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6-6 STATUS OF TRANSPORTATION SYSTEMS OF HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT (HLRWM)

EXECUTIVE SUMMARY

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Executive Summary

Used nuclear fuel in Canada is currently stored on-site at the nuclear power generation stations, in wet or dry storage. Among possible storage/disposal methods under scrutiny for a long term management plan are a central storage facility and a deep geological repository. Both of these options would require high level nuclear waste to be transported by road, rail or water.

Of the various types of nuclear fuel cycle wastes, the focus of this discussion in this paper is on used fuel that is removed from nuclear power and research reactors. As part of the international perspective, the paper also includes some discussion on the transportation of radioactive reprocessing waste.

Currently there are approximately 1.5 million used fuel bundles in Canada. The projected quantity of used fuel bundles in 2035 (when the last reactor is predicted to end its service), is 3.6 million fuel bundles.

Under the Nuclear Fuel Waste Act, nuclear energy corporations in Canada are required to take ownership of the waste produced at their plants, and must pay into a trust fund for long-term used fuel management. To date, over $1 billion dollars has been contributed to the fund. This fund is to ensure that the producers of nuclear waste are the ones who pay for its disposal, and to prevent future generations from bearing the financial burden.

Transportation of Used Fuel: An International Perspective

Radioactive materials have been transported around the world for 40 years. In that time, there have been no accidents that resulted in the release of significant amounts of radioactivity. It is estimated that a few hundred packages of used fuel are shipped every year around the world by road, rail and sea.

In the US, nearly 3000 shipments of commercial used fuel have been transported over 2.5 million km in the last 30 years. The majority of the shipments to date have been between different reactors owned by the same company. The transportation of nuclear materials in the US is jointly regulated by the US department of Transportation and the Nuclear Regulatory Commission.

Used fuel is transported in IAEA approved containers. Transportation vehicles are accompanied by armed escorts. The US approved the Yucca Mountain site in Nevada as a federal repository for nuclear waste. The US proposes to transport used fuel from 131 sites in 39 states to Yucca Mountain. Approximately 4300 shipments (primarily by rail) are proposed within a 24-year period. At approximately 175 shipments per year, it’s a small amount compared to the 300 million annual shipments of hazardous materials in the US every year.

The UK and France combined average 650 shipments of used fuel per year, through countries much more densely populated than Canada. Shipments within the UK and France are primarily by rail. Used fuel and high level reprocessing waste has been transported by sea between Europe and Japan. The average one-way distances in Europe are 1000 km. Average one-way distances between Europe and Japan are 15 000 km.

Over 15 different cask designs in Western Europe have been licensed under IAEA regulations for all modes of transport. Transportation casks are monitored at their point of origin and when they arrive at their destination. Any exceedences to the allowable limits of radiation must be reported.

Reprocessing plants in La Hague, France, and Sellafield, UK receive waste from Germany, Belgium, the Netherlands, Switzerland and Japan. The reprocessed waste is vitrified. The vitrified waste is eventually transported back to its country of origin.

Reprocessing of Japan’s waste in Europe is expected to halt in 2005, with the construction of a reprocessing plant at Rookasho-mura, Japan.

Pacific Nuclear Transport Ltd. (PNTL) operates a fleet of six purpose-built ships capable of carrying all categories of nuclear material. PNTL is owned by British Nuclear Fuels (BNFL), COGEMA and the Japanese Utilities. The ships have covered over 4.5 million kilometres transporting used fuel without and incident resulting in the release of radiation to an individual or the environment.

Transportation of used fuel and high level reprocessing waste in Germany was suspended between 1998-2001 in order to investigate exceedences on the surface of casks and wagons above regulated radiation levels. Remedial measures were taken to prevent further incidences. Transportation of used fuel in Germany is predominantly by rail. An agreement between the German power industry and the government will see reprocessing and most international transport of used fuel stopped by 2005. Used fuel will continue to be transported within the country to central interim storage facilities in Ahaus and Gorleban.

SKB, the nuclear waste management company in Sweden, is responsible for transporting used fuel by ship from the four Swedish nuclear facilities to a central storage facility.

Finland has selected a site for a final deep geological repository at the power plant in Okiluoto. Finland has two reactor sites. The permanent disposal site is located at one of the reactor sites, therefore minimizing the amount of used fuel transported. As well, Finish law stipulates that the import of foreign nuclear waste is prohibited.

