

MINUTES OF THE MEETING
OF THE DISPOSAL SUBCOMMITTEE
OF THE BLUE RIBBON COMMISSION
ON AMERICA'S NUCLEAR FUTURE
AT THE CROWNE PLAZA HOTEL IN
HELSINKI, FINLAND
ON OCTOBER 21, 2010

COMMISSIONERS PRESENT:

JONATHAN LASH, Chair
ALLISON MacFARLANE
PER PETERSON

Wendy Kahler, Economic Officer of the US Embassy in Finland, convened the meeting at 8:31 a.m. **Chair Lash** welcomed all attendees and introduced the Commissioners. He said that the role of the Commission was to advise Energy Secretary Steven Chu on the management, transportation, storage and disposal of high-level radioactive waste in the United States. President Obama found that Yucca Mountain was not a suitable site for a repository and asked the Department of Energy to re-look at the waste problem. The Commission will advise the Secretary in that process. The Commission is particularly interested in Finland's recent success, both in terms of identifying technical alternatives and the political process that has been employed. The Commission is policy-based, not a siting body.

Esko Ruokola, principal advisor at STUK, spoke on long-management of spent fuel in Finland as well as policy and regulatory issues. Finland is at the forefront of developing solutions for geologic disposal of high-level waste. Utility companies TVO and Fortum are implementing Finnish disposal policy through a subsidiary company Posiva. Posiva is currently working in research and development efforts but will be responsible for managing the country's repository. The Finnish government is the industry's regulator and issues licenses for nuclear facilities. The Ministry of Employment and the Economy is responsible for energy efforts. STUK is the nation's nuclear safety authority, an analogue of the US NRC.

In the early days of nuclear power in Finland, spent fuel was regarded as an asset and the desirability of reprocessing was self-evident. Spent fuel was sent to the Russian Mayak facility to be reprocessed and not returned to Finland. The policy changed in the mid-1980s, when domestic disposal of spent fuel was additionally contemplated. New legislation in the mid-1990s allowed for export and import of spent nuclear fuel. Disposal efforts should start in 2020 and continue for 100 years before permanent closure. A government plan laid out in 1983 is the cornerstone of planning and timing efforts for Finnish spent fuel and work has been timely thus far. Finland has explored alternative disposal methods and determined that deep geological disposal involves fewer uncertainties, greater safety and imposes a lesser burden on future generations.

Finland utilizes a three-step decisionmaking process, similar to the US's process. The Decision-in-Principle requires an application and the regulators' safety appraisal, short of a

definitive safety assessment. Next, a potential host municipality may decide to exercise its right of veto; Olkiluoto voted by clear majority to approve siting of the repository in that municipality. The government then decides whether the decision is in the overall good of the society, followed by parliamentary endorsement. The Finnish parliament endorsed the Olkiluoto site nearly unanimously nine years ago. After endorsement, the utility submits construction and operation license applications subject to STUK approval.

Spent fuel is kept in interim storage for 30-50 years, whereafter it is sent to the encapsulation facility and emplaced within a bentonite buffer in the repository. Encapsulation technology is close to maturity but there is more work to do, including demonstration that capsules can be produced at an industrial scale. Further testing is needed to ensure ultimate safety of the repository site and technology.

Member MacFarlane asked whether the municipality still had the power to veto siting of the repository. Mr Ruokola replied that only the regulator by finding safety deficiencies or parliament by changing legislation could stop the repository now.

Member Peterson asked about the shift of sending spent fuel to Russia to storing Finnish fuel in Finland and the possibility of Finland allowing importation of other countries' spent fuel. Mr Ruokola replied that current feeling in the parliament and public is counter to taking any other high-level waste

Member MacFarlane asked how STUK would evaluate the repository site and design and how the radiation standard would fit into that evaluation. Mr Ruokola replied that the Finnish government has issued radiation standards consistent with international recommendations. STUK utilizes the assessments of non-industry experts and, often, extra-national experts in order to maintain independence.

Chair Lash asked for comment about the shift away from recoverability. Mr Ruokola replied that it is a safety issue and should be reserved only upon discovery of some deficiency. Posiva must design the facility for retrievability before and after closure. The legislation was silent whether retrievability is required primarily for cost or safety purposes

Member Peterson asked the basis of a decay-storage period of 30-50 years, given that decay storage ceases to be significantly effective after 70 years. Mr Ruokola replied that the heat generation rates of different burnup fuels was the main consideration.

