COLD WEATHER EFFECTS ON DRESDEN UNIT 1

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INTRODUCTION

Dresden Unit 1 is in the final stages of a decommissioning effort directed at preparing the unit to enter a SAFSTOR status. Following an extended sub-zero cold wave, about 55,000 gallons of water were discovered in the lowest elevation of the spherical reactor enclosure. Cold weather had caused the freezing and breaking of several service water lines that had not been completely isolated. Two days later, at a regularly scheduled decommissioning meeting, the event was communicated to the decommissioning team, who quickly recognized the potential for freezing of a 42" diameter Fuel Transfer Tube that connects the sphere to the Spent Fuel Pool. The team directed that the pool gates between the adjacent Spent Fuel Pool and the Fuel Transfer Pool be installed, and a portable source of heat was installed on the Fuel Transfer Tube. It was later determined that, with the fuel pool gates removed, and with a worst case freeze break at the 502' elevation on the Fuel Transfer Tube (in the Sphere), the fuel in the Spent Fuel Pool could be uncovered to a level 3' below the top of active fuel.

Brief History and Status of Dresden Unit-1

The Dresden Nuclear Power Station, which includes Units 1, 2, and 3 is located on a 953 acre site near the confluence of the Des Plaines and Kankakee Rivers, about 50 miles southwest of Chicago in Grundy County, Illinois. The nearest population center of Morris, Illinois, is located eight miles to the West.

Dresden 1 was a first generation, turnkey, demonstration plant that was the first full-scale privately financed nuclear power plant in the United States. When built, Dresden 1 was the largest single operating nuclear reactor in the world. Initially, it was rated at 180 MWe (net) and was subsequently up-rated to 210 MWe.

Dresden 1, owned and operated by Commonwealth Edison, received its construction permit May 4, 1956 and its operating license, DPR-2, November 16, 1959. Commercial power operation between August 1, 1960 and October 31, 1978 generated approximately 15.8 million MWhrs of electricity.

On October 31, 1978, CECo suspended operations of Dresden 1 to refuel, perform major system modifications, to add a High Pressure Coolant Injection (HPCI) system, and to perform a major primary system chemical cleaning. Following the Three Mile Island-2 accident, the cost of additional modifications grew to more than $300 million to bring the unit into compliance with federal standards. Company officials concluded that the age of the unit, together with its relatively small size, (compared to the available power at the time), made such an investment impractical. On August 31, 1984, it was announced that Unit-1 would be retired.

In July 1986, the Dresden 1 provisional operating license was amended to a possession-only status. Amendment No. 36 to operating license DPR-2 continued CECo's authority to possess the facility and its contents, and permitted maintenance of Dresden 1 in its present status. By maintaining the facility in the proposed manner, the safety of the public would be assured.

The Dresden 1 reactor was de-fueled in 1978. All 464 spent and partially-spent fuel assemblies in the reactor were discharged to the pool. There are currently 660 assemblies stored in the Spent Fuel Pool (SFP) and 23 assemblies in the Fuel Transfer Pool (FTP). These fuel assemblies will remain in their present storage locations until permanent disposal alternatives are available. CECo is presently pursuing alternate fuel storage options, including dry fuel storage.

Dresden is currently undergoing preparations for the dormancy period as part of our SAFSTOR plan for decommissioning. A chemical decontamination of the primary system, completed in September 1984, removed the bulk of the internal contamination.

Areas of Unit 1 no longer required to be vital areas have been devitalized.

Primary systems have been drained, and supporting systems are being reviewed for lay-up options. The Fuel Service Building is being cleaned, and a new ventilation system is being installed. Presently, the existing pool filtration system in the SFP is not operational and will remain inoperative. A portable demineralizer/filter system is being installed for water chemistry control. Fuel pool storage rack metal monitoring coupons are in place and being trended for corrosion rate.

Unit 1 procedures have been reviewed, and revisions are in progress. A Unit 1 structural monitoring program has been developed, and baseline walk-downs are near completion.

A baseline radiological survey is complete, and quarterly radiological surveys are being conducted in accordance with Reg. Guide 1.86.

CHARACTERISTICS OF UNIT 1 FUEL HANDLING SYSTEM

The fuel handling system essentially consists of a water shielded path for the spent fuel to travel from the reactor vessel to the Fuel Service Building (located outside of the containment), equipment for handling the fuel and various reactor parts, a water shielded storage pool, and shipping and receiving facilities.

