FACT SHEET

MOX Fuel Shipments from Europe to Japan

Mixed Oxide (MOX) fuel assemblies are manufactured in dedicated facilities in France and the United Kingdom and loaded into nuclear reactors to generate electricity.

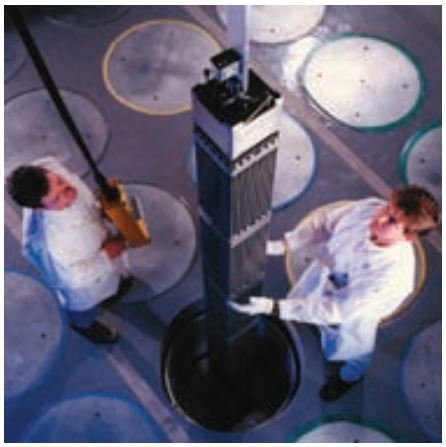
The assemblies contain hundreds of small cylindrical pellets, held within zirconium alloy tubes around four metres in length. Once sealed and welded, a series of these fuel rods is placed into a special framework to complete each assembly.

The pellets contain a mix of mainly uranium, with a small proportion of plutonium. The plutonium content ranges from 5–10 percent according to the fuel design.

Nuclear reactors can use uranium fuel, MOX fuel or a combination of the two. MOX fuel was first loaded in nuclear power stations on a commercial basis in the 1980s and is used today in over thirty reactors. To date, more than 5,000 MOX fuel assemblies have been loaded in nuclear reactors in France, Germany, Belgium, Switzerland and the United States.

Over the next decade, the number of nuclear reactors utilizing MOX fuel is forecast to increase. Japan, which has limited natural energy resources, plans to use MOX fuel in 16–18 of its nuclear reactors as part of a long-term programme to provide secure and stable electricity supplies.

MOX fuel effectively makes possible a new energy resource, derived from nuclear fuel that has already been used in a reactor. Electric utilities in Japan sent their used nuclear fuel to Europe for chemical reprocessing from the late 1960s until 2001. Reprocessing used fuel separates out the reusable products (97%) from the waste (3%) and allows it to be recycled.



MOX Fuel Assembly

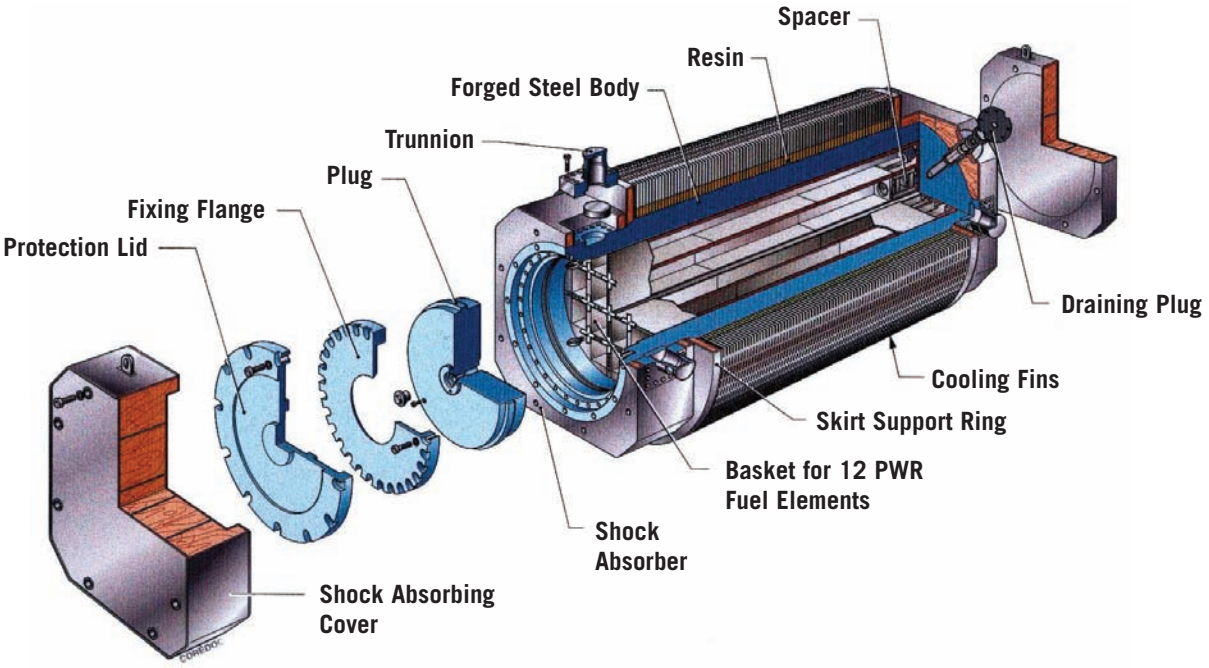
BENEFITS OF MOX

MOX fuel is an attractive energy source for several reasons.

