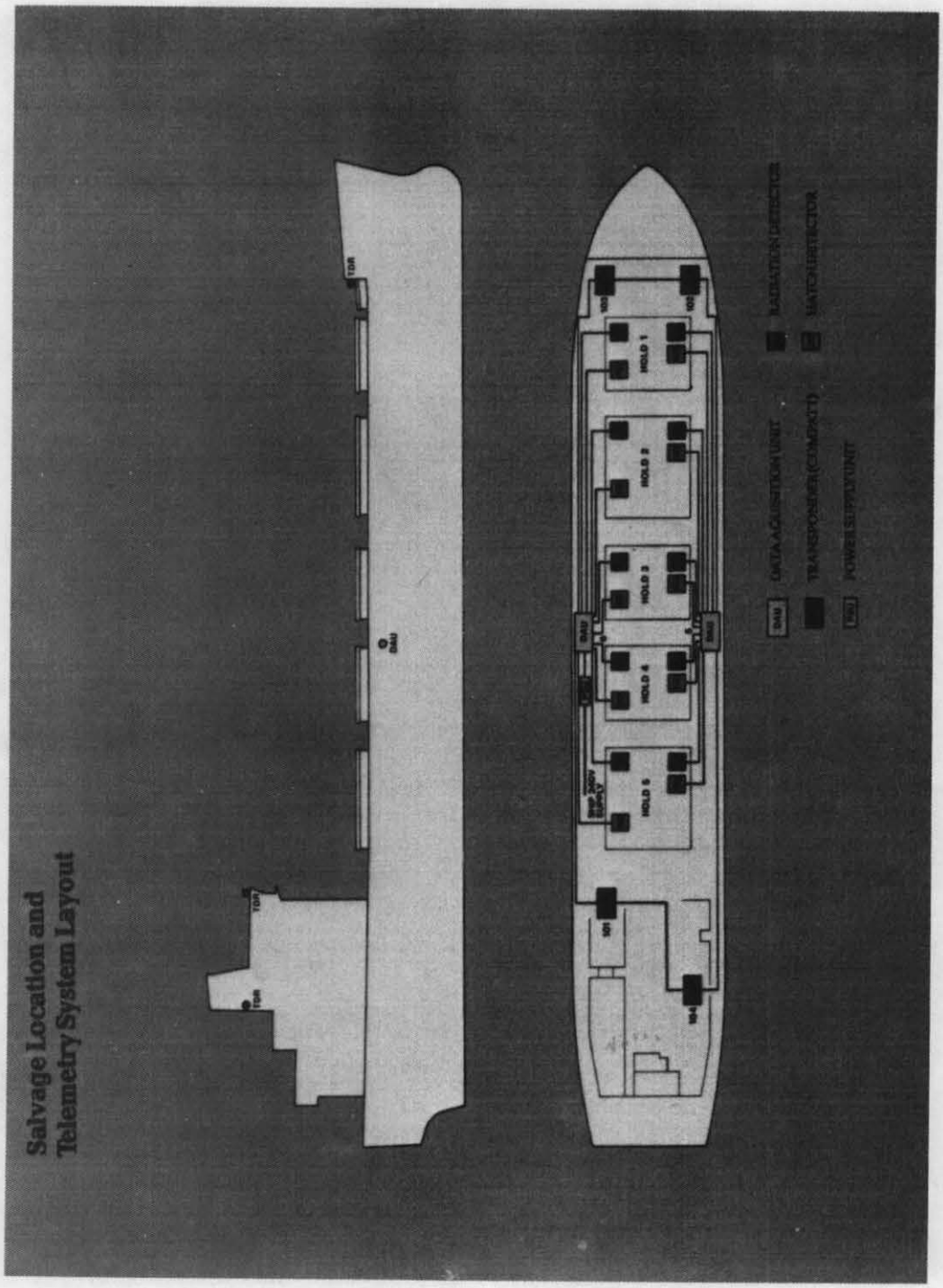

Salvage Location and
Telemetry System Layout
HOLD 1
HOLD 2
HOLD 3
HOLD 4
HOLD 5
DATA ACQUISITION UNIT
TRANSPONDER (COMPACT)
POWER SUPPLY UNIT
RADIATION DETECTOR
WATER DETECTOR

FIG 4

In the event of a vessel misfortune, including sinking, the emergency response procedures will involve search and relocation of the ship and salvage of the ship and cargo, if appropriate and feasible. The PNTL ships are all fitted with acoustic transponders. The transponders will return an acoustic signal in response to an interrogation signal from the Programmable Acoustic Navigator search unit. The search unit is fairly small and easily transported with the emergency team and can be operated from either a search vessel or a helicopter. It connects via a cable to a dunking transducer which is lowered until it is a few metres under the surface of the sea. This system, which was developed especially for the BNFL/PNTL fleet of irradiated fuel carriers, allows the emergency team to ascertain the position and depth of the sunken vessel. In addition the system is designed so that the shipboard transponders can be instructed to range between themselves thus providing valuable information as to whether the ship is still intact or not. Having located the ship and ascertained it's condition the operator can then interrogate the system to obtain information regarding the condition of the cargo. This will tell him whether the hatch covers are still in place and whether there has been any release of radioactivity.

A database system has been developed to provide a comprehensive information system on search and survey resources worldwide. The system is regularly updated ensuring that correct up to date information is available should it be required. The system is installed on a lap top microcomputer and is available to be taken with the emergency team.

An important feature of PNTL's emergency response arrangements is the communication link between the emergency response team and the BNFL Control Centre at Barrow in the UK. Generally the satellite communications system onboard all PNTL ships will be available to provide a direct link. If this system is not available a portable satellite communications system can be taken with the emergency team to enable them to establish a base station at the nearest landfall to the incident.

LAND INCIDENTS

This paper is primarily concerned with the emergency response arrangements applicable to an incident involving a loaded nuclear transport flask on board a BNFL/PNTL vessel or to the vessel itself. However, as noted earlier the final part of the journey from Japan is by rail from the BNFL Marine Terminal at Barrow to Sellafield. In the event of an incident during this rail journey BNFL would be notified under the Irradiated Fuel Transport Flask Emergency Plan for England and Wales (IFTFEP) and the flask emergency team would be despatched. IFTFEP is organised and operated by the Central Electricity Generating Board (CEGB) and was discussed by Mummery at PATRAM '83.

EMERGENCY EXERCISES

Emergency exercises are held regularly to test the emergency response arrangements. Separate exercises are held for the sea journey and the rail journey. In both cases an exercise scenario is prepared. Although the probability of a serious flask incident involving the release of radioactivity is very small the scenarios often postulate that a release has occurred so as to allow the participants to test their response to a radiological incident. The participants respond to the exercise scenario using the communications arrangements and equipment specified in the plans. The sea exercises are carried out onboard ship and may involve the flask emergency team in boarding a ship at sea.

In addition to testing the emergency response arrangements the exercises provide the participants, who are trained in the use of the emergency equipment, with an opportunity to practice using this equipment in the field thus strengthening their confidence in handling a real emergency.

REFERENCES

International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials, 1973 Revised Edition (As Amended), Safety Series 6, IAEA, Vienna 1979.

Mummery G.B, 20 Years Experience of Large-Scale Movement of Irradiated Fuel by the CEGB. PATRAM '83 7th International Symposium on Packaging and Transportation of Radioactive Materials, May 15-20 1983, New Orleans, Louisiana, USA, Volume II p 1486-1489, December 1983.