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REPORT OF FOREIGN TRAVEL TO PARIS, FRANCE

S. D. Van Hoesen
L. S. Jones

July 1990

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Martin Marietta Energy Systems, Inc.
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under Contract No. DE-AC05-84OR21400

MASTER

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Date: July 20, 1990

Subject: Report of Foreign Travel of Martin Marietta Energy Systems, Inc., Team to Paris, France

To: W. R. Bibb

From: Team Members: S. D. Van Hoesen (Engineering Division) and L. S. Jones (Central Waste Management Division)

PURPOSE: To participate in a technology exchange on French - U. S. low-level radioactive waste management facility design, construction, and operation.

SITES VISITED:

6/4-7/1990	L'Aube Site	Soulaines-Dhuys	J. Dodemant
6/8/1990	ANDRA	Paris	Y. Marque
6/11/1990	La Hague Plant	Cherbourg	B. de Wavrechin
6/12/1990	La Manche Site	Cherbourg	M. Noraz

ABSTRACT:

The Martin Marietta Energy Systems, Inc., Team, consisting of representatives of the Engineering Division and Central Waste Management Division, participated in a technology exchange program on French - U. S. low-level radioactive waste (LLW) management facility design, construction, and operation. Visits were made to the new French LLW disposal facility currently under construction, the Centre de Stockage de l'Aube (CSA), to the La Hague reprocessing facility to visit LLW conditioning and storage facilities, and to the operating LLW disposal facility, the Centre de Stockage de la Manche (CSM). A meeting was also held with representatives of the Agence National pour la Gestion des Dechets Radioactifs (ANDRA) to discuss overall French and Oak Ridge LLW disposal facility development programs and to review the status of the efforts being conducted under the current subcontract with NUMATEC/Societe General pour les Techniques Nouvelles (SGN)/ANDRA.

REPORT OF FOREIGN TRAVEL TO FRANCE

June 1 - June 12, 1990

S. D. Van Hoesen and L. S. Jones

The purpose of this trip was to continue the exchange of information on the design, construction, and operation of low-level radioactive waste (LLW) management facilities being utilized in France and in Oak Ridge. This technical information exchange was focused on the following items:

- construction activities at the new French LLW disposal facility, the Centre de Stockage de l'Aube (CSA), which is under construction;
- operating and closure activities at the existing French LLW disposal facility, the Centre de Stockage de la Manche (CSM);
- operating and construction activities at the Oak Ridge LLW disposal facilities, the Tumulus I and II, the Interim Waste Management Facility (IWMF), and the Low Level Waste Disposal Facilities (LLWDF);
- waste conditioning and storage activities at the La Hague reprocessing facility; and
- the status of Martin Marietta Energy Systems, Inc., contract with Societe General pour les Techniques Nouvelles (SGN).

The exchange was particularly valuable in that it provided an opportunity to view construction and operation techniques which will be directly applicable to facilities (Tumulus, IWMF, and LLWDF) currently being operated, constructed, and planned in Oak Ridge. Information was also obtained which confirms that the high pH levels being experienced at the Tumulus facilities are typical of concrete based engineered LLW disposal facilities and are not indicative of any premature concrete degradation. The enormous progress noted in the CSA construction since the visit last year highlighted the French commitment to ensuring LLW disposal continuity.

SUMMARY OF WORK ACTIVITIES

The following sections provide an overview of the topics covered during the visit. The discussion is focused on those areas that differ significantly from the visit last year (see ORNL Foreign Trip Report ORNL/FTR-3346). The itineraries of the Energy Systems team members are provided in Appendix A. A list of the persons contacted during the visit is provided in Appendix B. A list of literature acquired during the visit is provided in Appendix C. Details of the design and construction activities at the CSA are provided in Appendix D.

June 4 - 7, 1990 - Visit to the Centre de Stockage de l'Aube, Soulaines-Dhuys, France

Summary

The purpose of this visit was to review the status of construction of the CSA facility. A series of in-depth briefings and tours were provided by CSA personnel over the four day visit which covered all aspects of the facility design and construction. Significant progress has been made in facility construction since the visit last year. It appears that construction will be complete in time to support initiation of CSA operations in early 1991 as scheduled.

