UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 11 1991

DOCKET NO: 70-1113

LICENSEE: General Electric Company
Wilmington, North Carolina

SUBJECT: SAFETY EVALUATION REPORT, LICENSE AMENDMENT APPLICATION DATED DECEMBER 3, 1990, AND SUPPLEMENT DATED JANUARY 9, 1991, RE URANIUM RECOVERY FROM LAGOON SLUDGE

Background

GE requested NRC concurrence on September 22, 1983, to construct a facility to recover uranium from calcium fluoride lagoon sludge from an onsite pond. On December 21, 1983, the NRC granted this request. GE reported on July 1, 1985, that the facility structure was complete but that the project was deferred; however, pilot testing was anticipated. On July 10, 1985, GE requested permission to develop techniques for and to recover uranium from nitrate sludges and to perform testing for filter media selection and associated operations based on the results of these tests. The NRC granted approval on August 9, 1985. This activity, however, was not begun, and on November 9, 1989, GE requested permission to use the structure (Uranium Recovery from Lagoon Sludge (URLS) Project Facility) to conduct uranium recovery development and process operations. On February 14, 1989, the NRC requested additional information on the basis for the safety controls; and on August 2, 1990, GE resubmitted the application with a significantly expanded safety discussion. Additional information regarding the operations was obtained during telecons between NRC and GE representatives on October 15, October 18, October 23, October 30, and November 7, 1990. On November 13, 1990, GE resubmitted the application with an expanded discussion of safety controls. NRC and GE staff discussed specifics of this application during telecons on November 26, and November 27, 1990. As a result of questions asked, GE submitted a revised application on December 3, 1990, containing proprietary information, a non-proprietary submittal on December 10, 1990, and a supplement dated January 9, 1991. This report is based on the December submittals and the January 9, 1991, submittal.

Discussion

The URLS operation will recover uranium from the lagoons, basins, and pits that receive waste streams from past fuel manufacturing operations. The uranium will be leached from the various sludges, purified by a solvent extraction process, and precipitated as a solid for transport back to the main plant.

The equipment involved is generally large compared to the minimum critical values associated with the specific enriched uranium anticipated in the sludge. Controlling the uranium concentration is the fundamental control philosophy to prevent an accidental criticality event in the URLS facility. Such an accident in this unshielded facility could cause lethal radiation exposure to staff.

The highest enrichment expected in the sludge is 4.025 percent uranium as shown by extensive sampling of the lagoons and anticipated by records of past operations contributing to the waste streams. The oxide form of uranium is considered the worst case. The single parameter limit (SPL) for 4 percent enriched uranium is 335 g U(4)/liter assuming UO_2F_2 (see ANSI/ANS 8.1-1983, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors", table 6). The SPL accounts for uncertainties and is thus lower than the expected minimum critical concentration of 360 g U(4)/liter (see ARH-600, "Criticality Handbook", figure III.3.2-7). If either of these is considered the failure limit, the safety limit of 180 g U/liter proposed by GE in the license amendment application provides an adequate margin to the failure. Operational limits and controls must then be used to assure that the safety limit is not challenged. These controls must make sure that uranium precipitation chemicals are not added to the process before the final stage, that solution concentration mechanisms are defeated, and that adequate diluents are present before uranium is dissolved in the sludge. The final stage uses thickness and mass controls.

The following analysis is based on the safety-related controls presented in GE's December 10, 1990, submittal.

A. Dredge and Feed System

The fundamental assurance that the safety limit uranium concentration is not challenged in this system is an accurate characterization of the existing sludge. The sludge characterization study is included as Appendix I to the application and supports the weight percent uranium and uranium enrichment assumptions of the safety demonstration.

B. Leaching/Filtration System

The core process for criticality safety in this system is concentration control. This involves assuring that enough diluent is present before uranium leaching to meet the concentration control limit and assuring that the uranium stays in solution. The material in the first leach tank must be 70 weight percent liquid to ensure the leached uranium meets the concentration limit in solution. This is determined by a program of dual samples and time limits on sample validity. Experiments on the sludge indicate the diluent will not drain away at greater than 4 percent per day and the validity of the sample will be 1 day.

The second leach tank operation is expected to require the addition of water to support the 70 percent water assumption. Demonstration of the presence of adequate diluent will also be required before the addition of the acid leach. Adequate mixing before sampling is a license requirement (4.2.7.1). The second leach tank has a heating system so concentration by overheating must be controlled. A requirement to sample this tank every day should control this latter risk.

A system containing calcium hydroxide is hard pipe connected to this process. As this material would defeat the concentration control, it is kept out of this process with an arrangement of interlocks. The testing of these interlocks is addressed in license requirement 6.6.1.1.

C. Solvent Extraction/Scrubbing/Stripping System

The limitation of uranium concentration is also the criticality control in this system. The transfer of uranium between liquid streams is controlled by the chemical makeup of the organic and strip solutions. The organic chemistry is administrated by dual sampling of the organic makeup solution. The strip solution chemistry is checked by sampling and an in-line density monitor. The monitor will activate a block valve if the solution density is too high. The risk of process upsets diverting the uranium solution to the aqueous raffinate is controlled by an in-line uranium monitor. The monitors will be treated as engineered-safety features, and the calibration requirement is specified in license requirement 6.6.1.2. Low flow rates for the strip or organic solutions should not cause the limit to be challenged.

D. Uranium Precipitation/Filtration System

The aqueous uranium solution from the stripping operation is fed to a 10-inch cylinder for precipitation. Concentration control is lost in this vessel so it is appropriate that the diameter is significantly less than the single parameter limit for UO_2 and water slurries. The slurry is then fed to a hood containing a filter. The safe slab thickness for the slurry within the filter is controlled by procedure and by a product filter level sensing device. The batch mode of the operation of this part of the system dictates that less than 30 kg of UO_2 would be fed to the filter in each step. The single parameter mass limit for U(4) is significantly higher.

Criticality control in the hood and filter is further based on limiting uranium buildup between batches. An overflow line on the hood will limit liquid buildup in the hood. An operability check on the overflow is required. Solid buildup is controlled procedurally by a requirement to cleanup all significant spills for each batch.

Handling of the 5-gallon product containers will be limited to one at a time. The combination of one can with the process equipment will not pose a criticality safety problem.

E. Raffinate Treatment System

Concentration control of input streams assures criticality control in the raffinate system. The in-line uranium monitor is the primary line of defense with downstream sampling as the backup control. With a limit of 100 ppm, millions of gallons of raffinate would be required for a critical mass of uranium to enter the system.

Conclusion

From the safety controls proposed in the GE license amendment application, the staff concludes that GE can process the uranium bearing sludge in the URLS facility in a safe manner and in accordance with the license. Therefore, the staff recommends approval of the request.

The Region II staff has no objection to this proposed action.

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Approved by: Original Signed By:
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RW/NOTE3

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