U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 072-00001/94002(DRSS)

Docket No. 072-00001

License No. SNM-2500

Licensee: General Electric Company
175 Curtner Avenue
San Jose, CA 95125

Facility Name: G. E. Morris Operation

Inspection At: Morris, Illinois

Inspection Conducted: March 21-25, 1994, April 1, 1994 - onsite;
April 7, 1994 - in-office review

Inspectors: Gary L. Shear for
George M. France, III
Fuel Facilities Inspector — 4/25/94 Date

Loren J. Hueter
Loren J. Hueter, Licensing
Reviewer/Health Physicist — 04/22/94 Date

Steven McDuffie
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USNRC HQ Staff Geologist — 04/22/94 Date

Approved By: Gary L. Shear for
George M. McCann, Chief
Fuel Facilities and Decommissioning
Section — 4/25/94 Date

Inspection Summary

Inspection onsite March 21-25, 1994, and April 1, 1994, and in-office telephone discussion on radiological protection and basin leak-seal project on April 7, 1994 (Report No. 072-00001/94002(DRSS))

Areas Inspected: This was a special inspection to observe the radiation safety practices associated with the basin-leak seal project and the radioactive waste (radwaste) systems; to compare the location of the utility systems that service the fuel basin with an approved engineering drawing; and to discuss the groundwater monitoring program.

Results: Of the areas inspected, no violations of NRC requirements were

identified. The licensee's contractor repaired the leak in the basin liner via its underwater welding technique. The project was completed with minimum exposure to personnel. The basin utility service lines such as the basin makeup water line and the cooling water return line, that penetrate the basin liner were located according to an approved engineering drawing. Sonic emission measurements of the welded seams indicated the service lines that penetrated the basin liner were leak tight.

One concern was identified. The new groundwater monitoring well system may not be adequate for detecting a leak near the base of the fuel storage basin.

DETAILS

1. Persons Contacted

*L. L. Denio, Manager, Plant Services
*J. E. Ellis, Manager, Morris Operations
*J. D. Kesman, Manager, Plant Operations and Maintenance
R. Wright, Health Physicist

The inspectors also met with the licensee's contractors regarding the basin seal-leak repair and radwaste system.

*Denotes those present at the exit meeting on April 1, 1994.

2. Licensed Program

The General Electric Morris Operation (GE:MO) provides a storage and service facility for nuclear reactor spent fuel. The GE:MO fuel storage facility includes three interconnected water-filled basins with cranes, water treatment systems, and other facilities required to receive irradiated fuel and store it underwater for an indefinite period. The storage facility reached capacity in January 1989. Consequently, the shipping casks were sold and the facility no longer receives shipments of spent fuel. Now, the licensee's major activity is to maintain the basin and basin water quality. The basins were constructed below ground with stainless steel lined, reinforced concrete walls about 2 feet (2') {0.61 meters} [0.61 m] thick poured in contact with the sides of a bedrock excavation. A leak detection system and pump-out facilities are provided for the space between the concrete walls and floor, and the basin stainless steel liner. Currently, the licensee is remediating the low activity waste (LAW) vault. The licensee has installed a resin filter system for processing future radwaste water. This system is independent of the basin water filter system.

3. Operations Review (IP 88020)

On January 31, 1994, the licensee's contractor United Marine Services (UMS) performed sonic emission tests on the basin liner and discovered several leaks near a welded seam. The licensee and UMS agreed that the primary method of detecting minor leaks of less than 2 gallons per hour (2 GPH) {7.6 E-3 cubic meter per hour} [m^3/h], still lies with the basin leak detection system. The sonic emission system was effective in detecting the basin liner leak, because the leak rate was nearly 6 GPH (2.3 E-2 m^3/h).

The inspectors reviewed the circumstances that led to the licensee's discovery of a failure in the fuel basin leak detection system and leaks in the basin liner in Inspection Report No. 072-00001/94001.

a. Fuel Basin Utility Services

The licensee stated that the basin utility service lines penetrate the basin wall and liner. Sonic emission tests ruled out any leaks around the service line welds at the point where the lines penetrate the basin liner. Tests also showed that the leak in the liner did not subside when the water level was lowered below the entry point for each utility service line.