Transportation of Used Fuel: A Canadian Perspective
As yet, used fuel has not been transported off-site (other than for research purpose) in Canada, though it is a possibility in the future. In order to transport nuclear material in Canada, a CNSC license is required. The requirements of licensing ensure the risks to workers, the public, and the environment are as low as reasonably possible. A CANDU fuel bundle is transported at various stages of its life, from production through to consumption.

Three million tonnes of dangerous goods (including hazardous waste) in approximately 27 million shipments are transported in Canada every year by road, rail and air. Used fuel is classified as Class 7 Hazardous Material. The CNSC works in conjunction with Transport Canada to ensure the safe transport of radioactive material in Canada

The main difference between transportation systems for used fuel and other hazardous substances are the containers in which they are transported. The design of the transport cask is the main safety feature in used fuel transport. Currently, two different containers are licensed in Canada (meeting IAEA requirements) for transportation of used fuel: the Irradiated Fuel Transport Container (IFTC) and the Dry Storage Container Transportation Package (DSCTP). The IFTC is designed to carry 192 fuel bundles with a total payload of approximately 35 tonnes, and the DSCTP is designed to carry 384 fuel bundles with a total payload of 70 tonnes.

Three options are available for transportation of used fuel within Canada: road transportation, a combination rail & road transportation system, and a combination water & road transportation system. Transportation origins of used fuel include:

- Pickering NGS (Ontario),
- Bruce NGS (Ontario),
- Douglas Point (located near Bruce NGS),
- Darlington NGS (Ontario),
- Point Lepreau NGS (New Brunswick),
- Gentilly NGS (Quebec), and
- Chalk River (Ontario).

Advantages of road transport are flexibility, existing infrastructure and short turn-around times. The biggest disadvantage is the limit on payload. Because of the weight of the DSC, special permitting would be required from Transport Canada. Therefore it is proposed that for road transportation, the IFTC should be used. This would require additional work to transfer used fuel currently stored in DSCs to IFTCs for transportation.

Both IFTCs and DSCs are designed for the fuel storage configuration used at Bruce, Darlington and Pickering. The IFTC can be adapted to accommodate the fuel storage configuration used at Gentilly, Point Lepreau, Douglas Point and Chalk River. Using the IFTC as the only container, an average of 12 truckloads/week with a total of 18747 shipments would be required to move the estimated 3.6 million fuel bundles to a central facility in Ontario.

Road transport would be restricted by inclement weather to 275-300 transportation days in a calendar year. A fleet of dedicated trailers would be used. The trailer would be a standard 4-axle 48-foot flatbed trailer, modified with the regulatory tie-down system. The trailer would be loaded with one IFTC. A rolling removable plastic weather cover would be provided to prevent the casks from rain. A standard tractor could be used to haul the trailer.

Transport by rail is practical for loads exceeding 40 tonnes and therefore large shipments are possible. Existing rail lines in Ontario could be used to transport used fuel in Canada, though additional feeder lines or spurs would have to be constructed/extended. Rail transport is largely unaffected by seasonal requirements, so ultimately there would be 365 transport days in one year.

One advantage of vessel transport is that all the reactor sites are located on a body of water. Another advantage is the existing technology and precedence. Most of the transportation by ship in Canada would be limited to in-land waters, and the dedicated ships would be adapted accordingly. The expected cargo capacity of a vessel is 15 DSCTPs or 32 IFTCs. Used fuel from Pickering, Darlington, Gentilly, Point Lepreau and Bruce would be transported by vessel to a central land transfer facility. There the casks would be transferred from the vessels for final transport to the central storage/disposal site by road. The following shipments would be required:

- 647 shipments by boat to a land transfer facility, and
- 12927 road shipments from the land transfer facility to the central location.

In order to obtain a CNSC license for transporting used fuel, a written transportation security plan must be completed. As well a comprehensive Risk Assessment must be performed. Generally, the routes chosen will minimize the time/distance of transportation, minimize the number of transfers, and avoid where possible densely populated areas.

Public Perception

In general, the transportation of used fuel is a contentious issue. The Seaborn panel concluded that Canadians were very mistrusting of nuclear technology in general, including transportation. Transportation of used fuel is probably best accepted in the UK, where regular shipments of used fuel by rail are transported through London. Public opinion by the scientific community towards the concept of transportation of used fuel to Yucca Mountain in the US is generally accepted, while in the community-at-large it is sceptical. Germany is renowned for the protests against the transportation of nuclear fuel by anti-nuclear groups.