- Recycling used nuclear fuel extracts substantial additional energy from uranium resources. This helps extend uranium reserves.
- Utilizing MOX fuel means that useful energy-producing material does not go to waste.
- MOX fuel is energy efficient. One pellet of MOX fuel, approximately one centimetre in length and weighing about six grammes, generates the energy equivalent of one tonne of coal.
- Since nuclear power stations do not emit carbon dioxide and other harmful substances associated with fossil fuels, MOX contributes to promoting clean air.
- Utilizing MOX fuel reduces the amount of radioactive material that would otherwise need disposal, reducing demands on waste storage facilities.
- By using plutonium, it reduces concerns about the proliferation of nuclear materials.

With its inherent stability, portability and high energy content, MOX fuel is an attractive source of electricity that is set to expand in use in the twenty-first century.

TN 12/2 Transport Cask



In 1999, with all the components of the nuclear fuel cycle infrastructure in place, MOX fuel began to be shipped to reactor sites in Japan. Completed deliveries to Tokyo Electric Power Company (TEPCO) and Kansai Electric Power Company (KEPCO) will be followed by shipments to reactors operated by Kyushu, Shikoku and Chubu Electric Power Companies. Future shipments of MOX fuel to Japan will take place at a rate of approximately one per year.

Shimane nuclear power plant, Japan

Shipping Packages

Nuclear materials are transported in packages that will protect workers, the public and the environment in severe accident situations. This ensures high levels of safety whatever mode of transport is used. Many shipments involve transport by a combination of different modes — road, rail, air and sea.

Standards for packages of nuclear material are set by the International Atomic Energy Agency (IAEA), which is a United Nations agency. The standards have been established by experts and national regulators from many of its 145 member countries and are systematically revised on a continual basis.

The IAEA has set standards for packages based on the different characteristics of the nuclear material being transported. MOX fuel is moved in "Type B" packages, which are able to withstand a series of challenging tests that demonstrate resistance to severe impact, fire and immersion.

The Type B casks used for shipments of MOX fuel are massive steel structures made from 10-inch thick forged steel and weighing around 100 tonnes or smaller, lighter packages that meet the same tough standards.

Purpose-Built Ships

MOX fuel is transported to Japan in purpose-built ships owned by Pacific Nuclear Transport Limited (PNTL). In turn, PNTL is owned by International Nuclear Services Ltd., AREVA and Japanese nuclear companies.

PNTL has pioneered standards for the safe shipment of nuclear materials. It designed and operates a fleet of purpose-built ships that is now into its second generation. The ships meet the requirements of the INF code of the International Maritime Organization (IMO), the United Nations agency that regulates international shipping. The INF code establishes design and construction standards for vessels carrying different nuclear cargoes, with the PNTL ships meeting its highest rating.

PNTL ships have a range of safety features far in excess of those found on conventional vessels:

- Double hulls and hull reinforcing to withstand collision damage
- Enhanced buoyancy to ensure the ship will continue to float even in extreme circumstances
- Dual navigation, communications, cargo monitoring and cooling systems
- Satellite navigation and tracking
- Twin engines and propellers
- Additional firefighting equipment, including a hold flooding system and spare electrical generators