The total disposal capacity of the CSA is to be limited to 1 million m^3 (30 million ft^3) over a 30-year period, or approximately 30,000 m^3/year (900,000 ft^3/year). The entire cost of the CSA facility, including site characterization and selection, engineering, and construction is estimated to be FF 1.2 billion ($220 million), with FF 700 million ($130 million) for engineering and construction only. Mr. J. Dodemant and Ms. I. Pacquetet provided an overview of the status of construction which is summarized in the following sections.

- The Reception Center is essentially complete except for final interior decoration and landscaping. The center is situated outside the disposal area with a panoramic view of the site and will eventually be a real showplace. The decoration is very vibrant and attractive. The center will make a very good impression on the visitors.

- The Guard Post is located at the main entrance to the disposal area. The building structure is complete and utilities and finish work are ongoing. The Guard Post will provide site access control for the approximately 180 site workers and garage space for a fire truck and an ambulance.

- The Administration Building rough structural work is essentially complete. The building will house the engineering and administrative functions.

- The foundation for the Mechanical Building is being prepared. This building will provide maintenance areas for operating equipment and areas where waste shipments will be checked upon arrival to ensure that the manifest is correct and that the surface dose and contamination levels are within limits. The trucks delivering waste also receive a health physics (HP) check at the Mechanical Building prior to leaving the site. While work in the Mechanical Building is not expected to involve contaminated items, this is an area where trucks or other equipment could be decontaminated if needed.

- The Services Building rough structural work is complete, and utility services and equipment are being installed. The Services Building is located adjacent to the Waste Conditioning Building (ACD [Atelier de Conditionnement des Dechets]) and will provide laboratory areas, HP facilities, and personnel change areas. Storage space and systems to transport drum overpacks to the ACD for compacted drums will also be provided.

- The ACD rough structural work is complete with utility services and equipment being installed. The building will house waste container receiving, storage, compaction, and grouting capabilities along with automated handling systems. The grouting capabilities will be available when operations commence in 1991; however, the compaction capability will be delayed approximately a year due to a long delivery time for the compactor. A more detailed description of the ACD is provided in Appendix D of this report.

- The Transit Storage Building construction is essentially complete except for punch list items and the installation of a rail mounted gantry crane. The building will provide approximately 2,000 m^2 (19,000 ft^2) of enclosed floor space for the short-term storage/staging of waste awaiting disposal.

- Construction of the holding basin for site discharges has been complete for over a year. Groundwater discharge, surface runoff, as well as disposal unit drainage, are routed through this 30,000-m^3 (6.7-million-gal) basin. The basin contents are analyzed prior to being pumped to the nearby stream. Potable water and sewage treatment package units will be installed adjacent to the holding basin.

- A restaurant and site meteorological station are to be constructed near the holding basin. Construction has not yet begun.

- Disposal vault construction is proceeding rapidly. Each vault is approximately 25-m x 25-m x 15-m (77.5-ft x 77.5-ft x 46.5-ft) high and is constructed of reinforced concrete. Each unit will receive about 6,000 m^3 (180,000 ft^3) of waste. Eighteen disposal "platforms", or single lined vaults, are under construction. The basic structural work for all eighteen is complete, with final plastic coating and drainage layer concrete placement remaining. Six disposal "alveoles", or double lined vaults, are under construction. Basic structural work appears to be about 75% complete with the first and second layer pads complete for all units and about 50% of the vault walls remaining to be constructed. Additional discussion of the disposal vaults is provided in Appendix D of this report.

- The erection of the six movable buildings which will provide cover for the operating vaults is also well under way. Each building will cover 1 1/2 vaults (the vault being loaded and the truck transfer area in the adjacent vault). The buildings consist of steel frame structures located on rails, covered with a metal roof, and metal sides which come about halfway to the ground. A bridge crane and shielded operator cab are located in each of the buildings.

- A railway terminal is being constructed in the nearby town of Brienne le Chateau. Approximately 75% of the waste will arrive by train and be transferred to trucks for the final 25-km (15-mile) shipment to the site. The remaining 25% of the waste will be shipped directly from the generator by truck. The basic foundations for the six rail spurs, three rail mounted gantry cranes, and two buildings (vehicle maintenance and administration) are complete.