Timo Ruskeeniemi of the Geological Survey of Finland spoke about site selection. Finland has four reactors operating on two sites. One reactor (OLK3) is under construction. 25% of Finland's power is nuclear-generated. The Finnish government has made a Decision-in-Principle to construct two more reactors. The country generates 70 tons of spent fuel per year and must dispose of about 5,500 tons of spent fuel. The Olkiluoto repository is authorized to hold up to 9,000 tons. Final disposal of waste is the best alternative for Finland due to their stable bedrock geology.

The Finnish government established a waste commission in 1978 to coordinate research and development work. Posiva Oy, established in 1995, is responsible for implementing the research. Regulators ensure that all activities are carried out in accordance with the law. Suitability criteria were developed first, using OECD guidelines. These guidelines give broad standards for the geological conditions, as well as for population density and land ownership. The whole country was screened for suitability. Following a nationwide screen in 1983, some 300 regional blocks were found to be suitable. A list of about 100 investigation areas was developed. TVO selected four of these sites for preliminary site characterization. Deep boreholes were drilled and detailed models developed. Following characterization efforts,

Posiva recommended Olkiluoto for the repository site. Long-term safety is now the primary area of interest with permafrost and glaciation being the dominant characteristics to be understood.

Member MacFarlane asked whether the four sites selected for characterization had similar geology. Mr Ruskeeniemi replied that sites were selected for their varied geologies. Eurajoki was not selected purely for its geological qualities, though it was considered acceptable. It is not one of the best sites in terms of geology. Transportation from Olkiluoto to Eurajoki would be simpler than for many other sites. She asked whether the authorities were concerned about copper-canister corrosion. Though this is not Mr Ruskeeniemi's field, natural analogues have been studied and an inference of acceptability has been made.

Member Peterson wondered whether, the site characterization having been done once, it could be done more quickly a second time. Mr Ruskeeniemi replied that the authorities were developing methods during the various rounds of site characterization, causing the process to take more time than it would for other nations who now have the benefit of Finland's experience.

Chair Lash asked which parts of characterization were performed by Posiva and which by the regulators. The work was initially performed primarily by the utilities with Posiva taking over upon its creation. Posiva coordinates research, combines data and formulates conclusions. Posiva, STUK and the Ministry of Employment and the Economy are responsible for public communication and transparency. The 100,000-year period of performance was derived from reduction of the radiation to that of uranium ore.

Juhani Hyvarinen, Chief Nuclear Officer for Fennovoima, spoke about that company's plans for spent fuel management. Being a new company, Fennovoima is not yet generating any waste. Fennovoima is an electrical co-operative, founded in 2007 with the sole purpose of building a nuclear power plant. The company is engaged in a siting process for their plant as well as an interim storage facility. The two remaining candidate sites are located in the northern part of Finland. Public outreach and education efforts have led to acceptance of Fennovoima's siting plans.

Following prohibition of export of nuclear waste, TVO and Fortum started to work together to develop solutions in the mid-1990s. The DIP sets an absolute limit on the repository's capacity. The Olkiluoto site seems to have plenty of repository-usable space, even if Finland were to build one or two more reactors.

Member Peterson asked whether waste would be transported by sea. Mr Hyvarinen replied, yes, assuming an agreement can be developed with Posiva.

Member MacFarlane asked when Fennovoima's plant would go online. Mr Hyvarinen replied, in 2020 with one reactor. A rough waste management plan has been developed but refinements are needed.

Chair Lash asked whether Fennovoima's power would be sold outside of Finland. Mr Hyvarinen replied that Fennovoima provides the power to its owners, who do with the power what they will. The cooperative was formed to reduce uncertainty in the marketplace on the part of Fennovoima's owners. Waste Fund fees are assessed based on a predicted cost of disposing and managing of the waste in the future.

Juha Karhu, Professor of Geology at the University of Helsinki, spoke about evaluating past hydro-geological conditions at a site for nuclear waste disposal. Hydrogeological evaluation is essential in siting a repository. Finnish bedrock is mostly 2-3 billion years old, very stable and located in the middle of a lithospheric plate. Earthquakes do occur but are generally barely detectable. The bedrock is formed of solid blocks surrounded by fracture

zones, which are filled by groundwater. This is important because water might react with materials emplaced in the repository. Groundwater at the Olkiluoto site increases in salinity as one drills deeper. Characterization efforts have taken a variety of forms, including mineral and radiological analysis. There has been some movement of natural uranium at higher elevations within the fracture zones. Groundwater analysis at the site has been done well but is fragmentary; more work needs to be done. Evidence of fracture creation within the last 50,000 years has not yet been found.