The inspector performed a "walkdown" of the fuel basin and compared the location of each service line that penetrates the basin liner with its respective location on an approved engineering drawing. The drawings showed that piping from the basin skimmer, basin filter, basin make-up/water return system and basin cooler/water return system penetrated the basin wall and basin liner. These piping systems enter the fuel basin at depths no lower than 2 feet (2') or 0.61 meters (0.61 m) from the surface. This design prevents the suction systems associated with each utility service from pumping more than 2' (0.61 m) of water from the 50' (15.24 m) deep basin. If the water level were to drop 2' (0.61 m) below the basin surface, an alarm would signal the control room. A butterfly valve, or check valve mounted on the suction part of the line prevents accidental backup of basin water.

There are no basin utility service lines at the depth (33') {10.06 m} of the basin liner leak. The utility service lines do not penetrate the basin liner panels that were involved in the leak. To date there is no indication that the basin leak is associated with the integrity of the service lines that penetrate the basin and the basin liner.

b. Basin Leak Repair

A diver observed that imperfections on the surface of the liner as shown by the underwater camera were not holes in the liner, but surface stains. It was apparent to the diver that the actual leak occurred in the welded seam that held four liner panels. Two areas in the seam appeared to be less than "full fillet" welds. The location of the surface stains on the liner panel and the welded seam were nearly contiguous. These observations were made visible to the metallurgist and the NRC inspector through the underwater audio-video system.

The metallurgist instructed the diver to proceed with cutting out a section (coupon) of the area where the surface stains appeared. The diver cut out a sample (1.5 x 3.75 inches {"} or 3.81 x 9.52 centimeters {cm}) coupon of the basin liner. After examining the coupon, the metallurgist stated that other than surface staining there was no corrosion resulting from the metal steel bars used to reinforce the concrete. Also, there was no evidence of surface degradation on either side of the coupon. The licensee plans to

submit the coupon to its corporate metallurgical laboratory for further testing. Results of the nondestructive analysis will be forthcoming.

An epoxy adhesive was applied to a new coupon, to replace the "liner cutout." The epoxy was of more than general interest to both UMS and the metallurgist, as a future technique for sealing leaks underwater. The leak in the basin liner continued after the diver replaced the coupon. This was consistent with the divers' opinion that the leak must have occurred in the welded seam of the basin liner panels.

The licensee certified two UMS divers to perform underwater welding according to the Underwater Welders Association requirements that transcend pertinent OSHA regulations. The inspectors observed while a diver welded a larger coupon over the epoxy held coupon. To complete the seal, the diver rewelded the nonfillet portion of the weld that joined the basin liner panels. The welds proved to be leak tight, as shown by the vacuum box test.

On April 7, 1994, the licensee communicated that an increase in the water level between the basin wall and the basin liner averaged less than 0.1 GPH (3.8 E-4 m^3/h). These changes are thought to be caused by groundwater intrusion through the concrete basin and not by a leak in the liner. An increase in water level/volume could continue, especially during spring rains. As the level rises, the Leak Detection System (LDS) pump is activated to discharge the excess volume. The region will monitor this condition through periodic telecommunication with the licensee.

No violations or deviations were identified.

4. Radiation Protection (IP 83822)

Licensee staff provided orientation and background information on the basin leak-seal project and the radwaste program. The inspectors reviewed the licensee's radiation protection requirements for contractor personnel engaged in the basin leak-seal project and the radwaste program. The inspectors also reviewed the Safety Work Procedure/Permit (SWP) and the contractors/divers procedure. The inspectors also observed the divers remove a section (coupon) of basin liner for metallurgical examination and the final weld to seal the basin liner leak.

a. Basin Leak-seal Project

The licensee contracted United Marine Services (UMS) of Florida to perform underwater welding services to repair a leak in the spent fuel basin liner. The leak was located in the cask unloading pit about 33 feet (33' or {10.06 meters} 10.06 m) below the surface of

the basin. This location is nearly 30' (9.14 m) from the nearest fuel bundle.

