6.3

Radioactive waste from the Non-Nuclear industry. Developments at COVRA in the Netherlands

H.D.K. Codée, J. Welbergen

COVRA N.V.

The Netherlands

RADIOACTIVE WASTE FROM THE NON-NUCLEAR INDUSTRY DEVELOPMENTS AT COVRA IN THE NETHERLANDS

J. Welbergen[1] and H.D.K. Codée[1]

ABSTRACT

In the Netherlands, radioactive waste is managed by COVRA, the Central Organisation for Radioactive Waste. Its task is to execute the radwaste policy of the Dutch government, which is to store all radwaste above ground, for a period of at least 100 years, in engineered structures, which allow retrieval at all times.

Since 1993 radwaste from the Non-Nuclear Industry (NNI) gains interest; notably from the oil & gas industry and from the phosphoric acid plants. Waste from the oil & gas industry is produced in relatively small quantities but in a large variety of forms whereas waste from the phosphoric acid production or other ore-processing industries is produced in large quantities but as a defined product. Generally the concentration of the radioactivity is low and of natural origin but the nuclides present are highly radiotoxic. The high safety standards of waste management for "normal" waste from the nuclear industry are also applicable to waste from the non nuclear industry.

In its planning phase is the realisation of a storage facility for low level radwaste originating from ore-processing industries such as phosphoric acid plants. These will be stored as a stable product in containers. After decay of the radioactivity of this waste subsequent disposal as non-radioactive waste may be possible.

INTRODUCTION

COVRA is the Dutch central organisation for radwaste and its task is to take care of all Dutch radwaste. COVRA operates a facility located in the south west corner of the Netherlands in the Province of Zeeland.

COVRA has a facility in operation for treatment, conditioning and storage of low level radwaste (LLW) and a storage building for intermediate and high level radwaste (ILW/HLW) is in its planning phase. This storage-building for ILW/HLW will be in operation in the year 2001.

The radwaste in the Netherlands originates from approximately 300 producers. The main producers are two nuclear power plants (NPP) and two research reactors.

Besides the NPP's and two nuclear research reactors, the volume of radwaste produced by other users of radioactive materials in research, medicine and industry is relatively important and equals the volume of waste produced by the nuclear sector. The low level radwaste consists of solid compactable waste, animal carcasses, liquids, spent sources and solidified sludges and resins from the NPP's. After treatment some 300 m^3 of conditioned and packaged waste results annually.

Radwaste from the NNI will result in larger volumes of conditioned waste.

COVRA calculates for handling and storage of radwaste a price based upon the volume needed by treated and conditioned radwaste, in a storage-building. For final disposal an extra fee is included. The total price covers all costs including the future costs and there will be no retrospective adjustment.

There are two stages of quality assurance (QA) for radwaste at COVRA's. One stage is the QA of transport and treatment of unconditioned radwaste and the other one is the QA of storage of conditioned radwaste.

The demands for safe transport and handling of radwaste are based upon the European transportation rules (ADR) and the radiation protection principles such as ALARA (As Low As Reasonably Achievable), doselimits and justification.

---

[1] COVRA, Postbus 202, 4380 AE Vlissingen

For conditioned radwaste there is an additional criterium besides ADR and ALARA. This criterium is based upon Isolation, Control and Surveillance (ICS).
The conditioned radwaste is stored for an interim period of 100-150 years in an above ground storage facility. After this interim period the conditioned radwaste will probably be transported to a repository for disposal in deep geological formations.
Radwaste from the NNI with relatively short lived nuclides (e.a. Po-210, Bi-210 and Pb-210) will be exempted from radwaste after the interim period of storage in an above ground storage building.

The radwaste to be treated and the radwaste already conditioned has to be in compliance with the waste acceptance criteria before sending it to COVRA.
The acceptance criteria of radwaste from the NNI is still in development and up till now COVRA has only accepted calcareous slag in two 20 ft ISO-containers suitable for transport of radwaste LSA I.