Several areas of construction, namely the disposal vaults and associated concrete batch plant, are of particular interest because of their similarity to disposal units being constructed in Oak Ridge. Also, the moveable buildings were noteworthy because of their potential for eliminating a source of difficulty being experienced with the Oak Ridge tumulus units - namely high pH in the pad storm runoff. Items of note in these areas are described in Appendix D.

June 8, 1990 - Meeting at ANDRA Headquarters, Paris, France

A meeting was held at the ANDRA Headquarters near Paris to review Oak Ridge waste management facility operations experience and development status and to discuss future directions of the technology exchange program. Areas identified by the Oak Ridge team for future interaction included disposal unit concrete development, testing, and performance modelling, and facility construction and operation training. ANDRA indicated that they would need to discuss the potential for future interactions with other Commissariat a l'Energie Atomique (CEA) personnel. ANDRA will inform the team members of the results of these discussions. ANDRA was asked to provide a copy of a video tape on the CSA which is dubbed in English to the team. The tape was received after arrival back in the U. S.

June 11, 1990 - Visit to the La Hague Reprocessing Plant, Cherbourg, France

Mr. B. de Wavrechin and Ms. M. Seugnet led the tours and discussions at the La Hague facility. The visit was focused on touring the waste conditioning facility (AD2), the alpha waste storage facility (EDS), and the bitumenization facility (STE3). All these facilities were visited during the technology exchange program last year. Major changes noted during this visit were that all facilities were now operating, or being checked out for operation. As noted in the previous visit, all building areas were spotless. No materials or equipment were stored in hallways. Workers were always noted to be carrying their emergency respirators.

A major highlight of the tour was being able to view some of the final checkout operations of the very impressive handling systems located in the EDS building. Transfers of empty shielded storage containers from the receiving trolleys to the final storage location were witnessed. All the equipment seemed to work well. An interesting development was noted with the concrete overpacks utilized at the AD2. The containers were originally planned to be manufactured utilizing an asbestos fiber reinforced concrete. Apparently, concerns with the health implications of this material have led to use of a steel fiber reinforced concrete. The steel fibers are short thin strips of cast iron dispersed throughout the concrete. The overpacks are manufactured at a plant off-site.

A batch plant located on site produces steel fiber reinforced concrete for backfilling the overpacks after waste placement.

Waste Conditioning Building (AD2)

The AD2 facility is a combination of two buildings. The A building handles LLW materials contaminated with short half-life radionuclides, while the B building handles wastes contaminated with long half-life alpha and/or high surface dose short half-life radionuclides. The A building wastes are sent for storage in the ADT facility, which consists of two above-grade, open topped, shielded storage vaults. These wastes will eventually be shipped for near surface disposal. The B building wastes are stored in the EDT vaults at the EDS facility (described in later sections), and are destined for geologic repository disposal. Operations in the A building were initiated in January 1990. Operations in the B building were recently started, but no materials have been transferred to storage yet.

The A building waste, primarily technological waste (paper, rags, plastic, etc.), is received in 120-L (32-gal) drums. Surface doses of the drums are <200 mr/h at contact and <10 mr/h at 1 m. The drum bar codes are scanned to identify the drum and gamma and passive neutron assays are conducted. We were provided with an opportunity to walk through the drum assay area during the tour since it coincided with the periodic calibration tests that are run with dummy drums. The results of these assays are tied into process based correlations to estimate total drum radionuclide inventories. The drums are then stored in a drum magazine before being compacted in the 1500-ton press. The press was not operating during the tour due to alignment difficulties. The compacted drum pucks are then placed on a table so they can be selected for 200-L (53 gal) overpack drum filling to minimize the dead space in the overpacks. The overpacks are then placed in the steel fiber reinforced concrete containers and injected with grout. The containers are then cured, checked for surface contamination, and transported to the ADT for storage. Approximately 8500 containers/year are produced and stored.

A similar process is used for contaminated filters. The filters are received in cardboard boxes. These boxes are compacted in 120-L (32-gal) drums, which are then routed through the process described previously.