Two experienced divers made four dives into the cask unloading pit of the spent fuel basin over a four day period, ending March 25, 1994. Altogether, the two divers expended about 13 hours and 42 minutes underwater with the time about evenly divided between the two divers. The diving team consisted of two fully suited divers, one topside, and a tender who supported the diver in the handling of hoses, cables, and other supplies. The supervisor of the diving activity acted as time keeper and overall manager of the project. The crane operator was a licensee employee. These were the most likely individuals to receive significant radiation exposure from the basin leak-seal project.

b. Radiation Exposure

Only one diver had a history of previous occupational exposure. His previous total dose was less than 3 rem or 30 millisievert (30 mSv) and occurred before 1990. Based on dosimeter data reported for the basin seal-leak project, the highest whole body exposure to any individual was 50 millirem (mrem) or (0.5 millisievert {mSv}), received by the tender. The divers received 30 mrem (0.30 mSv) and 25 mrem (0.25 mSv) whole body exposures, respectively. These exposures are commensurate with measured dose rates of about 1 to 3.5 mrem/h (0.010 μSv to 0.035 mSv/h) in the general area of the fuel basin unloading pit, in the areas of the weld seal 30' (9.14 m) below the water level, and in the walkway around the fuel basin.

The licensee placed 8 thermoluminescent dosimeter (TLD) sets on each diver inside the dry suit. Dosimeters were placed on each ankle, thigh, wrist and the chest, back, and head of each diver.

Negative test results of wipes taken inside the suit confirmed absence of water in-leakage. The licensee stated that they would not release the diving suit and helmet to UMS until fixed and removable contamination levels were reduced to less than 1,500 disintegrations per minute per 100 centimeters squared (dpm/100 cm^2).

According to approved procedure, the licensee used demineralized water to hose down the diver and cage, as he emerged from the water. The diver and diving apparel were immediately surveyed. Precisely the same procedure was used after the completion of each dive. These surveys confirmed the absence of any "hot particles." When moved to the decontamination pad, the divers suit and helmet were further cleaned with a soap solution before the diver unsuited. The inspector observed the practices of surveying and bagging equipment removed from the pool. Plastic sheeting was used to cover the basin walkway and decontamination pad to prevent the spread of contamination.

Only background levels of activity were detected from whole body counting the divers and two other UMS employees. The licensee stated that background levels were detected before and after the diving activities.

c. Fuel Basin Monitoring Data

Analysis of particulate air samples collected adjacent to the fuel basin unloading pit and at the fuel basin main exhaust showed beta concentrations of 2.3 E-13 microcuries per milliliter (μCi/ml) and 4.8 E-13 μCi/ml, or (8.5 E-15 megabecquerel/milliliter {MBq/ml} and 1.8 E-14 MBq/ml) respectively, during the period of welding. These levels fall within the range of concentrations experienced over the past calendar quarter and were significantly less than the license specification of 4 E-8 μCi/ml beta (1.5 E-9 MBq/ml).

The fuel pool filter was changed on March 18, 1994, four days before the diving activities were to commence. A review of basin water data indicated that changing the filter minimized the concentration of activity in the fuel basin. Analysis of fuel basin water samples during the period of the dive showed activity to be primarily cesium-137, ranging from about 3 E-4 to about 1 E-3 μCi/ml (1.1 E-5 to about 3.7 E-5 MBq/ml) and tritium (H^{+3}) reported at 1 E-4 μCi/ml (3.7 E-6 MBq/ml). These levels were consistent with the results (range of 1 E-5 to 4 E-4 μCi/ml) beta, or {3.7 E-7 to 1.5 E-5 MBq/ml} shown in the Safety Analysis Report dated 1983, and significantly less than the maximum license specification of 2 E-2 μCi/ml (7.4 E-4 MBq/ml) beta.

d. Training

The licensee provided 1.5 hours of radiation protection training to UMS personnel before the start of the basin seal-leak project. The training emphasized the types of radiation associated with the spent fuel, units of radiation dose, exposure hazards, and the protective measures and instrumentation required for the project. The licensee also stressed the importance of time, shielding and distance in maintaining exposure to the divers "as low as reasonably achievable" (ALARA).

