MEMORANDUM TO: Eric J. Leeds, Branch Chief
Special Projects Branch
Division of Fuel Cycle Safety
and Safeguards

THRU: Melanie A. Galloway, Chief
Enrichment Section
Special Projects Branch, FCSS

FROM: Timothy C. Johnson
Senior Mechanical Systems Engineer
Enrichment Section
Special Projects Branch, FCSS

SUBJECT: SUMMARY OF SEPTEMBER 19 AND 21, 2000, VISIT TO FRENCH MIXED OXIDE FUEL FABRICATION FACILITIES

On September 19 and 21, 2000, staff from the Enrichment Section and the Region II office visited the French reprocessing facilities at La Hague and the mixed oxide (MOX) fuel fabrication facility at Marcoule. Both of these facilities are operated by COGEMA, one of the consortium partners in the MOX fuel fabrication facility project intended to produce fuel for United States (U.S.) commercial nuclear power plants from surplus plutonium from the U.S. nuclear weapons program. The visit included tours of the scrap recovery system process operations at La Hague and the MOX fuel fabrication operations at Marcoule. These operations are expected to be similar to the facilities proposed by the MOX fuel fabrication facility consortium for a U.S. Nuclear Regulatory Commission license. I am attaching the meeting summary for your use.

Docket No: 70-3098

Attachment: French MOX Facility Meeting Summary

cc: Mr. Peter Hastings, DCS
Mr. James Johnson, DOE
Mr. Henry Potter, SC Dept. of H&EC
Mr. John T. Conway, DNFSB

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French Mixed Oxide Fuel Facility Visit Summary

Date: September 19 and 21, 2000

Place: COGEMA facilities in La Hague and Marcoule, France

Attendees:

E. Leeds/NRC	L. Giaffe/COGEMA
T.C. Johnson/NRC	M. Arslam/COGEMA
D. Brown/NRC	J.L. Voitellier/COGEMA
D. Ayres/NRC	S. LeBreton/COGEMA
S. Steele/NRC	K. Niemer/DCS
R. Wescott/NRC	
T. Pham/NRC	

Purpose:

The purpose of this visit was to tour and discuss the scrap recovery system process operations at the French spent nuclear fuel reprocessing plant at La Hague and the mixed oxide (MOX) fuel fabrication operations at Marcoule. These facilities are expected to be similar to the designs submitted as part of the Duke, COGEMA, and Stone & Webster consortium (DCS) application for a MOX fuel fabrication facility to be located at the Savannah River Site.

Discussion:

DCS is expected to submit a license application for a MOX fuel fabrication facility in December 2000. This facility will be constructed at the Savannah River Site and is intended to produce fuel for use in United States (U.S.) commercial nuclear power plants from surplus plutonium from the nuclear weapons program. DCS is expected to propose a facility process design similar to the COGEMA operations in France. The scrap recovery system at La Hague will be similar to the plutonium polishing system used at the Savannah River Site facility. The rest of the U.S. facility will be similar to the MELOX plant at Marcoule.

On September 19, 2000, the NRC group arrived in Cherbourg, France, to visit the COGEMA reprocessing operations at the La Hague facility. At this facility spent nuclear fuel is reprocessed and wastes are vitrified into borosilicate glass. The vitrified waste is stored at La Hague or shipped back to the country of origin. The reprocessing plant uses a scrap recovery system to recover plutonium from reprocessing generated wastes and wastes and scrap generated at the MELOX facility in Marcoule. The system leaches waste products using nitric acid and recovers plutonium using counter-current solvent extraction columns. Approximately 1-2 kg of plutonium are recovered annually and is returned to reprocessing product streams. Leached waste products are stored at La Hague until a suitable disposal site is developed. These wastes cannot be disposed of at the Center de l'Aube as routine low-level waste.

On September 20, 2000, the group traveled from Cherbourg to Orange, near the Marcoule facility. On September 21, 2000, the group toured the MELOX MOX fuel fabrication facility. This facility began operations in 1995 and now fabricates MOX fuel primarily for use in French and German reactors. The facility tour began with a briefing on the facility and unclassifed safeguards practices. The facility tour followed a sequence beginning with the entry of plutonium from the La Hague reprocessing facility through the fabrication of fuel assemblies.

Attachment

The La Hague and the MELOX facility designs consider earthquakes and fires. The French also consider potential flooding from the Rhone river at the MELOX facility.

In general, French took a defense-in-depth approach in the fire protection and power supply considerations for the plant processes. Large auxiliary generators were seen in a separate building on the La Hague site. Not all areas of La Hague had smoke detection, however, and vents were cut in stairway fire doors to improve ventilation compromising the use of the door as a fire barrier.