The B building waste, primarily contaminated process equipment, is received in a dedicated shielded transport container (MERC). The wastes are received and loaded into a cell where the wastes are placed in a transfer box. The wastes are assayed and then placed in a cylindrical concrete overpack (either 1.5 m^3 [45 ft^3 or 3 m^3 [90 ft^3]). The overpacks are injected with grout which is then covered with an epoxy seal. The completed overpack is placed in a shielded transport container for transfer to the EDT vaults for storage. A decontamination unit is located in the B building. It consists of an immersion tank and high pressure spray. The unit is only used to clean failed process equipment for inspection.

Alpha/High Surface Dose Storage (EDS)

The EDS is a facility primarily designed for the storage of high surface dose alpha wastes from two La Hague sources. Cladding hulls produced in the fuel disassembly area are stored in T1 vaults, and wastes from the B building at AD2 are stored in EDT vaults. The facility consists of a control room and the storage vaults. The vaults are located on either side of a central hall which contains truly impressive handling equipment. Seven vaults have been constructed. Four are ADT vaults to be used for the AD2 building wastes, and 3 are T1 vaults for the cladding hulls.

At ground level, a rail mounted transfer system is located which can be moved up and down the central hall to service each of the receiving bays and disposal vaults of the facility. The transfer system mates with the waste shipping container located in the receiving bay and pulls the waste onto a trolley and into the central hall. Electrical motors are normally utilized for moving the transfer system. Independent mechanical systems are provided for redundancy to operate the transfer system. One system ensures that the trolley for pulling the wastes from the shipping container can be operated, and one system ensures that the trolley can be moved to other locations in the central hall.

Two large overhead bridge cranes are located in the upper levels of the central hall. The waste is picked up by one of these cranes, which then moves down the hallway to the designated vault. At the vault, the crane then moves perpendicularly into the vault to deposit the waste in its storage location. Each of the vaults is outfitted with massive doors which provide access for the cranes, but which can be closed to enable maintenance activities to take place in the central hall. The central hall is also fitted with massive doors at its ends which allow the ground level transfer systems or crane to be removed for maintenance while still allowing the remaining systems to operate.

During the visit, we were fortunate to be able to witness testing of the overhead crane. Simulated waste packages were lifted from the transfer trolley and moved into one of the storage vaults. In addition, one of the overhead cranes was moved from one end of the central hall to the other, then into one of the storage vaults and back out again.

Bitumenization Facility (STE3)

At the STE3, liquid wastes from a variety of plant areas are processed. Sludges generated in the treatment process are then solidified in bitumen and stored. The bitumen operation contains two processing trains. Train one began operation in May 1989 and has produced 1200 drums to date. The drums are stored in one of the four storage cells located in the building, each of which holds 5,000 drums. Each drum has a surface dose of approximately 200 r/h. The second train was scheduled to start operation on the day of the tour, and in fact the Team was able to see (through a thick glass shield) one of the first drums being filled with the extruded bitumen/waste product.

June 12, 1990 - Centre de Stockage de la Manche (CSM)

Ms. M. Ro provided an overview of the CSM operation. The CSM has a projected capacity of 500,000 m^3 (15 million ft^3) with approximately 480,000 m^3 (14.4 million ft^3) of waste being disposed of to date. Of the waste received at CSM, 38% is from reprocessing operations, 38% from nuclear electricity generating stations, 12% from research institutions, 4% from fuel fabrication/enrichment, 4% from small producers, and 4% miscellaneous.

Several notable changes had occurred at the site since the visit last year.

- The number of personnel working at the site has been reduced. Apparently, as the cessation of operation becomes immanent, personnel are transferring to other operations at La Hague. It does not appear that many, if any, of the current operators of CSM will be moving to the CSA.

- The old metal box grout injection facility has been demolished and relocated to an area which will not interfere with disposal operations. The old grout injection facility location is already being used for waste disposal units. It was indicated that the existing 400-ton compactor will be shut down and removed by the end of the year to make additional disposal space available. The existing high activity storage facility is also expected to be removed over the next 2-3 years. However, some of the waste stored there is old (15-20 years), and some difficulties are likely to be encountered during the removal activities. It is not clear that this area will contribute greatly to remaining disposal capacity over the next several years.

