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A SOLUTION THAT WORKS!
RADIOACTIVE WASTE MANAGEMENT IN THE NETHERLANDS

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ABSTRACT

In the Netherlands the policy to manage radioactive waste is somewhat different from that in other countries. The philosophy is that hazardous materials must be isolated, controlled and monitored. This is done by securing containment of radioactive waste in terms of organisational aspects as well as in terms of physical treatment.

Really long-term, i.e. at least 100 years, storage in above ground engineered structures of low, medium and high level waste, including spent fuel and TENORM is the first element in the Dutch policy. Secondly, and included in the policy are all necessary steps to be taken for the longer term. The burden will not be transferred to the next generations because a clear system of liabilities is created and the availability of finances is guaranteed for the future. For a country with a small nuclear power programme and an important amount of waste from other applications of radioactive materials, it is a practical solution that works.

I. INTRODUCTION

In The Netherlands there are some 200 producers of radioactive waste, varying from nuclear power plants, research establishments, all sorts of industries and hospitals. Most of them generate only small volumes of low and medium level waste. These small volumes however cover a wide range of waste forms: solids, liquids of all natures, slurries, animal carcasses, machines, equipment, sealed sources etc. Some processing industries generate larger volumes of solid low level radioactive material. The concentration of the radioactivity is low but the nuclides present are alpha emitting nuclides, which are highly radiotoxic. These materials are commonly called NORM or TENORM waste: (Technically Enhanced) Naturally Occurring Radioactive Material. The presence of a uranium enrichment plant in The Netherlands also results in the production of depleted uranium, which has to be taken care of.

Even smaller volumes of high level waste are produced by the nuclear power plants and by the research reactors. Research reactors at Petten and Delft were constructed in the late fifties. The research reactor at Petten is also used for radioisotope production: important quantities of molybdenum for medical use are produced here. In the late sixties and early seventies two nuclear power plants in Dodewaard and Borssele started producing electricity. The Dodewaard reactor was shut down in 1997. The Borssele plant will continue to operate as long as safety and economics permit: foreseen is a lifetime of sixty years.

II. LEGAL FRAMEWORK

The basic legislation governing nuclear activities, including all activities with radioactive materials, is contained in the Nuclear Energy Act. The act covers two targets: the promotion of peaceful

uses of atomic energy and the protection against adverse effects of radiation. Due to societal and political developments the protective target nowadays is the most elaborate part. The act lays down rules in the nuclear field, makes provisions for radiation protection and designates the different competent authorities. Since the protective character of the act dominates, the ministry of the environment is in most cases leading.

The application of radioactive materials is permitted only if licensed under the Nuclear Energy Act and this act stipulates that a licensee can dispose of its waste only by handing it over to the authorised waste management organisation. As such the Central Organisation for Radioactive Waste (COVRA) is the only organisation authorised by the government of The Netherlands.

All activities with radioactive substances, excluding shipments, have to comply with the rules laid down in the Radiation Protection Decree, which is part of the Nuclear Energy Act. In the decree a definition is given for radioactive waste.

Radioactive waste: a substance can be considered to be waste if for this substance no use, reuse or recycling is foreseen and the substance is not to be discharged.

This definition is in compliance with the IAEA Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. In the decree also limits are given for exemption and clearance of radioactive materials. The limits are based on the Council directive 96/26 of the European Commission. In The Netherlands it has been decided to use the same levels for exemption and clearance.

III. ISOLATE, CONTROL AND MONITOR

In general, waste prevention and reuse of materials is an important environmental goal. But when the production of hazardous waste is unavoidable then these materials must be isolated, controlled and monitored. Of course this philosophy is also applied to radioactive waste management.

Over twenty years already, the government of The Netherlands follows a straightforward policy based on the above-mentioned philosophy. The main elements of this policy are:

- all kinds and categories of radioactive waste are stored for at least 100 years above ground, in engineered structures, which allow retrieval at all times;
- this long-term storage, together with a central treatment facility is considered as a normal industrial activity and is located on one single industrial site;
- research will be performed on final disposal possibilities within the Netherlands or within an international framework;
- COVRA takes care of all the wastes produced.

Long-term storage is essential because direct disposal is not yet feasible in The Netherlands. A disposal site for this type of waste is not available, the public acceptability for deep geologic disposal is low and the small volumes of waste available for direct disposal do not require an immediate final solution. Also the financial burden of a direct disposal facility is prohibitive for the small quantities concerned. The money has to be generated in a capital growth fund that is allowed to grow over a substantial time period.