COGEMA relies heavily on manual fire suppression. Most of the common areas such as corridors had portable carbon dioxide (CO_2) or pressurized water extinguishers, but no automatic suppression. The MOX processing areas at MELOX have CO_2 suppression systems which can be actuated manually or remotely from the control room. Glove boxes containing plutonium had inerted atmospheres and provisions for manual carbon dioxide application. However, there was no automatic suppression inside the glove boxes.

The mixer/settler process at the La Hague facility, which will be included in the U.S. MOX facility, had a fixed water mist fire suppression system and a smoke detector inside the glove box. There was no automatic fire suppression capability outside the glove box.

All the glove boxes were composed of Lexan. The gloves were neoprene-hypalon and the glove port covers were polyethylene. In some cases, additional shielding was provided in the form of leaded Polymethyl-methacrylate (PMMA). The glove box materials comprise a significant fuel loading.

In most cases, the cable trays were open or vented aluminum trays. Sometimes cables in the corridors were protected with "Flamastic" which provided 2-hour fire resistance according to the MELOX staff. The MELOX staff explained that they conduct fire and emergency drills on a quarterly basis.

Ventilation filtration at the MELOX plant has four high efficiency particulate air (HEPA) filter stages. These stages are at the glove boxes, the room cubicles and zones, with a final stage downstream of a header connecting all ventilation ducts but prior to release to the atmosphere. In the event of a fire, COGEMA assumed that there is sufficient dilution air from other areas to reduce the air temperature below the point where damage to HEPA filters can take place. There are no provisions for water sprays or other means to reduce air temperatures. At the point where the dilution occurs, there is one bank of HEPA filters prior to release. MELOX does not use sand filters because the MELOX staff considers that the dilution system is sufficiently protective.

Spent fuel casks arriving from ships offload at Cherbourg, are taken by rail to Valognes, and at Valognes, are transferred to trucks and then brought to La Hague. Other rail shipments from inside France and Europe are transferred to trucks at Valognes. The shipping cask is robust and comparable to spent fuel shipping casks in the United States in regard to its ability to withstand transportation accidents.

The sintering oven is the piece of equipment in the MOX fuel fabrication line that, according to MELOX staff, requires the most maintenance. It is a pusher-type oven that operates in three stages. The middle, high-temperature stage operates at 1700^{o} C. Sintering takes place in a reducing atmosphere of 5 percent hydrogen and argon. Hydrogen is stored outside the building to minimize explosion impacts on equipment. The hydrogen-argon mixture is mixed prior to entering the building and is tightly controlled. The oven uses an alumina-based insulation and has molybdenum heating elements and trays for the fuel pellets. After 5 years of operation, the insulation has not required change-out. The sintering oven is not enclosed in a glove box but operates at a positive pressure to minimize air entering the oven because air and moisture will have a substantial corrosive effect on the oven equipment at the operating temperatures. Three of the four ovens were manufactured by Leybold. The other oven was made by a French firm based on a hybrid design. The ovens are water-cooled to the point that areas immediately adjacent to the ovens at normal ambient temperatures.

For material accountability and control, the French government authority does not establish a national state system of accounting and control (SSAC) of nuclear materials for reactors and fuel cycle facilities and does not provide any regulatory oversight on a material control and accounting (MC&A) system. Safeguards inspection activities are carried out by the supranational organization European Atomic Energy Community (EURATOM) in which France is a member state. At the La Hague and MELOX fuel cycle facilities there are EURATOM resident inspectors for the MC&A program. Both sites have an intensive network of cameras installed at various material processing areas and material movement/transfer locations for safeguards purposes. The facilities perform annual semi-static and moving physical inventories and report to the EURATOM safeguards information system. The MC&A program for both plants includes a near real-time computerized material accounting system and monthly reports to EURATOM and the International Atomic Energy Agency safeguards system. Due to time constraints during the site visits, there was no discussion and observation of both facilities' measurement equipment and measurement methods in use or analytical laboratory services.

Although the DCS facility would be designed to process a less radioactive, but more fissionable isotopic mixture of plutonium, certain features of the French facilities were useful indicators for the development of the NRC inspection program. The extra leaded glass shielding provided for Pu glove boxes at the two French facilities was indicative of the need to verify the DCS designs to protect workers from external radiation exposure. The compactness of most of the Pu operations in France was also indicative of the need for NRC verification of key criticality safety design features prior to equipment installation.

The NRC delegation did not visit health physics offices or laboratories at La Hague or MELOX. The following health physics observations are limited to those made during a tour of the processing facilities. At the beginning of the tour, the NRC visitors were briefed on the function of the areas that were visited. However, the group was not specifically trained on the types of postings, other radiation or hazard demarcation or audible alarms that might be encountered, or emergency response procedures that should be followed in the event an alarm sounded. Each NRC visitor and all workers at the plant were issued white coveralls, shoes, and a red and green dosimeter belt to be worn at the waist. The belts were impregnated along their entire length with neutron dosimeters that are intended to assist emergency response personnel in the segregation of workers exposed to radiation from a criticality accident from those who were not exposed and to facilitate the reconstruction of worker doses following a criticality accident. A single pocket dosimeter for beta/gamma radiation was issued to one member of the group. Visitors and workers at both La Hague and MELOX were also issued respirators in packs to wear on their belts, that were to be donned in the event of an emergency. The respirators were equipped with cartridges for particulate matter removal.