- Activities are under way in preparation for the closure of the CSM. A cover design has been proposed and is being reviewed by the safety authorities. The design has apparently been approved in principal, with final authorization for construction expected this summer. Bids for construction have been prepared and will be sent out when approval is received.

  The cover design includes fill of varying thickness to provide a uniform subbase, a 0.3-m (1-ft) thick sand drainage layer, a bitumen membrane, a 0.5-m (1.67-ft) thick sand drainage layer, a 1-m to 2-m (3.1-ft to 6.2-ft) thick clay layer, a 0.3-m (1-ft) thick sand drainage layer, and a biological barrier layer consisting of 0.6-m (2-ft) of gravel and a 0.4-m (1.33-ft) vegetative support layer. Total cover thickness would range from 3.1 m to 4.1 m (10 ft to 13 ft). Apparently this cover will only be used on the two thirds of the facility which has been most recently utilized. The older one third of the disposal area will be covered with a bitumen membrane only and monitored for 20 years. Apparently, some uncertainty exists concerning the condition of the waste located in the older portions of the facility, and CSM plans to wait before applying the final cover.

The two thirds of the facility that will be covered will require 400,000 m^3 (440,000 yd^3) of fill. Clay material will be hauled 40 km (24 miles) from St. Sauveur. The cover is expected to be complete by 1995.

- The portion of fence at the common boundary with the La Hague reprocessing facility has been moved about 5 m (15 ft) further out from the CSM. The reason for this was to provide enough room at the base of the disposal area so the cover could be constructed on a stable slope.

- The CSM operators confirmed ORNL experience with pH levels at the facility outfall. During the tour we were able to observe the readouts from the on-line pH monitors at the facility discharge. The surface drain system pH hovered around 10.5, while the gallery collection system discharge pH was about 7.9. The CSM operators indicated that the pH of their discharge was not a problem since it was covered in, and dwarfed by, discharge allowances for the reprocessing plant complex.

APPENDIX A

OAK RIDGE TEAM MEMBERS ITINERARIES

S. D. Van Hoesen

June 1-2, 1990	Travel to Paris, France
June 3, 1990	Weekend, Paris, France
June 4-7, 1990	Travel to Troyes, France and tour of Centre de Stockage de l'Aube
June 8, 1990	Travel to Paris, France and Meeting at ANDRA
June 9, 1990	Weekend, Paris, France
June 10, 1990	Travel to Cherbourg, France
June 11, 1990	Tour of La Hague Reprocessing Facilities, Cherbourg, France
June 12, 1990	Tour of Centre de Stockage de la Manche, Cherbourg, France
June 13-19, 1990	Vacation, France
June 20, 1990	Travel to Clinton, TN

L. S. Jones

June 1-2, 1990	Travel to Paris, France
June 3, 1990	Weekend, Paris, France
June 4-7, 1990	Travel to Troyes, France and tour of Centre de Stockage de l'Aube
June 8, 1990	Travel to Paris, France and Meeting at ANDRA
June 9, 1990	Weekend, Paris, France
June 10, 1990	Travel to Cherbourg, France
June 11, 1990	Tour of La Hague Reprocessing Facilities, Cherbourg, France
June 12, 1990	Tour of Centre de Stockage de la Manche, Cherbourg, France
June 13, 1990	Travel to Paris, France
June 14-15, 1990	Vacation, Paris, France
June 16, 1990	Travel to Knoxville, TN

APPENDIX B

PERSONS CONTACTED

C. Hutchison	NUMATEC	US
Y. Marques	ANDRA	France
J. Dodemant	ANDRA	France
I. Pacquetet	ANDRA	France
N. Paviot	Technicatome	France
J. P. Guth	ANDRA	France
C. Beaume	Technicatome	France
P. Daubrive	Technicatome	France
B. de Wavrechin	SGN	France
K. Broutechoux	COGEMA	France
M. Seugnet	COGEMA	France
B. Leroy	COGEMA	France
M. Roueda	COGEMA	France
M. Ro	ANDRA	France
M. Noraz	ANDRA	France