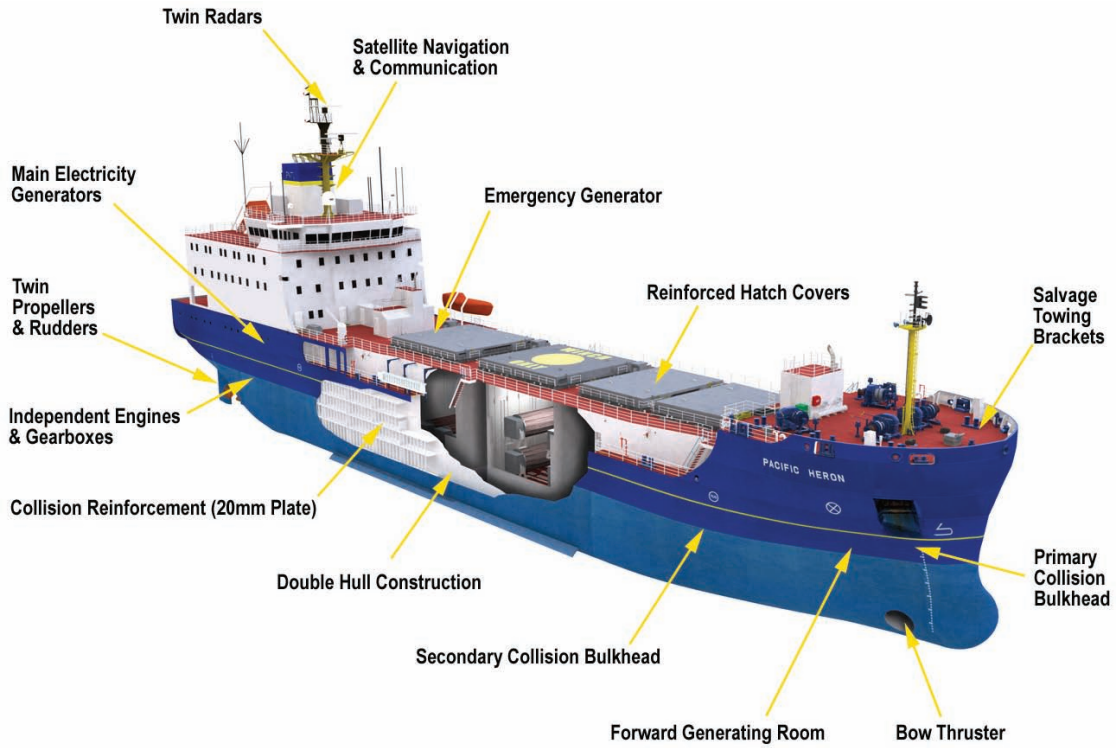
Each ship undergoes regular maintenance inspections. Operational equipment is checked and tested

Pacific Heron

prior to each voyage from the ships' home port of Barrow, England. The ships all have a fully qualified, trained and experienced crew and, while at sea, maintain a communications link with a report center manned 24-hours a day. The ships travel to Japan non-stop, making no port calls.

PNTL ships have a safety record second to none, having covered more than 5 million miles without a single incident resulting in the

Purpose-Built Nuclear Carrier



release of radioactivity. Over 2,000 casks of nuclear material have been safely transported since the 1960s.

All the shipments are conducted in full compliance with international laws and the ships carry all the necessary certificates and documentation to demonstrate their compliance with international regulations. The shipments are also covered by shipping and damage insurance.

Physical Protection

Two PNTL ships, the Pacific Heron and Pacific Pintail, are fitted with special security equipment for transporting MOX fuel. For mutual protection, these vessels travel together, each escorting the other. They are fitted with fixed naval guns and have other additional physical protection systems, only some of which are visible.

They carry armed officers from the United Kingdom Civil Nuclear Constabulary (CNC) who provide on-board protection. CNC officers are specially trained to protect nuclear facilities and materials.

The overall physical protection system, established through cooperative agreements between the governments of the United Kingdom, France, Japan and the United States, ensures that appropriate measures are in place to counter any threat of theft or sabotage.

Safety in Depth

MOX fuel shipments employ a system of "safety in depth" — a series of independent barriers between the radioactive material and the outside environment. This encompasses the solid and passive fuel, the zirconium alloy fuel rods, the special packages in which they are transported, and the protection provided by the ships with their reinforced double hulls.

This safety system provides much greater protection than typically exists for shipments of hazardous cargoes and removes the need to rely on specialist emergency assistance from countries adjacent to shipping routes.

The fuel itself is a solid material that is characterized by both long-term stability and low solubility, and it maintains its structural integrity in water without dispersion. It is designed to withstand high temperatures and pressures and has no explosive properties.

Emergency Arrangements

A fully trained and equipped team of nuclear experts is available on a 24-hour emergency standby system for each shipment. In the event of an emergency, this team would be dispatched to the ship and would direct and manage all remedial operations.

PNTL contracts with the world's most experienced international salvage experts, who have operations in all regions of the globe. They are able to respond quickly to all requests for assistance and have successfully recovered large vessels from the seabed. Special monitors in the holds of each PNTL ship would provide information about the status of the cargo to a salvage team.

Energy Demand

Worldwide energy demand is forecast to increase well into the future. MOX fuel provides nations operating nuclear power plants with a reliable long-term means to generate clean electricity. This is particularly important for Japan, where 55 nuclear power plants generate almost 30 per cent of the nation's electricity.

For more information, visit:
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