All points of egress from controlled areas of the La Hague plant were equipped with portal monitors that, at a minimum, surveyed hands and feet and, in one model, also surveyed both the front and back of the body. It was observed that all glove boxes were shielded to reduce x-ray, gamma, and neutron fluence while still permitting adequate visibility of the contents. There were no conspicuous areas of fixed contamination that had been sealed or for which barriers had been erected. Area radiation monitors and criticality alarm systems and postings were conspicuously located throughout the plant. Work stations and glove boxes throughout the plant were equipped with continuous air samplers that collected air through approximately 1 inch steel pipes flared at the ends to about 1.5 to 2 inches diameter. These samplers alarm locally and provide remote indication to operators in the control room of elevated airborne contamination. The host at La Hague demonstrated at the end of the tour that the total measured gamma dose for the tour was 0.1 µSv (0.01 mrem). This level is essentially indistinguishable from the natural background radiation dose in this area of 0.3 µSv/hour. A high level of automation was observed throughout the La Hague plutonium finishing plant. This level of automation appears to have minimized the need for direct operator intervention and monitoring in the vicinity of operating equipment. It was mentioned during the briefing that the plant will soon adopt International Commission on Radiation Protection (ICRP) 60 recommendations, including the 20 mSv whole body dose limit, in lieu of the current 50 mSv whole body dose limit recommended in ICRP 26.

L. Gaiffe, who accompanied the NRC visitors, indicated that doses to workers from the reprocessing cycle were primarily attributable to gamma-emitting radioactivity and doses in the plutonium finishing cycle were about 50 percent attributable to gamma-emitting radioactivity and 50 percent attributable to neutron fluence. With regard to the planned response to a potential plutonium intake by workers, the plant deputy director for nuclear safety indicated that it is La Hague's policy to administer decorporation therapy upon suspicion of intake, before any bioassay results are available.

The radiation safety measures observed on the tour of the MELOX plant were similar to those observed at La Hague. However, in addition to air sampling devices near work stations, hand-held, portable air samplers with solid-state alpha spectrometers were located near the glove box ports. Operators were trained to use the sampler to monitor for leaks. The samplers were also designed to be relatively insensitive to radon and radon progeny interference, which greatly improves its sensitivity. Two sources of potential non-ionizing radiation hazard were observed. These included the laser used for measuring fuel pellet diameter following the grinding operation and the view ports on the sintering ovens, which require eye protection to reduce the intensity of visible light. We inquired about the design basis plutonium isotopic mix. In other words, we asked if MELOX is capable of processing only first cycle plutonium (1.5%^{238}Pu, 57%^{239}Pu, 26%^{240}Pu, 11%^{241}Pu, 5%^{242}Pu, etc.) or is it authorized to receive second or third recycle plutonium (4.4%^{238}Pu, 20%^{239}Pu, 20%^{240}Pu, 5%^{241}Pu, 51%^{242}Pu, etc.), which poses a significantly higher hazard because of its higher heat output, higher specific activity and higher neutron fluences. We were told that although the MELOX design basis was "broad" in this regard, the French regulatory authority has not authorized the reprocessing of spent MOX fuel.

The NRC visitors briefly visited the environmental monitoring building at the La Hague site. This tour was very brief, but we were able to see the control room. The control room receives data from many on-line monitors and surveillance points both on-site and in the environs surrounding the site. The host was able to demonstrate the ability to retrieve data stored in their information management system. Later, we were taken to the edge of the site and were able to observe maintenance on the liquid effluent discharge pipe that extends into the ocean. We were told much of the environmental monitoring data is available at www.cogemalahague.fr. An analysis of the discharge data posted on this website indicates that the reprocessing aspect of the La Hague operation overwhelmingly dominates the quantity and radionuclide mixture of air and liquid effluents. For example, the facility released over 150,000 curies of ^{85}Kr and other noble gases, 45 curies of ^{3}H and nearly 7 mCi of ^{129}I during August 2000. The uranium and plutonium release would likely be a very small component of the "aerosol" value of 0.43 mCi in August 2000, a value for which no distinction is made between alpha-emitting and beta-gamma-emitting radioactivity. The La Hague website reports that the calculated annual dose to most exposed population group is 30 µSv per person, as compared to their 1000 µSv limit and a 2500 µSv background level.

The NRC visitors did not observe environmental protection features at MELOX.