The extent of these instructions adequately meets the requirements of the Commission's regulation, 10 CFR Part 19.12, "Instruction to Workers." In addition to the formal instructions, the licensee's Senior Health Physics Technicians provided direct supervision of radiation protection practices, during the basin seal-leak project.

The inspectors identified no discrepancies with the licensee's implementation of the SWP, nor with those steps of the diving procedure that relate to radiation safety. The detailed planning and implementation resulted in minimal radiation exposure in accomplishing the repair of the fuel basin liner.

No violations or deviations were identified.

5. Radioactive Waste Management (IP 88035)

a. Low Activity Waste (LAW) Vault

Since 1972, low-level radioactive wastes from aqueous process operations have been stored in below-grade containment. This onsite waste storage system, Low Activity Waste (LAW) Vault was constructed of reinforced concrete poured 77' (23.47 m) below grade into the underlying bedrock. The structure houses an inner tank fabricated of welded A-36 structural steel 75' (22.86 m) below grade. The inner tank has a diameter of about 39' (11.89 m). Typically, about 300,000 gallons (G) {1,135 cubic meters [m^3]} of liquid waste and sludge was maintained in the LAW Vault. Early in 1993, the vault contained about 300,000 G (1,135 m^3) of alkaline liquid and about 2,000 cubic feet ($ft.^3$) {56 m^3} of contaminated resin, alumina and natural uranium. The vault contained about 2,000 curies (Ci) or (5.4 E+4 gigabecquerels {GBq}) of radioactivity, predominantly from cesium, cobalt, and nickel isotopes.

A licensee contractor is removing contaminated waste from the low activity waste vault (LAW Vault). This project is being conducted in several phases: affect the precipitation of cobalt-60 and collect the solids by high efficiency filtration, dewater via a Rapid Dewatering System (RDS) composed of special vacuum pumps and blowers, and process bulk media such as spent resin and solka-floc and cesium-137 bearing liquid through an ion exchange system into a high integrity container (HIC). Low-activity effluent produced from filtration and ion exchange are processed by evaporation and solidification. These materials are shipped to a licensed disposal site (Envirocare of Utah). All other solids and resin waste generated during this phase will be dewatered through the RDS for shipment to a licensed disposal site in Barnwell, SC.

As of March 24, 1994, Chem-Nuclear had packaged/shipped about 700 Ci (2.6 E+4 GBq) {Type B shielded cask shipment} of cesium-137 to off-site burial. The total initial cesium-137 activity in the LAW Vault was about 1,300 Ci (4.8 E+4 GBq). This activity should be completed by the end of June followed by evaporation, solidification and off-site disposal.

b. Radiation Exposure

According to the licensee's safety analysis, the projected total dose for the LAW Vault project was about 7 man-rem (70 mSv). Due to unforseen problems, the licensee stated that the total dose will be higher, but less than double the initial projected man-rem. Dose rates are now dropping rapidly with the reduction in radwaste inventory. The increased man-rem is primarily attributable to pump maintenance caused by the alkaline liquid

attacking pump seals. The licensee's corrective measures included, moving pumps to a low background area for maintenance and switching to pump seals that are less reactive to alkaline solutions.

Engineering methods were used to reduce radiation exposure to workers assigned to the LAW Vault project. For example, the contractor used an existing scaffold to position a pump for removal of sludge from the bottom of the LAW Vault. Exposure was minimized by not having to build the remainder of the scaffold in a significant radiation field.

During a tour of the waste project area, the inspector observed dose rate measurements performed in preparation for the cesium-137 radwaste shipment. Maximum contact dose rates on the high integrity container (HIC) were 70 rem/h (700 mSv/h) and 35 rem/h (350 mSv/h) on the side and top, respectively. The maximum dose rate on the shielded cask after closure was 2.5 mrem/h (0.025 mSv/h). The licensee demonstrated the use of good ALARA practices in performing these surveys.

The contractors constructed concrete cubicles to shield/reduce worker exposure during radwaste packaging. In other ALARA practices airborne effluent from the area was twice filtered with HEPA filters. No significant concerns were identified.

c. New Radioactive Waste Handling System

The inspector observed that process lines previously used to route waste material to the LAW Vault were severed and capped. Radwaste is now routed through two sub systems that collect high and low activity waste. This design separates highly radioactive basin filter sludge from other plant waste water such as laundry, sump waste and decontamination solutions.