Member MacFarlane asked, if the site seems suitable for a repository, what would alarm Prof. Karhu about the site. Prof. Karhu replied that interactions between the groundwater and copper canisters needs to be better understood. Hydrogen sulfide levels must be minimal.

Member Peterson asked what depth is planned for the repository. Prof. Karhu replied, between 400 and 500 meters, a depth at which high-salinity waters are found.

Chair Lash asked whether Prof. Karhu's work had been financed by Posiva. He replied, yes.

Matti Kojo, a Researcher at the University of Tampere, spoke about local perception of a spent nuclear fuel repository in Eurajoki, Finland. Nuclear waste policy in Finland has changed since the late 1970s, shifting from reprocessing to direct geological disposal. Changes are ongoing and some questions remain unanswered. Eurajoki has been a nuclear community since the late 1970s and yet the community said no to a repository in the early 90s. Closer cooperation with TVO led to greater collaboration and discussions of a compensation package for the municipality in exchange for siting of the repository. The local council has twice approved expansion of the repository.

Finnish attitudes about waste disposal have changed over time. A peak in public dissatisfaction around 2003 may have been caused by Posiva's Onkalo activity. Eurajoki residents do see some positive impacts of siting the repository there including employment, economic development, and their own satisfaction with the area as a place to live. Perceived negative impacts are concern about the state of nature, rural non-farming livelihoods, and image. A majority of local residents perceive a risk to health, safety and well being imposed on future generations. The public seems to trust TVO and Fortum to handle nuclear waste, though trust is lower for other newer power utilities in Finland. Local opinion is strongly opposed to import of spent nuclear fuel.

Member Peterson asked if factors limiting acceptance of foreign fuels might draw public opinion upward. Mr Kojo replied that they might at the national level but the local level would be harder to predict.

Member MacFarlane asked for demographic information about the respondents to the Eurajoki surveys. Analysis was done to ascertain the quality of the data and found to be acceptably descriptive of the 7000 residents of the municipality. More information will be available when the report is published.

Chair Lash asked at what points public participation has been encouraged during the siting process and who has been involved. Mr Kojo replied that written comments were accepted throughout the hearing and DIP processes. The Swedish process has allowed for much more public participation than that undertaken in Finland. Public support is stronger for dealing with legacy waste. Trust at the community level contributed to public acceptance of siting the repository in Eurajoki. Communities neighboring Eurajoki have raised some concerns but, not having veto power, their concerns have not been vociferous.

Dr. Martti Tiuri, Professor Emeritus at the Helsinki University of Technology, spoke

about nuclear waste issues at the Finnish parliament from a parliamentarian's perspective. The parliament's 15 committees heard testimony from several experts on the implications of the creation of a repository in Finland. Parliamentary acceptance of the DIP was high. Several parliamentary acts have been made to get to where Finland now finds itself: producing nuclear power and constructing a repository. Dr. Tiuri sees the Finnish position on nuclear waste as very pragmatic. Parliament was involved in understanding some technical aspects of the repository's design. Future glaciation was extensively discussed. Many parliamentarians were surprised to learn that Finland has higher levels of uranium and thorium than most other countries.

Member MacFarlane asked how it was decided to place industry in charge of disposing of waste rather than a government organization. Dr Tiuri replied that it was based on MP discussions with municipalities and the industry.

Dr. Seppo Vuori spoke about evaluation of long-term safety of spent fuel repository and cost/finance issues related to spent fuel management. VTT is leading producer of nuclear waste research in Finland. VTT performs work for Posiva, STUK and the Ministry of Employment and the Economy, among others. Engineered and natural barriers are relied on for safety of the repository. Transportation of nuclear waste requires more understanding and research. VTT has coordinated the national research program on nuclear waste, though it constitutes only 5% of what Posiva spent on their own research program. Some uncertainties remain and VTT is working to resolve those. In performing research, conflicts of interest must be avoided. Different employees of VTT provide services to Posiva and STUK. VTT is participating in international studies on advanced fuel cycles.