APPENDIX C

LITERATURE ACQUIRED

1. ANDRA, "A Government Agency for Safe Radioactive Waste Management," Paris, France, 1990

2. ANDRA, "Quality Assurance for Short-Lived Waste Management," Paris, France, 1990

3. ANDRA, "The Centre de la Manche," Paris, France, 1990

4. ANDRA, "The Centre de l'Aube Disposal Facility - Design and Operation," Paris, France, 1990

5. ANDRA, "Centre de Stockage de l'Aube," Videotape, Paris, France, 1990

APPENDIX D

DESIGN AND CONSTRUCTION ACTIVITIES AT THE CENTRE DE STOCKAGE DE L'AUBE (CSA)

Disposal Vaults

Ms. N. Paviot and Mr. C. Beaume of Technicatome described the two types of disposal vaults that will be utilized at the CSA. Approximately 75% of the waste will be disposed of on "platforms," or single lined vaults, with the remaining 25% disposed of in "alveoles," or double lined vaults. The platforms are designed for waste which has been stabilized (i.e., contained in a concrete overpack or in a metal container which has been injected with stabilizing grout) and which is below the immobilization threshold (i.e., below a set radioactivity concentration). The waste will be placed in the platforms in layers and backfilled with granular material before pouring of a reinforced concrete roof. The alveoles are designed for waste which is above the immobilization threshold. The waste will be placed in the alveole and backfilled with immobilizing grout before pouring the concrete roof. The interior surfaces of both types of disposal vaults will be coated with a polyurethane waterproofing material.

The vaults are constructed in rows of four or five units to form a module. Two modules of five units and two modules of four units will be used for platforms. One module of five units and a module with a single unit will be used for alveoles. Space (approximately 1 1/2 m [4.5 ft]) is provided between the ends of each of the vaults so there is not a common adjoining wall. It was stated that this was done for seismic considerations, with the size of the space being determined by the clearance needed for wall form removal.

The platform unit is constructed with the following elements. A gallery (concrete tunnel) is constructed which runs down the center of the module. Each vault unit drains into the gallery which contains a drain piping system. Each module gallery connects with a central gallery which leads to a central holding tank prior to discharge to the site holding basin. The gallery is constructed from precast concrete sections, similar to those planned for the IWMF. Each of the joints is tested with 10-psi water pressure to minimize water in-leakage. The top of the gallery is covered with a teflon material and a sand layer is placed before a 5-cm (2-in.) mud slab is poured as the first layer of the platform slab.

A 40-cm (16-in.) steel reinforced concrete pad, approximately 25 m x 25 m (77.5 ft x 77.5 ft) is then poured (CLC 45 cement, 245 kg/m^3 [18 lb/ft^3] of reinforcing steel). The first concrete layer is finished level since the material is too fluid to allow it to be sloped to the center drain. Another stiffer concrete layer is then placed which can be finished to provide the desired slope to the drain.

A polyurethane coating will then be sprayed on the slab and about 1 m to 1 1/2 m (3 ft to 5 ft) up the sides of the vault walls. The polyurethane product is "BAYTEC" manufactured by Baigon, a German company. The material is olive green in color and appears to be 30 to 40 mils in thickness. The French indicated that extensive research was conducted to identify and ensure that this material meets their performance requirements. A small area of one of the concrete pads and walls had been covered with this material for test purposes. The material appeared to bond to cleaned concrete very well, although an area where the liner was applied to concrete with sand on it appeared to be susceptible to damage from abrasion, such as would be applied by the rubber tires of forklifts or trucks when turning.

The polyurethane coating will then be covered with a layer of filter fabric (350 g/m^2 [0.09 lb/ft^2]) for protection before a drainage layer of 10 cm to 12 cm (4 in. to 6 in.) is placed. The drainage layer consists of gravel (approximately 2-cm [3/4-in.] diam) which appears to be coated with just enough concrete paste to hold it together, but with considerable void space between the gravel allowing it to drain water to the center floor drain. The top of this layer will be finished level to provide a flat surface on which to stack the waste containers.