The choice to store for a long time was well considered and was not taken as a ‘wait and see’ option. This is clearly demonstrated by the fact that integral parts of the policy are: the establishment of the capital growth fund and a clear choice for the ownership of the waste within COVRA. This policy does not leave the burden of waste generated today to future generations. Only the execution of the disposal action is left as a task for the future. A disposal solution is at principle available and the money will become available in the capital growth fund.

IV. COVRA

COVRA has been set up in 1984 as a joint venture between the major producers of radioactive waste in the country and the government. Due to the liberalisation of the energy-market within the EU

and because no new nuclear capacity is foreseen, COVRA has become a company fully owned by the State in 2002.
Since the beginning, COVRA's only statutory task is to execute the policy of the government with respect to radioactive waste. This means more specifically:

- collection and shipment of the radioactive waste;
- treatment and conditioning of low and medium level radioactive waste;
- storage of all categories of waste in buildings;
- monitor the environmental impact of treatment and storage;
- advise government on matters related to final disposal policy or other possibilities;
- execute in the future the final option to be chosen by government;
- stimulate and perform research and development of waste treatment-methods;
- stimulate and perform research and development necessary for the final removal;
- contribute to national and international work in advisory committees;
- inform the public about the management of radioactive waste.

COVRA has a site available of about 25 ha at the industrial area Vlissingen-Oost. This site offers enough space for the storage of existing waste and the waste expected to be produced in the next hundred years. At this site COVRA operates a facility including the following:

- an office building including an exhibition centre;
- a building for the treatment of low and medium level wastes;
- various storage buildings for conditioned low and medium level waste, for NORM waste, for depleted uranium and for high level waste.

Storage of low and medium level waste

V. QUANTITIES, TREATMENT, STORAGE

Low and medium level waste

Annually some 300 m^3 of conditioned low and medium level waste is produced. Most of it is conditioned at the COVRA facilities. Only resins and evaporator sludges are directly conditioned with cement at the nuclear power plant Borssele.

In the treatment building various installations are available, such as a super compactor, an incinerator for biological waste, an incinerator for organic liquids, shearing and cutting installations, a

cementing station and wastewater treatment systems. The final conditioned waste form is a cemented package of 200 or 1000 litre. These packages are stored in concrete storage buildings.

At the moment COVRA operates three storage units, each unit has a capacity for approximately 5000 m^3 conditioned waste. A reception bay connects the three storage units. A fourth unit can be built and connected with the central reception bay when needed in the future. At the site there is room available for sixteen storage units. Blocks of waste packages are placed in rows, which leave open corridors for inspection. Lower dose rate packages are stored along the outer walls of the modules, and on the top layers in order to provide additional shielding for higher dose rate packages at the interior. Humidity in the storage building is kept below 60% in order to prevent condensation of air moisture on the packages.

NORM waste

In the ore processing industry the natural radioactivity present is sometimes concentrated in the process streams leading to the generation of radioactive waste. Thus phosphor production generates a radioactive waste product: a calcinate. Up to some 500 tonnes of calcinate can be produced per year, depending on the radioactive characteristics of the ores used. The activity in this calcinate is dominated by polonium, bismuth and lead isotopes and ranges from 500 to 4000 Bq/gram. These elements are concentrated in the calcinate because they are volatile at the high temperatures in the electrofurnace. These radioisotopes are highly radiotoxic but their half-lives are relatively short. Depending on the initial activity the material will have decayed to exemption/clearance levels within some 100 years. So after the foreseen storage at COVRA as radioactive waste, the material can be disposed of as chemical waste.
The calcinate itself is a product that does not need to be conditioned to assure safe storage. Any additional conditioning would enlarge the volume and would add to the costs.

The calcinate is collected in a specially designed 20-ft container. Inside the container a polyethylene bag is present that serves as a liner. In- and outside of the container are preserved with high quality paint. The container can be filled with 30 tonnes of material. The containers are stacked four high in the container storage building.

The container storage building is a steel construction frame with steel insulation panels. High quality criteria were set for the construction and for the type of materials used in order to meet the 100 years lifetime with practical maintenance. The building can modularly be expanded and per storage module an overhead crane is present. As a start two modules were constructed, having a capacity to store some 12,000 tonnes of calcinate. Ten more modules can be built at the site. Technical provisions inside the building are minimal. With mobile equipment the air humidity in the storage building is kept below 60%.

