WASTE MANAGEMENT WITH SPECIAL EMPHASIS ON VOLUME REDUCTION

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ABSTRACT

Volume reduction was not a value per se in Waste Management until 1979 in the Federal Republic of Germany, as a low cost final disposal facility in the form of the ASSE salt mine was available. However, when it was closed at the beginning of 1979, the reactor operators had to find on site storage methods, and this naturally led to the strong desire to reduce the amount of waste to be stored on site.

Therefore, volume reduction technologies had to be either applied on a broader scale or to be found, if not yet developed.

INFLUENCE OF THE FINAL DISPOSAL FACILITY

It is still possible that the ASSE salt mine might be available again as a final disposal mine. However, for the time being, it is used essentially for testing purposes.

Meanwhile, two new disposal facilities are under development and they are differentiated through the waste form which is intended for final disposal: The non-heat-generating wastes will only be stored in the Konrad-iron-mine; this mine is no longer used for iron mining. The heat-generating wastes will be stored in the Gorleben salt mine which is still under exploration and will only be available around the turn of the century, if the salt formation proves to be adequate.

The distinction between LAW, MAW and HAW - meaning low, medium and high active wastes - is no longer maintained in Germany. We only distinguish between heat- and non-heat-generating wastes.

Both disposal facilities have in common that they are based on a deep geological formation. Generally, the depth is more than 600 meters underground and it results in the consequence that handling of the waste containers, drums, etc. needs to be standardized. Extensive studies have been made concerning the underground handling in the Konrad-iron-mine and have led to a spectrum of standard casks or containers which will be used from 1992 onwards, if the licensing procedure can be closed by then.

The maximum allowable weight of any package acceptable in Konrad is 20 tons and another requirement is that the containers are not allowed to have empty spaces.

When the licensing procedure started in Konrad, it was thought that the total capacity of this mine would only be sufficient for 15 to 20 years. However, the volume reduction methods introduced in the meantime, in order to reduce the interim storage requirements, led to such a reduction in waste volumes that now the Konrad disposable volume may be sufficient for 100 years.

NEW TREATMENT METHODS FOR REACTOR WASTES

Core Components

Among these we count absorber rods of PWRs, control blades and water channels of BWRs, start-up sources and other core components which essentially contain cobalt 60 due to activation or tritium in the case of the control rods.

These core components are transferred from the reactor into the reactor pool which is in the same building in Germany. This is one of the major differences when compared with American reactor designs. In the pool, with the help of special mobile installations, the core components are cut to a length which is compatible with the inner dimensions of the waste cask of the MOSAIK type. These waste casks are in the range of four to eight metric tons and have useful volumes of 150 to 500 liters, depending on the shielding requirements.

The cask material is cast iron and where necessary for shielding purposes the use of inner lead liners is made to reduce the outside dose rate.

These low cost/high integrity waste casks are licensed for transport on public roads, for interim storage and final disposal.

In order to show the adequacy of this concept to the authorities, not only long-term corrosion tests with different waste forms inside the casks have been made, but also so-called mechanical super tests in order to show that these casks, even in the hypothetical case of a drop in the final disposal mine from a height of 800 meters, do not lose their shielding capacity. Heretofore, several of them have been taken by helicopter to 800 meters and dropped on a concrete plate, 30 centimeters thick, on top of a gravel foundation.

Ion Exchange Resins

Ion exchange resins were generally cemented in Germany and disposed of in concrete overpacks. GNS had introduced in 1975 another process based on thermally hardening polystyrene. This process has the advantage that it leads already to lower storage volumes than cementation, giving a reduction of about 50% in volume.

A further step in volume reduction was made in the early eighties, when it was decided that the ion exchange resins could be stored and disposed of within the MOSAIK waste casks after simple dewatering. It is evident that this procedure which avoids the use of a conditioning matrix leads to the highest volume reduction which can run up to a factor of 20 if compared with cementation.

Evaporator Concentrates, Sludges

Here again, cementation was a standard operating procedure in the past. However, it is evident that complete drying of the concentrates and sludges would give the maximum volume reduction. This procedure would once more suppose that all the safety required for transport, interim storage and final disposal must be presented by the final disposal package, again in general in MOSAIK casks.

The process chosen is vacuum drying, batch-wise, in MOSAIK casks. A vacuum system is used in order to transfer the wastes from the collection tanks of the power station to a dosage tank of the mobile FAVORIT facility. From the dosage tank it is transferred again by a special vacuum system to the MOSAIK casks in which the vacuum distillation process takes place.

The mobile installation FAVORIT is describe extensively in another session by Mister Benavides who reports about its use in the Spanish Almaraz power station. In this particular Spanish application, ion exchange resins which had been conditioned following the "tiger-lock"-process had to be reconditioned. This was done by putting the 200 l drums with the waste into vacuum distillation chambers. The dried waste is then supercompacted within a GNS-delivered FAKIR station.

The services of vacuum distillation are provided in Germany either on site or away from the reactor in a central research facility.

The volume reduction possible with this process, depending on the activity level of the sludges, is generally greater than five and can in extreme cases run up to a factor of 20.

Miscellaneous Low Level Solid Wastes (LLS)

The first remark which has to be made here is that LLS *is practically* never 100% solid. In most cases, minor or greater volumes of moisture or even liquids are contained within the various type LLS wastes. The humidity can be simply due to condensation effects during extreme temperature changes while loading drums, but in most cases the LLS contains drain waters of minor quantities.

Not in all power station a separation of incinerable and non-incinerable wastes is possible. Therefore, it has to be done externally or the miscellaneous wastes are just supercompacted. For this purpose, GNS has *developed a mobile* system called FAKIR which was put in service for the first time in June 1981 in Germany. FAKIR is a super-compactor with a maximum compressive force of 1,200 metric tons. The advantage of this procedure is that free liquids are expelled from the LLS matrix. In order to give to the compressed pellet a stable form, the LLS is compacted in between two metal cartridges. The cartridge *assures that* the pellet will not change its form and size when the compression force is reduced. The compression ratio range from 1.6 in case of steel bars and concrete to 15 in case of low density miscellaneous wastes. In the case of purely metallic wastes of small geometries, half the theoretical density of steel could be easily achieved.

Super-compaction has become a standard application in Germany now for most of the low level solid wastes.

As incineration has already been presented, we will not discuss it any further except that the volume reduction for LLS-incineration when compared with a super-compaction is generally highly over-estimated, due to the high content of non-incinerable wastes in LLS.

In a German economic study about the advantages of incineration and super-compaction, it could be shown that incineration was only favorable, if the final disposal cost would exceed a value of more than 1,500 dollars per 55 gallon drum.

Contaminated Scrap Metals

Contaminated scrap metals arise in the power station during repair works, but mainly during commissioning. In the Federal Republic of Germany, we distinguish at this moment between two categories of the radioactivity content: > 74 Bq/g and < 74 Bq/g. The wastes which have less than 74 Bq/g can be cut to oven-size. The charge unit for the high capacity induction oven is a 200 l drum. After cutting, sorting can be done depending on the material selection required.

This is necessary as not all metal constituents can be used as base material for high quality waste and transport casks of the MOSAIK type. Lower quality scrap metal is molten and used only as a shielding material.

In case that the limit of 74 Bw/g is overrun on a charge of one metric ton, the activity is reduced by normal decontamination procedures and then the melting route is taken.

So far, in the Federal Republic of Germany, almost 1,300 metric tons of scrap metal have been recycled in this way, minimizing the activity release to the environment.