The platform walls are constructed in sections approximately 10-m (30-ft) wide x 15-m (46.5-ft) high x 40-cm (1.33-ft) thick. The rebar is constructed into mats on a jig located nearby and lifted into place by cranes. Dowel connections are provided at the edges of each of the wall sections to allow the rebar to be connected. The wall rebar is tied to rebar in the slab. Sturdy reusable metal forms are utilized to form the walls. The concrete utilized (CPA 55) is characterized as a low shrinkage mix.

After waste loading is complete, a roof will be constructed on the top of each of the vaults. The final details are not completed, but the concept involves the following components. First, a layer of 20-cm (8-in.) precast concrete panels will be placed on top of the waste to provide shielding. An approximately 25-cm (10-in.) steel reinforced flat (i.e., no slope) slab will then be poured. The roof slab and outside vault walls will be coated with the polyurethane waterproofing. The waterproofing layer will ultimately be covered with a layer of filter fabric for protection prior to placing soil for the low-permeability cover several years after waste loading is complete.

The alveoles are similar in construction to the platforms, except that two concrete slabs are poured to provide a double liner. The gallery and mud slab are constructed in the same manner as the platform. A 25-cm (10-in.) steel reinforced slab with an approximately 40-cm (16-in.) high integral curb along the perimeter is then poured. Filter fabric is then laid on the pad and up the sides and over the top of the curb. The second steel reinforced pad is then poured. This second pad is 40-cm (16-in.) thick and is finished with the polyurethane layer and drainage concrete in the same fashion as the platform. The walls of the alveole are constructed in the same fashion as the platform.

The CSA personnel were asked about the pH of the water collected from the disposal unit runoff. It was confirmed that the pH was in the 9-10 range. It is not clear whether this will present a problem for CSA since the disposal unit discharges will be mixed with other site runoff at the holding pond prior to release. The CSA personnel noted that if the pH of the holding pond discharge were in the 9-10 range that treatment would likely be required before release.

Disposal Vault Concrete

Two types of concrete are utilized in the construction of the disposal units. The pads are constructed with a CLC 45 concrete mix, while the walls are constructed with a CPA 55 concrete mix. The specifications for each of these mixes is to be supplied in the final technical report being prepared as a part of the Energy Systems' contract with SGN. The CLC 45 mix was understood to be a cement/silica fume base, with quartz aggregate. The CPA 55 mix was characterized as being a low-shrinkage mix.

The pouring of an alveole upper pad was witnessed during the visit. The concrete was very fluid, almost to the point of being watery, and it appeared that paste/aggregate segregation could be a problem. It was surmised that the mix was made so fluid because it was being pumped. During a visit to the same site later in the day, the back-up bucket and crane were being utilized to place the concrete. The concrete was not nearly as fluid at this point. Concrete sampling at the job site involves taking 6 compressive strength samples at the beginning of the pour, 12 during the pour, and 6 more at the end of the pour. Samples are also taken at the batch plant as described in the following section.

The concrete is produced at a batch plant approximately 7 km (4 miles) from the site. The batch plant was erected specifically to service the CSA, but it does provide concrete to commercial projects in the area. The batch plant is computer operated and produces a batch ticket listing weights of all ingredients, plus a plot of the mixer power required during the batch mixing. Approximately three batches were required for each concrete truck. Testing at the batch plant includes slump tests for every fourth truck and analysis (water content and sieve analysis) for every eighth truck. The plasticizer being used was Pozzolith 400-N by Master Builders--the same as was used in the Tumulus II pad pour. The aggregate utilized appeared to be a washed quartz gravel. The size was much smaller than that utilized in the Tumulus I and II pours.

Mobile Buildings

Mr. P. Daubrive described the large mobile steel frame with metal skin buildings that will be used to provide weather protection during vault loading operations. The buildings are mounted on rails which run along the sides of each disposal module. The buildings are wide enough to cover the width of a disposal unit, long enough to cover one and one half disposal units, and high enough to provide clearance over the disposal unit walls for a bridge crane which runs on beams attached to the building frame. The buildings are powered by electric drives. Each building weighs approximately 225 tons with the bridge crane. Bridge crane capacities vary from 10 tons to 35 tons. The cost of the six buildings being provided for operations was stated to be FF 22 million ($4 million).

