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Transports of MOX (Mixed-Oxide) Nuclear Fuel

Eight years after the last transport of plutonium Mixed-Oxide (MOX) fuel to Japan - a fiasco that resulted in worldwide protests by governments and environmental organisations - two separate transports of the dangerous nuclear fuel will take place in the beginning of 2009:

- A total of 65 MOX fuel elements will be transported from the MOX factory in Marcoule, France to three nuclear power plants in Japan (Kyusu Electric's Genkai Unit, Shikoku Electric's Ikata Unit 3, Chubu Electric's Hamaoka Unit 4).
- Up to eight MOX fuel elements will be transported from Sellafield, UK via France to Grohnde nuclear power plant in Germany.

MOX fuel is an alternative fuel for nuclear power plants, combining uranium with plutonium.

The International Atomic Energy Agency (IAEA) classifies MOX fuel as 'direct-use' nuclear weapons material [1]. A total of 1,800 kg plutonium - enough to make 225 nuclear weapons - will travel more than 20,000 km overseas to Japan.

Areva's announcement of the MOX transport to Japan confirms the high security risks:

> **"(…) and for obvious security reasons (…) the hour of departure from Europe to Japan as well as the maritime route to be used will be made public the day after departure. " [2]**

These MOX transports are yet another example of the unacceptable risks that nuclear energy creates. MOX transports pose as much unnecessary and unjustifiable environmental, nuclear proliferation and public health risks as they did years ago. This factsheet highlights the main concerns around these upcoming dangerous and needless transports.

The reprocessing myth

Nuclear power reactors normally use low-enriched uranium fuel, a material unsuitable for making nuclear weapons. However, the nuclear power plant operation transforms uranium fuel into a rich, highly-toxic and dangerous cocktail of radioactive elements, including plutonium. Plutonium is the manmade element used in nuclear bombs and is extremely hazardous even in minute quantities, remaining dangerous for about 240,000 years.

The nuclear industry has long recognised that the highly radioactive material is a major problem. Nevertheless, it has continued producing more and more of it. The industry started separating plutonium and uranium out from spent fuel (in a process known as reprocessing) initially for use in nuclear weapons, while later the process was adopted for civil purposes.

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The intention was to re-use the plutonium as fuel for fast breeder reactors, but this route turned out to be highly problematic and expensive. The Japanese fast-breeder reactor Monju has been shut down since a serious accident in 1995, while the German fast-breeder in Kalkar has been turned into an amusement park.

To avoid the embarrassment of closing the expensive reprocessing plants and to deal with the large stockpiles of plutonium, the industry developed a new justification. The separated plutonium could be used in existing light water reactors in the form of MOX fuel, blending plutonium with uranium. This was also meant to solve the problem of transport after two shipments of pure plutonium from Europe to Japan (in 1984 and 1992) raised large public and political outcry in countries along the route for its extreme radiotoxicity and the associated proliferation risks. The industry hoped the shipments of plutonium in the form of MOX fuel would prove less controversial.

MOX – a total waste

Despite the industry's efforts, growing concerns about environmental, economic and proliferation risks caused the reprocessing industry to collapse. Countries like Belgium, Germany, Switzerland, the US and Sweden all banned reprocessing. Only France (La Hague), the UK (Sellafield) and Russia (Mayak) currently conduct reprocessing on a commercial scale. Japan proposed building its own reprocessing plant in Rokkasho in 1985, but due to continuing problems the start-up of the plant, originally scheduled for 1998 and after many delays rescheduled for 2008, continues to be delayed.

MOX recycling is a myth:

- Only 39 reactors in the world (less than 10% of the existing 436 nuclear power reactors worldwide) currently have a licence to use MOX as fuel. Though in France 22 of the 58 reactors are licensed to use up to 30% MOX fuel, only half of the allowed volume of MOX fuel is being used.
- Compared to standard uranium fuel, MOX is more complicated and unstable to use, resulting in lower performance and higher safety risks. The quality of MOX fuel cannot meet the expected performance standards [3].
- Though one of the arguments for using MOX is to reduce the plutonium stockpiles, none of these reactors effectively burn up plutonium (a reactor only uses more plutonium than it produces if more than 40% MOX fuel is loaded).
- The economic benefits of using MOX are questionable. Handling plutonium and MOX fuel production are highly expensive because of the high levels of radioactivity involved. Transport costs rise significantly because of extra safety and security requirements.