The high activity system dewaters basin filter spent resins and returns the water to the basin, while the low activity system processes waste water through an evaporator. The dewatered filter resins and evaporator bottoms are packaged and shipped as radioactive waste to a burial site.

The low activity system collects discharges from various sources in the basin area, the laundry and the laboratory. Intermediate holding tanks and pumps were established to support system discharges. About 20,000 G (75.71 m^3) of waste water per year will be routed to the evaporator. No significant radiation safety concerns were identified either during a tour of the facility or a review of the radioactive waste handling system.

No violations or deviations were identified.

6. Environmental Protection (IP 88045)

a. Groundwater Monitoring Program

In mid-1992 GE contracted with Dames & Moore to examine the adequacy of the groundwater monitoring system at the Morris, IL, spent fuel storage facility. The placement of monitoring wells in the 1970's was not based on a groundwater model, and there was some concern about the ability of the existing wells to detect potential leaks in the leak detection systems of the vaults and fuel basin. NRC staff expressed such concern in a letter to J. E. Ellis, Plant Manager, GE Morris Operation, dated September 28, 1992.

After developing a groundwater model for the GE site and vicinity, Dames & Moore recommended that 7 additional groundwater monitoring wells be installed. The model results suggest that in the first 50 feet (50') {15.24 meters}(m)} or so below the surface, groundwater movement is to the north, east and south. Groundwater flows more westward in the 50'-90' (15.24 m -27.43 m) depth range. As a result, Dames & Moore advised 6 new wells in 3 locations north, east and south of the fuel basin. At each location, one well screens 15'-25' (4.57-7.62 m) depth and the other 25'-35' (7.62-10.67 m). In addition, a well screen at 50'-60' (15.24-18.29 m) depth was recommended west of the basin. These 7 monitoring wells were installed in October 1993 by D&G Drilling, Inc. of New Lenox, IL, a Dames & Moore subcontractor.

Four older wells on the GE property are presently included in the groundwater monitoring program. "First well" (788' deep {240.18 m}) serves as the water supply for the site. It is extremely unlikely that contamination from the GE facility would be detected in this well. "New well" (50' deep {15.24 m}) and "sand filter well" (52.5' deep {16.00 m}) lie east of the major facilities, and chances are very slim that these wells would provide first detection of groundwater contamination. The "6 inch LAW well" (82.5' deep {25.15 m}) lies just east of the LAW vault, which extends to about 80' (24.38 m) depth. This well may be the only means of detecting a leak near the base of the LAW vault; other nearby wells are too shallow. This well is not optimally located for LAW vault leak detection, as the Dames & Moore groundwater model predicts westward flow at the base of the vault. However, this is not a serious concern, as activities are underway to decommission the LAW Vault.

The cladding vault extends to about 75' (22.86 m) below grade, but it has no adjacent deep monitoring well to detect potential leaks near the base of the tank. Groundwater flows westward at the base of the cladding vault, and there are no down-gradient wells deep enough to sample a leak at 75' (22.86 m) depth. This is of no concern as long as the cladding vault remains empty, but this lack

of monitoring at depth could be a concern if the vault is used for storage of radioactive liquid in the future.

The most serious concern regarding the present groundwater monitoring program is the detection of potential leaks between 35'(10.67 m) and 50'(15.24 m) depth in the area of the fuel basin. It is unclear how such a leak in the leak detection system would be detected by the monitoring wells. The maximum depth of the basin is approximately 48' (14.63 m) below grade, still within groundwater model layer 1, so water escaping from the basin's leak detection system would likely travel northward, southward, or eastward. Vertical permeability is much lower than horizontal, so contaminated water would move more or less horizontally. If escape through the concrete barrier occurred below 35' (10.67 m), it appears that contaminated water could escape detection by the 7 new wells.

On March 23, 1994, the inspector spoke with the licensee's contractor Dames & Moore regarding the water level data which was used as input to construct the groundwater model for the GE Morris site. The inspector also inquired about the 9 foot differential in the water levels of wells DM-2, which was noticed in a review of the Dames & Moore report on well installation. These two wells are adjacent, but they are screened at different depths.