Jaan Avolahti spoke about financing procedures for nuclear waste storage and disposal in Finland. The two key players in nuclear waste management are the authorities and the licensees. Construction and operation of a nuclear facility require two separate licenses. Three organizations have operating licenses. License holders bear full responsibility related to operating and financing issues. Funds must be available if or when they are needed. The state Nuclear Waste Management Fund was started in 1988; prior to that, industry funded their own waste management funds. The Fund is operated by a Board and a Managing Director, all nominated by the Finnish government. The main principles of the Fund are to invest in securities and yield the best possible return, and that the fund capital should correspond to the cost of the remaining waste. Each license holder in the Fund has a specific account and associated interest rates. Prices are assessed on an annual basis. Payments to the Fund are made annually. Repayments from the Fund are possible but rare. Operators should keep 10% to provide as additional security. The distribution period will last 25 years. Seventy-five percent of funds may be borrowed back by the licensee against full security. The state may borrow 25%. Liabilities now total €2 billion. Fund shares total €1.9 billion. The difference is covered by securities. The total projected cost of future waste management is €6 billion.

Member MacFarlane asked whether the Fund was assessed based on electricity production. Ms Avolahti replied that it is based on the technical plan for the implementation of waste management. Funds cover administration and research work.

Chair Lash asked if the funds were apportioned according to market share or waste output or by some other means. Ms Avolahti replied, yes.

Member MacFarlane asked whether the safety assessment was quantitative or qualitative. Dr Vuori replied that it tended to be more quantitative in the short term, skewing to be more qualitative over longer periods of time.

Member Peterson asked for comment about the fact that anticipated return on investments seems not to be taken account of. Ms Avolahti replied that it is a conservative approach to ensure availability of funds. The system works well.

Chair Lash asked what form the Fund securities took. Ms Avolahti replied that shares in power plants may be offered as well as bank guaranties.

Harri Lammi, of Greenpeace Nordic, spoke about Greenpeace's perspective on Finnish nuclear waste repository plans. Greenpeace has been observing the Finnish process since the mid-1990s. They do not believe that Finland has developed a solution to the waste problem. Technical questions remain about the bedrock at the repository, though siting it at Olkiluoto solved some social concerns. Some residents of Eurajoki were pressured to move away because of their opposition to the repository. Finland is a small society with an even smaller community of experts. Opposition has been left mainly to NGOs. Industry-funded research was used by Parliament in their decision of 2001. Because of the small size of the research community, confirmatory studies are rare and underfunded. There has not been a real discussion about risks and challenges in the Finnish system. The politicians did not know what they were approving. The time scale is the greatest challenge to accurate risk assessment. Production and retrievability of the copper canisters remain open questions. Funding and plans to prevent intrusion have not been developed.

Janne Bjorklund, of the Finnish Association for Nature Conservation, gave a talk entitled "Finland, the Nuclear Waste Country." Finland is trying to be the first to solve the nuclear waste issue. German low- and medium-level waste capsules began to leak after 30 years. The new reactors produce more dangerous waste than the old ones. The problem of final disposal has not been solved anywhere in the world. Posiva has misstated the depth of the permafrost in Finland. The repository will be uncontrollable if or when it is covered by two kilometers of ice in a future ice age. Renewables are the next "king" technology. In the European Union, new electrical capacity from renewables has increased from 20% to 60% over the course of 15 years. OLK3 has led to dispute between TVO and AREVA. It is too late to meet Kyoto Protocol targets. A nuclear repository would be by far the longest-term structure that mankind has ever produced. He translates Onkalo as "hiding place," not "cavity."

Member MacFarlane asked Mr Lammi how his proposal differed from what has already been proposed viz. monitoring, retrievability, etc. Mr. Lammi replied that the process has been flawed and that once the repository is closed, additional data will not be collected.

Member Peterson asked about the impact on public health in the circumstance that there is a leak from the repository after Finland has been covered by two kilometers of ice. Mr Bjorklund replied that the repository cannot be controlled at that depth of ice and once the ice clears the area, leakage is far more likely.

Chair Lash asked for comment about Finland's consent-based process; how could it be strengthened? Mr Lammi replied that other municipalities need to be granted veto power, parliament needs to be more involved in the whole process and that it might be helpful to update the waste management plan which has been in place since the 1970s.

Risto Paltemaa, an employee of Posiva providing public comment, said Posiva has a research program now being conducted by VTT to explore questions of copper corrosion by water. The aim is to reproduce results that have been published. In Finland, the utilities are responsible for waste, following the principle that the polluter pays.

Anni Huhtala, an employee of MTT providing public comment, said she is surprised so few organizations have been involved in developing a solution in Finland. As a researcher, she

is particularly interested in the social cost of a disposal facility. There has not been an independent assessment of social costs and impacts.

Chair Lash thanked those assembled and acknowledged having rushed speakers through their presentations. Hearing from the speakers was a very important part of developing the Commission's recommendations to the Secretary of Energy. He adjourned the meeting at 11:42 a.m.