Transporting Nuclear Materials

This briefing note explains why, how and where we transport nuclear fuel. It looks at the safety elements involved in transport, including the flasks that contain the fuel and the different modes of transport used.

The key headings in this briefing note are:

The briefing note is approximately 1500 words.

Introduction

• When nuclear fuel has been burnt in a reactor for a few years it becomes less efficient. This is because waste builds up in the fuel. After we remove the fuel from the reactor, the used nuclear fuel is stored in a cooling pond to allow some of the heat and radiation to fade away. After at least 90 days, it can then be moved to a recycling plant so we can recover the reusable uranium and plutonium that is still in the fuel.

• We also separate out the 3% of waste in the fuel. The two main recycling plants in the world are at La Hague near Cherbourg in France, and at Sellafield, Cumbria in the United Kingdom. We operate the plant in England and we have customers in Europe and Japan.

• The used nuclear fuel is transported by road, rail and sea in specially-designed containers called 'flasks'. We have a number of subsidiary companies which transport nuclear materials throughout the world:

- Pacific Nuclear Transport Limited (PNTL)
PNTL was set up in 1975 as a subsidiary company of BNFL. It has shareholders from the UK, Japan and France. PNTL transports nuclear materials by sea between Japan and Europe. PNTL has five purpose-built ships. The five ships, along with our own European Shearwater, are all managed by BNFL.

- BNFL SA
BNFL SA, which is based in France, was set up in 1996 to manage the way

nuclear materials are transported for BNFL on the mainland European rail network. BNFL SA also manages a marine terminal at Dunkirk, France. The BNFL ship, European Shearwater, transports the used fuel from Dunkirk to the Barrow marine terminal near Sellafield.

Transport by rail and sea

• We own Direct Rail Services (DRS) and run it from Carlisle. DRS transports:
- nuclear materials by rail, safely and reliably to Sellafield from sites around the UK;
- low-level waste to Drigg, close to Sellafield, where it is disposed of; and
- chemicals from the North West of England which are used in the Sellafield reprocessing plant.

• Vitrified waste (high-level waste that is concentrated by evaporation and mixed with molten glass) is returned by rail and sea to the country it came from. In France, Cogema subcontracts to PNTL for shipments from the Cherbourg marine terminal near La Hague to Japan. Like used fuel, we load vitrified waste into flasks and transport it safely in the same specially-designed ships. We began doing this in 1995 when the first shipment from Cherbourg arrived safely in Japan.

• The recycling plants at La Hague and Sellafield also turn the reusable uranium and plutonium into new fuel, called Mixed Oxide (MOX). The first transport of MOX fuel from Europe to Japan was completed successfully in 1999. Some people question whether transporting nuclear materials is a good idea and say it should not be done. But our transport safety record is the best in the world.

• In the 40 years we have transported used fuel, we have travelled more than 16 million miles without a single escape of radioactivity, and, we are always looking at ways to improve our equipment and the way we transport fuel to make it even safer.

• When Lloyds List International, the independent shipping newspaper, commented on the safety record of the nuclear transport industry in 1990, they said: "There are more immediately hazardous cargoes than reinforced containers of spent fuel being transported on road, rail and sea everyday of the week with far fewer and less comprehensive precautions."

Transport flasks

• When used fuel is taken out of a Magnox Reactor or an Advanced Gas-cooled Reactor it is stored in box-shaped skips in cooling ponds at the power station. After a cooling period, the full skip is then loaded into a steel transport flask.

• Fuel from Light Water Reactors is not stored in skips but is put straight into the cooling ponds at the power station. For shipments to Sellafield, before the fuel is transported, it is put in a stainless steel container known as a multi-element bottle (MEB). This fits inside the transport flask. For shipments to France, fuel is transported dry inside the flask in special support grids called 'baskets'. These flasks are cylindrical.

• The used nuclear fuel is highly radioactive and protection is needed when we transport it. We transfer the used nuclear fuel in massive steel flasks which can weigh up to 110 tonnes each. The flasks are made from steel or a combination of steel and lead. The flasks give protection to workers and the public against radiation and the flasks have the strength to withstand the most serious accidents.

• Because of their safety features, each 110 tonne flask will only have up to five tonnes of used fuel in it.

• When the fuel arrives at the reprocessing plant in the UK, the skip or bottle of used nuclear fuel is taken out of the protective flask and stored in a deep water tank called a 'pond'. This is to allow the level of radioactivity to go down even more. The empty flasks are then washed, tested and checked for radiation before being sent back to the power stations to be used again.

Safety tests carried out on the flasks

• We can transport radioactive materials by road, rail, sea and air. To make sure this is always safe when we use lorries, trains, ships or planes, strict rules have been made for the design of all transport containers. These rules are laid down by the International Atomic Energy Agency (IAEA). The IAEA regulations set the standards for impact and fire tests to check that the containers can withstand the most serious accident and that no radioactivity will escape. These tests include two 'drop' tests - one onto a massive solid surface and the other onto a steel spike. These surfaces are made from reinforced concrete and steel and are built so solid that they do not move when they are hit by the flask. This means that most of the force is directed back into the flask when it hits the surface.

• These tests are far more demanding than actual accidents. As an example, in 1984 a demonstration was carried out at a former British Rail test track at Leicester. A 140 tonne train, travelling at 100 miles an hour, was remotely driven into a flask which had been placed on the track in its most vulnerable position.

• Although the train was destroyed the flask only received one-third of the impact force it would receive from the series of tests set by the IAEA. It came as no surprise to us that the flask in the train crash received only minor damage and did not leak.

• In the USA, tests have also been carried out to show the safety of nuclear fuel flasks. At Sandia, in New Mexico, a flask on a lorry was remotely driven at 60 miles an hour into huge concrete block. The flask suffered so little damage that it was cleaned and used again in a similar test, this time at 80 miles an hour. Again, the flask passed this very severe test. Another test which is carried out on flasks is to put the flask in a fire of 800 degrees centigrade for 30 minutes.

• Flasks are individually inspected before fuel is loaded at the power station. They are checked again after they are emptied at the reprocessing plant. Routine maintenance is carried out regularly, and flasks are given a major overhaul at certain times.

• Even though the special ships and flasks make this transport very safe, we regularly practise our emergency plans.

• The design and construction of the fleet of ships must be approved by the UK's Department of Transport and Lloyds Register. The ships trading to Japan are also fully checked and approved for service by the Japanese Ministry of Transport.

• We always check the safety systems on the ships to make sure they are working properly before they leave for Japan. The ships can spend up to five weeks visiting different ports to collect their cargo of used nuclear fuel before they return home. Each of the ships used to go to Japan generally make two trips a year.

• There are three routes routinely used between Europe and Japan - through the Panama Canal and around Cape Horn and the Cape of Good Hope.

The safety features of these ships include:

• double hulls to withstand damage;

• at least two sets of safety-related equipment such as navigation, communication, cargo monitoring electrical and cooling systems so that the ship can use the second system if faults develop;

• satellite navigation and satellite tracking, so that the ship automatically transmits its position back to the UK;

• extra fire-fighting equipment including a hold-flooding system;

• twin propellers and engines; and

• a double bottom over the ship's length, divided into tanks.

• In 1993, the International Maritime Organisation (IMO) introduced new regulations for ships carrying nuclear cargoes. These regulations are known as the INF (irradiated Nuclear Fuel) Code. Ships can be INF1, INF2 or INF3. INF3 is the highest safety rating for any ship carrying a nuclear cargo. All of our fleet are in this category.