Depleted uranium

Depleted uranium from uranium enrichment is generally not regarded as waste. The depleted material still contains uranium that -depending on economic factors- can be used as feed material for an enrichment process. However when larger quantities are in stock and real use is not foreseen within some tens of years, the product comes close to the definition of waste. In the Netherlands a maximum of 2500 tonnes of depleted uranium is produced per year. In this material U-238 and all daughters are present. The activity is around 10,000 Bq/gram. For depleted uranium a solution similar to the one as for the calcinate has been chosen: storage of unconditioned material in DV70 containers, that can hold some 10 tonnes. The depleted uranium is produced as UF_6. This is not a chemically stable product suitable for long term storage and therefore this depleted UF_6 is transformed in the stable U_3O_8. This is done in installations in France. One storage module with a storage capacity of 650 containers became operational in 2004. Now some 100 containers are stored. In total eleven more storage modules can be constructed at the site.

For depleted U_3O_8 the argument to wait for decay to exemption/clearence levels is not applicable. The potential value of the material for reuse dominates here the choice not to embed the material in a cement matrix. If reuse does not take place in the far future and the decision is taken to dispose of the material, then this can be done according to then applicable standards. Money for this treatment and for the final disposal is set aside in the capital growth fund in the same way as is done for all other waste stored at COVRA.

High level waste

All the spent fuel of the Dodewaard plant will be reprocessed by BNFL in the United Kingdom while that of the Borssele plant will be reprocessed by Cogéma in France. The resulting reprocessing waste will be sent back to the Netherlands. The vitrified residues, cemented or compacted hulls and endcaps and other high level cemented waste will be stored in a storage vault that was commissioned in 2003. High and low enriched spent fuel from the research reactors and some other high level waste from research activities will be stored in this building also. A distinction is made between heat and non-heat generating waste, since the former category requires cooling. The non-heat generating waste is, remotely controlled, stacked in well-shielded storage areas. The heat generating waste such as the vitrified residues, is put into vertical storage wells cooled by natural ventilation. This method is proven technology in the storage facilities of Cogéma at La Hague.

The spent fuel elements of the research reactors are delivered to COVRA in a cask containing a basket with 33 elements. The basket with elements is removed from the cask and placed in a steel canister, which is welded tight and filled with helium. These sealed canisters are placed in wells, in the same way as the vitrified residues. The wells are filled with argon to prevent corrosion. At this moment nine canisters with spent fuel from the research reactors at Petten and Delft are stored and 28 canisters with vitrified waste from reprocessing in France.

The loading area for high level waste.

VI. A SOLUTION THAT WORKS!

As indicated in paragraph III , radioactive waste must be isolated and controlled. This can be done by storage in buildings and control by society. Also this can be done by shallow land burial and control of society, or by deep geologic disposal and control of society. For the three options mentioned the degree of societal control is the highest for storage in buildings and the lowest for deep disposal. When containment is required over periods of time longer than the existence of society doubt may raise on the capacity of society to fulfil the control requirement.

The Netherlands is a small country, 41,000 km^2, populated by 16 million inhabitants and it has a very high ground water table. Actually a large proportion of the country lies below sea level and is protected by manmade dikes and natural dunes. The ground water level must be regulated mechanically by a system of pumps and discharge canals. Under such circumstances shallow land burial is not acceptable for the low and medium level waste. Ground water contamination is a potential risk that is judged to be too high. As a consequence for all waste categories deep geologic disposal will be required as ultimate solution. Fortunately, deep lying, large salt formations with a good potential as disposal site, as well as deep clay formations, are available in our country. Unfortunately however public acceptance

for deep disposal is lacking. However it should be realised that the waste volume that is actually present is only a few thousand m^3 and for such a small volume it is not economically feasible to construct a deep geologic disposal facility. The waste volume collected in a period of 100 years can be judged as large enough to make a disposal facility viable. The solution chosen for The Netherlands creates at least six positive effects:

- Public acceptance is quite high for long term storage. The general public has more confidence in physical control by today's society than in long-term risk calculations for repositories even when the outcome of the latter is a negligible risk.
- There is a period of 100 years available to allow the money in the capital growth fund to grow to the desired level. This brings the financial burden for today's waste to an acceptable level without transferring it to future generations.
- During the next 100 years an international or regional solution may become available. For many countries the total volume of radioactive waste is small. Co-operation creates financial benefits, could result in a higher safety standard and a more reliable control.
- In the period of 100 years the heat generating waste will cool down to a situation where cooling is no longer required.
- A substantial volume of the waste will decay to a non-radioactive level in 100 years.
- A little bit more than 100 years ago, mankind was not even aware of the existence of radioactivity. In 100 years from now new techniques or management options can become available.

VII. CONCLUSION

The Netherlands followed a straightforward and clear line to implement the governmental policy to manage the small volume of radioactive waste. COVRA executes this policy: facilities are in operation to store low, medium and high level waste for a period of at least 100 years. COVRA takes over full title of the waste and prepares financially, technically and socially the steps to be taken after this period of storage. This is a dedicated management solution for The Netherlands that works!