ACCEPTANCE CRITERIA OF NON-NUCLEAR INDUSTRY RADWASTE

The waste acceptance criteria for NNI radwaste will be set up by COVRA with the aim to guarantee safe transport as well as safe handling and safe storage. In general there is not a clear cut distinction between criteria for transport and those for handling and storage. Only those waste packages whose application forms were judged and accepted by COVRA can be transferred. The NNI radwaste has to be collected in standardized 100 litre drums or in 20 ft containers.
The drums and containers must be clean and dry at the outside and no corrosion or deformation must have taken place. The total weight of the drums or containers is also depending on the type of lifting equipment. For 100 litre drums a maximum of 110 kg is allowed and for containers of 20 ft a maximum of 35 tons is allowed. The packages must be securely closed and metal drums older then two years will not be accepted before validation by COVRA. Containers must be of the ISO type and will be inspected before shipping to COVRA.

PACKAGES

Only standardized packages (except containers) as supplied by COVRA may be used. In this way transport of waste always takes place with packages of guaranteed quality.
For solid waste 100 litre carbon steel drums are used with a wall thickness of
1 mm with the A-type qualification.
For large volumes of solid NNI radwaste 20 ft ISO-containers with an inside plastic bag will be used. These containers are made out of a steel frame and plates. The maximum net weight of the containers is 30 tons and the containers have to be in compliance with the ISO-norm 1496/1-1979 "freight containers specification and testing". A special test will be performed to assure that these containers are suitable for a content of 30 tons.
For handling and transport the containers are provided with four corner fittings (ISO 1161)

For liquids COVRA supplies the waste producers with carbon steel drums of 30 or 60 litre in which a polyethylene liner has been blown. These drums have an UN-certificate and they do comply with the spray, punch and stacking test for A-type packages but not the very severe drop-test of nine meters. Liquids with a relatively high specific activity must therefore be offered by the waste producers in a 30 litre drum. This drum is for transport-safety placed in a carbon steel 100 litre drum in which an interior is present with absorbent material (vermiculite). Such a combination package does not withstand a 9-meter droptest either, but in case of an accident and damage of the inner container any liquid will be absorbed.

For sludges from the oil & gas industry 60 litre polyethylene boxes are used and these boxes fulfil the requirements for industrial packages (IP-2).

RADWASTE FROM THE PHOSPHORIC ACID PRODUCTION

In 1993 COVRA was confronted with the question how to handle radioactive waste (calcinate) from the phosphoric acid industry.
Calcinate is a by-product of the production of phosphorus (P_4) from P-ore and consists out of greyish grains with a density of 800-1000 kg/m^3 and a percentage of moisture is less than 1 %.
Calcinate contains the radionuclides Po-210, Bi-210 and Pb-210 and of each radionuclide the radioactivity is approximately 800 Bq/g.
The chemical contents of the calcinate is mainly SiO_2, P_2O_5 and CaO.
The amount of calcinate to be stored at COVRA is estimated to be 1000-2000 tons per year.
In 1993 the first tests how to condition the calcinate were done by supercompaction. These tests showed that the volume of the calcinate reduce by a factor 2 after supercompaction. The overall volume reduction factor was however less then 1 due to the fact that conditioning was done by cementation.
Treatment of large volumes of calcinate by supercompaction and conditioning with concrete is a very expensive operation.
Calcinate from the sintering process is already a type of a conditioning proces and leaching test showed that this form of "conditioned" radwaste is acceptable for storage .

In 1996 COVRA started with the engineering of a storagebuilding (COG) for containers with calcinate.
The construction of the COG storagebuilding consists of modules and one module consists out of a concrete plate of 60m x 42m with a steel construction to which steel sandwich plates with isolation material are placed. The height of the COG will be 17 meters.
The floor is coated with an epoxy resin for decontamination purposes and the floor has a storage capacity of 100 kN/m^2 (± 10 tons/m^2). The floor can contain more than 400 containers with in total weight of 12,000 tons of calcinaat.
The relative humidity in the COG will be kept under 60% by using construction dryers to prevent condensation of moisture inside the building.
Trucks loaded with containers enter the storage building through two big rolling doors (5m x 5m). The storage of the containers in rows of 4 containers on top of each other is done by a crane with the capacity of 40 tons.
Between blocks of four rows of containers there will be corridors of ± 1 meter to allow visual and radiological inspection.