Apparently, Dames & Moore has not reconciled the discrepancy at this time, but it could be the result of a localized lens in the stratigraphy. Further, the contractor seemed reluctant to discuss the depth of the LAW and cladding vaults. The licensee seemed uncertain about the capability of the new groundwater monitoring system to detect a hypothetical leak near the base of the fuel storage basin. Similarly, the Dames & Moore representative was uncertain about discussing the ramifications of a hypothetical leak from the base of the fuel basin outside the presence of a licensee representative. The licensee committed to respond to this issue. This item is being tracked by the inspector as an unresolved item (URI No. 072-00001/94001-01). During the exit meeting the licensee committed to resolving the issue through its contractor, Dames & Moore.

b. Well Sampling

The 7 Dames & Moore wells have been sampled at least monthly since their October 1993 installation, and GE Morris staff plan to continue monthly sampling. The samples are analyzed by Teledyne of Northbrook, Illinois, with some sent to Heritage Labs of Bolingbrook, Illinois, as a quality check. In addition to the 7 new wells, monthly water samples are analyzed from the north wall of the ETA pit, first well, new well, sand filter well, and the 6" (15.24 cm) LAW vault well. Samples are analyzed for gross beta, gross gamma, tritium, cobalt-60, cesium-134 and cesium-137. Most samples register below detection limits for these 6 categories.

However, samples from wells DM-4 and DM-5, southeast of the fuel storage basin and southwest of the cladding vault, have been reading 300-500 picocuries per liter (pCi/l) or (11.11-18.52 becquerels per liter, {Bq/l}) of tritium fairly consistently since sampling began in October 1993. The highest reading was 633 ± 194 pCi/l (23.44 ± 7.18 Bq/l) of tritium in well DM-4 on January 26, 1994. This same sample, analyzed by Heritage Labs, contains 17.6 ± 2.3 pCi/l (0.65 ± 0.08 Bq/l) cobalt-60, but GE Morris staff have reason to question this analysis. Well DM-4 has never yielded measurable co-60 aside from this one analysis, and GE Morris staff believe there may have been some cross contamination in this analysis. Moreover, cobalt tends to precipitate in alkaline environments, so it is difficult for cobalt to pass through the concrete barrier. Well DM-7 also shows tritium above 200 pCi/l (7.41 Bq/l) on occasion. The source of tritium in the groundwater is uncertain, but it may have escaped into the local groundwater as a result of the 1972 cask tip incident or the more recent basin leak. Tritium levels of 600 pCi/l (22.22 Bq/l) are of little concern at this time; the limit for tritium in effluent water, (10 CFR Part 20, Appendix B) is 1 E + 6 pCi/l (3.7 E + 4 Bq/l).

GE will continue monthly sampling of the 7 Dames & Moore wells. A GE representative suggested that GE may reduce or terminate sampling of the other wells contingent upon the contents of this report. Based on their locations and sampling depths, it is not necessary to continue monitoring the first, new, and sand filter wells. It is unlikely that these three wells would provide first detection of groundwater contamination from the vaults or fuel basin. However, it is prudent for GE to continue sampling the 6" LAW vault well as long as radioactive liquid remains in the LAW vault. This was discussed during the exit meeting.

No violations or deviations were identified. However, one concern regarding the detection of a leak in the base of the fuel basin was identified.

5. Exit Meeting

The inspectors met with the individuals denoted in Section 1 of this report at the conclusion of the onsite inspection. The inspectors summarized the scope and findings of the inspection and discussed their observations. The licensee committed to the following tasks:

Submit the metallurgical report on the cutout coupon (Section 3.b.).

Resolve the issue regarding the detection of a leak at the base of the fuel basin, and submit a written response from its contractor (Section 6.a.).

Continue to sample the 6" (15.24 cm) LAW Vault well until such time that the vault is removed from service (Section 6.b.).

The licensee did not indicate that any information concerning any product or equipment observed in use during the inspection such as, the use of new epoxy adhesives for sealing metal liners, vessels, containers, etc., normally designed for underwater usage, or special gear for the divers and the underwater audio visual equipment, was proprietary.