The building operator will be located at the end of the building away from the disposal vault being loaded in a shielded cab. The cab is located below the top of the disposal unit walls to reduce the radiation dose. The operator will position the crane to remove the waste package from the delivery truck. The package will be scanned with a remote bar code reader to identify the package and ensure that disposal has been approved. The operator will then place the first package using cameras, while a computer indexes the waste package placement. The operator will then position the crane to pick up the remaining packages and then the computer will control the operation to move the waste packages to their position in the disposal vault. The pick-up and placement operation will all be done with remote grapple equipment to eliminate handling exposures. In fact, the single operator is the only human involved in the operation except for the driver of the waste delivery truck. Shielded waste packages are used as needed to ensure that the waste has a surface dose of 200-mr/h maximum.

When loading of a disposal unit is complete, the building will be moved on its rails over the next disposal unit. When all the disposal units in a module are filled, the building will be moved to the isle which runs down the center of the disposal area. A set of building rails will run down the aisle perpendicular to the rails for the disposal modules. The building will be positioned at the crossing of these rails and hydraulically lifted so the rail wheels can be rotated 90 degrees. The building will then be lowered onto the center aisle rails and moved down to the next disposal module to be filled. The building will then be re-oriented and moved into position for loading the next disposal unit.

Waste Conditioning Building

The ACD will contain the waste package handling, storage, compaction, and grouting systems. The building will contain two basic process trains--a metal box grouting system and a metal drum compaction and grouting system. The building will have four receiving bays--three will be used initially, with one reserved, possibly for use in decontamination.

Metal boxes (5 m^3 [150 ft^3] and 10 m^3 [300 ft^3]) will be received in one bay and unloaded with a 35-ton crane (manually operated) onto a rail cart. Approximately 100 of the smaller and 25 of the larger size boxes will be received each year. The bar code label will be checked and, if accepted, the waste will then be moved to one of the two injection cells (only one is currently being completed). The box will be injected with immobilizing grout remotely. The cell will be checked for contamination, then opened, and the cart moved out. The injected waste package will be removed from the cart and set aside to cure for two days. After curing, the waste box will be loaded on a truck for transport to the disposal unit. Since the boxes can be injected with a neat concrete layer all around the waste, these packages will be considered to be durable and will be disposed of in the platform units. The grout injection area also contains a local control room, High Efficiency Particulate Air (HEPA) filtered ventilation systems with separate systems for the building area and for the grout injection exhaust, and grout cleanup settling basins.

Metal drums, either 100 l (26 gal) or 200 L (52 gal), will be received in one of three bays (two currently being developed with one to be developed in the future) and unloaded with a crane to a conveyor system. The drum bar code labels will be automatically scanned and checked for approval. The drums can then be sent to a storage magazine or directly to the press. The drum storage magazine will consist of two six story high by 50-m (155-ft) long storage racks which will hold a total of 400 drums. A drum loading retrieval unit will be located between the stacks. The storage unit will initially be operated as a random retrieval unit, although it will have the capability to retrieve specific drums to allow tailoring of radionuclide contents of drums fed to the press.

The drums will pass through an airlock where they will be scanned again before being fed into the 1000-ton press. After compaction, the drum pucks will be placed in 400-L (105-gal) overpack drums. The height of the stack of pucks in the 400-L (105-gal) drum will be checked and the remaining space checked with the height of the next puck. If space is not available, the filled drum will be moved out and replaced by an empty drum which will be fed from the adjacent services building to the press. A hold down device will be placed in the filled drum to keep the pucks from floating when the grout is added. The grout will be injected by gravity and the surface smoothed--no lid is utilized. The drum will pass through an airlock and is then scanned and weighed before being staged for two-day curing. After curing, the drum is loaded onto a truck for delivery to a disposal unit. Even though immobilizing grout will be used, an immobilized package is not produced since a neat concrete layer surrounding the waste cannot be guaranteed. The disposal unit destination will then be dependent on the radionuclide content, with those packages below the immobilization threshold going to the platform and those above the limit going to the alveole.

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