The administration of specific numbers and the coordinates of the containers in the COG are stored in a database.
Personel entering the storage building have to pass an entrancebuilding which is situated along the side of the COG. The entrance of the COG includes a controlroom with electric and health physics equipment.
Before entering the controlled zone of the COG the possession of a dosimeter and a keycard is checked at the entrance. After leaving the control zone hands and feet are monitored for contamination of radionuclides.
The operation time for the COG is estimated to be 100-150 years. In this period the radioactivity of the calcinate will decay under the exemption level.
The contribution of radiation from the COG to the radiation level at the fence of COVRA must be lower than 0,05 mSv per year. The radiation level at the fence is controlled by the health physics department of COVRA by on-line monitoring and by periodic measuring of the radiation.
Dryers in the COG, for keeping the relative humidity low, collect the condensation water in 1000 litre containers. The radioactivity of the condensation water will be monitored before sending the water as radwaste to the treatment facility.
Aerosol monitoring inside the COG is done by samplers with filters and the filters will be analyzed monthly by the health physics department for radioactivity.

After thirty years of operation time, maintenance of the COG will take place and during this period of maintenance an inspection of all containers for corrosion is planned.

RADWASTE FROM THE OIL & GAS PRODUCTION

During oil & gas exploitation primordial radionuclides are concentrated in the solid and liquid waste fraction.
After separation of the solid and the liquid fraction it is possible that radwaste will originate with a radioactivity of 100-500 Bq per gram.
The estimated volume of radwaste from this industry is 1 m^3 solid waste per year and 10-50 m^3 liquid waste per year.
The radionuclides in the radwaste are Ra-226, Pb-214, Bi-214, Pb-210, Ac228 and Th-228.
Besides radionuclides there are also hazardous chemical compounds (e.a. mercury) to consider.
Solid waste as scales plus operational waste will be treated with a supercompactor of 1500 tons.
Conditioning of these compacted drums is done by cementation in 200 litre drums. The drums will be stored in the storage building for low and medium level radwaste (LOG).
Liquid waste as sludge (sand + clay + scalings + inorganic and organic liquid) is separated in non-radioactive inorganic liquid and in sand + clay + scalings + organic liquid containing the radioactive components.
The radioactive fraction can be treated by using an incinerator. Test performed by COVRA with the inceration of sludges gave good results. The resulting cinder/ash can be supercompacted directly or can be supercompacted after mixing the cinder/ash with cement and water. Tests of direct supercompacting of the cinder/ash gave also good results.
Attempts to condition the sludges directly by cementation failed due to inadhesiveness of the organic products in sludge with cement.
Conditioning of the cinder/ash in a 200 litre drum with cement comply with the waste acceptance criteria for storage in a low and medium level radwaste storagebuilding.
Before treatment the sludge will be temporarily stored at COVRA in 5 m^3 stainless steel tankcontainers.

RADWASTE FROM OTHER NNI

The amounts of radwaste from other NNI like the steel industry, the fertilizer industry and metal industry are not yet clear.
At the moment research is done by the fertilizer industries how to concentrate the waste into manageable quantities.
COVRA is in principle not set up to handle huge volumes of NNI radwaste.

CONCLUSION

COVRA's waste management system is specifically engineered for small volumes of LLW, ILW and HLW from all Dutch nuclear activities.
Large volumes of calcinate from the non-nuclear phosphoric acid industry can also be dealt with.
Huge volumes of waste from de non-nuclear industry are beyond the range of the present COVRA organisation.