All in all, burning MOX fuel is a waste of time and money, and presents major security and proliferation challenges.

Dangerous transports

Reprocessing and the use of MOX fuel lead to large amounts of dangerously radioactive and proliferation-sensitive materials being transported very long distances around the world. Spent fuel travels from nuclear reactors to reprocessing plants,

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pure plutonium travels from reprocessing plants to MOX fuel fabrication plants, and MOX fuel is subsequently transported to nuclear reactors. Each of these transports poses serious security risks as well as threats to the environment and public health.

The overall plans around the current MOX transport are:

- Spent fuel from Japanese nuclear power plants has been shipped to the reprocessing plant in La Hague, in Normandy, France. Then after reprocessing the plutonium was transported 1,000 km by truck through France to the MOX fuel fabrication plant MELOX in Marcoule (Rhône Valley). A total of 65 MOX fuel elements were transported by truck back to La Hague (1,000 km), where they will be loaded into larger containers. Subsequently, trucks will take them from La Hague to the harbour in Cherbourg (20 km), where they will be loaded onto one of two ships specifically prepared for this dangerous transport (*Pacific Pintail* and *Pacific Heron*). These ships, which are loaded with naval guns for protection, will sail 20,000 – 25,000 km (12,000 – 16,000 nautical miles, depending on the route) to a harbour in Japan. In Japan, trucks will then transport the fuel elements to their final destinations.
- Spent fuel from German nuclear power plants was sent to the UK and transported to the Sellafield reprocessing plant in Cumbria, where the plutonium was separated out. This plutonium was subsequently mixed with uranium in the Sellafield Mox Plant (SMP), the long-troubled MOX production plant (a recent document of the UK Nuclear Decommissioning Authority (NDA) proposed to close down SMP prematurely [4]). Up to eight MOX fuel elements will be transported by truck and ship from Sellafield in the UK to Grohnde in Germany. The ship used for this transport is the *Atlantic Osprey*, a normal single-hull, single-engine ship with low security measures. The MOX fuel will either travel to Cherbourg in France to go a further 1,000 km overland to Grohnde, or the ship will go all the way to Bremerhaven, followed by 250 km overland through Germany to its final destination.

The transport to Japan will be the largest transport of plutonium in history: the MOX fuel elements contain a total of 1,800 kg plutonium, enough for the production of 225 nuclear weapons. The plutonium in the MOX fuel rods is far more accessible than the plutonium in spent fuel from a reactor. States or terrorists could extract the plutonium from the fuel and use it as weapons material. MOX fuel is classified under international IAEA regulations as Category 1 ‘direct-use’ nuclear weapons material [5], and could be transformed into a nuclear bomb in one to three weeks.

Scandalous

Previous MOX transports were marked by scandals involving the falsification of quality control data of the MOX fuel. The fraud was exposed after quality data sheets turned out to be falsified by employees of British Nuclear Fuel Ltd. (BNFL) [6]. Later it became clear that the problems with quality control of the MOX fuel are inherent to the fuel and were also encountered at other MOX production facilities [7]. Half of the MOX fuel that was transported from France to Japan in 1999 is still stored in pools as a waste, while the other half was returned to Sellafield unused years later (where it is still stored with unknown destination). The quality of the MOX fuel could not be guaranteed by the MOX producers.

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The plutonium MOX transports prove once again how the nuclear industry's promises are a dangerous illusion, and how nuclear energy increases insecurity. In brief, it is:

- Unnecessary: The so-called 'recycling route' of the nuclear industry is a myth. Reprocessing and the use of MOX do not decrease the plutonium stockpiles, but merely increase the complexity and danger of radioactive waste management.
- Unsafe: There is no evidence that the structural strength and thermal resistance of the containers used for MOX transport are sufficient to withstand possible accident conditions during a transport overseas [8]. Shipboard fires can last much longer (days or even weeks) than the fire duration the containers are tested for. Once the plutonium in the MOX fuel disperses it poses serious public health and environmental risks.
- Insecure: Reprocessing and the use of MOX fuel increase risks of nuclear proliferation. Plutonium in spent nuclear fuel is harder to extract for use in nuclear weapons than separated plutonium and plutonium in MOX fuel. For good reasons the level of security around the MOX transport by ship to Japan is enormous. For unknown reasons the security around the transport to Germany by truck seems limited.

Undermining climate protection

Though the threat of climate change has initiated a renaissance in the debate on nuclear energy, nuclear power could only make a marginal contribution to CO_2 emission reduction. The International Energy Agency (IEA) shows that, even if existing world nuclear power capacity could be quadrupled by 2050, its share in necessary carbon dioxide emission reduction would be less than 4% [9].

Implementation of this scenario would require that one new reactor to be built every 10 days from now until 2050. Even in 1985 and 1986, during the nuclear industry's peak, the equivalent of only 30 new reactors (30 GW) were being built per year. Investment costs for 1,400 new reactors needed would exceed USD 10 trillion at current prices. Nuclear power can only deliver too little, too late [10].

Finland provides an example of the risk of taking the nuclear energy route: the European Pressurised Reactor (EPR) currently under construction in Olkiluoto (Finland) is currently three year behind schedule and at least €1.5 billion (50%) over budget. The IEA warned Finland in 2004 against the risk of relying on the new reactor for emission cuts, saying that any delays in construction would inhibit Finland's ability to meet its greenhouse gas reduction targets under the Kyoto Protocol. The risk has become a reality.

The French nuclear giant Areva, which aggressively markets the EPR as safe and cheap, proposes to fill the EPR reactor core with 50-100% MOX fuel, but ignores the increased hazards associated with MOX. Not only will MOX significantly increase the number of dangerous transports, but also the spent nuclear fuel produced by the EPR will be more dangerous than is acknowledged by the French nuclear industry.

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Notes:

[1] IAEA Safeguards Glossary, 2001. http://www-pub.iaea.org/MTCD/publications/PDF/nvs-3-cd/PDF/NVS3_prn.pdf

[2] Areva website, 28 January 2009. http://www.lahague.areva-nc.fr/scripts/areva-nc/publigen/content/templates/Show.asp?P=8317&L=EN

[3] *Lessons from the French MOX Programme: plutonium fuel means lower performance, higher risk*, Wise-Paris, 25 August 2005.

[4] *10-year-old Sellafield plant may be closed*, Guardian, 17 February 2009. http://www.guardian.co.uk/environment/2009/feb/17/sellafield-plant-closure

[5] Nuclear weapons material = nuclear material that can be used for the manufacture of nuclear explosive devices without transmutation or further enrichment.

[6] *The reprocessed truths that may cost BNFL dear,* The Independent, 29 January 2000. http://www.independent.co.uk/news/science/the-reprocessed-truths-that-may-cost-bnfl-dear-727806.html

[7] *Fundamental deficiencies in the quality control of mixed-oxide nuclear fuel*, F. Barnaby, S. Burnie, March 27th 2000. http://www.greenpeace.fr/stop-plutonium/dossiers/MOX_quality_annexe4.pdf

[8] *Safety aspects of unirradiated MOX fuel transport*, E.S. Lyman, November 1997, from Final Report of the International MOX Assessment.

[9] Energy Technology Perspectives 2008, IEA/OECD, June 2008.

[10] *Nuclear Power – Undermining Action on Climate Change,* Greenpeace International, March 2008. http://www.greenpeace.org/raw/content/international/press/reports/nuclear-power-undermining-cl.pdf