To move fuel from the reactor vessel, the following operations were performed. The reactor vessel head and turning vanes were stored in the fuel handling canal. Fuel assemblies were withdrawn from the reactor using the fuel bundle grapple and hoist.

Sixteen fuel assemblies were placed in a Fuel Transfer Basket in the refueling canal. These baskets were lifted with the 7-1/2 -ton auxiliary hook of the reactor service crane and lowered 55 feet through the 42-inch diameter Fuel Transfer Tube into the Fuel Basket Carrier located in the Fuel Transfer Tunnel (beneath the Sphere)

To store the used fuel in the pools, the Fuel Basket Carrier was moved through the tunnel to the south end of the transfer pool by means of a cable drive assembly. The fuel assemblies were lifted from the Fuel Transfer Basket using the fuel bundle grapple and hoist, and were moved to the Spent Fuel Pool to be stored in fuel storage racks.

The Dresden 1 fuel pools consist of two to three foot thick concrete walls that were poured into excavated bedrock. The pools do not have a liner, but the original construction included an epoxy-type concrete coating.

The site grade elevation is at the 517' elevation. The SFP bottom is at the 494' elevation, and the FTP is about 20 feet deeper to accommodate the Fuel Transfer Tunnel. The top of active fuel is approximately the 505' elevation in the SFP.

A gate between the SFP and the FTP is located at the north end of the pools. The gate consists of two sections (one above the other) to isolate the SFP from the FTP. This gate is of an older design, must be lifted vertically and completely out of the pool to be removed, and extends completely to the bottom of the SFP. The normal configuration of this gate is out per the equipment manual. Due to the fuel grapple design, the gates were left out to allow movement of the fuel grapple bridge between the two pools. The design of the SFP is unusual in that it is relatively shallow (~ 25 feet) which requires that the fuel be moved horizontally between rows of racks, and then tilted into a storage location.

JANUARY 1994 COLD WEATHER EVENT

Following an extended sub-zero cold wave, on January 24, 1994, water was discovered on the floor of the Unit-1 Offgas Filter Building which was unheated and not in service at the time of the event. Unable to isolate the frozen and thawing pipes and valves associated with the affected Service Water System, the Operating Dept. shut down the Unit-1 Service Water System. The following day, water and ice were discovered in the basement of the Unit-1 containment during a quarterly radiation survey (Reg. Guide 1.86). The majority of this water was traced to frozen and thawing service water lines inside the containment. Shutting down the Service Water System as a result of the Offgas Filter Building leak precluded additional leakage of service water into the Sphere.

Heat had been discontinued to the Sphere in the spring of 1989 following maintenance problems with the steam heating boiler. A subsequent engineering review to determine the acceptability of not continuing heat to the containment structure erroneously assumed that all systems inside the containment had been appropriately isolated and drained. In fact, some systems could not be isolated by valve closure except inside the unheated containment, leaving a portion of the piping subjected to freezing conditions.

Service water leakage in the Offgas Filter Building was contained within the floor curbing. The estimated 55,000 gallons which collected in the Sphere basement was eventually pumped to radwaste for processing. The water in the Sphere was found to be contaminated, probably from the flushing of material from the floor drains in the Sphere basement.

On January 27, 1994, it was realized that the freezing conditions in the Sphere basement could subject the vertical fuel transfer tube to freezing. To preclude any significant consequences from freezing and possible rupture of the fuel transfer tube inside the containment (possibly below the top of active fuel in the Spent Fuel Pool), the pool gates separating the Fuel Transfer Pool and the Spent Fuel Pool were immediately installed. Temperature readings of the Transfer Tube were obtained by use of remote heat sensing equipment. The temperature below the isolation valves in containment was 64 ^{0}F and above the valve 36 ^{0}F. No freezing of this tube was identified and electric heat and a surveillance program for the tube were instituted immediately.

An internal investigation was begun, the NRC issued a Confirmatory Action Letter, and the NRC dispatched an inspection team to the site for a two week period to examine the event and other aspects of the decommissioning plan for Unit 1.

Although a UT inspection of the transfer tube on February 16th identified the possibility of a gas pocket under the 42" isolation valve on the Fuel Transfer Tube, this was later proven not to exist via direct sampling and measurement of tube contents. The UT signals are believed to have been influenced by a heavy accumulation of material on the inside of the transfer tube. This may have resulted from normal corrosion of the carbon steel pipe and from the existence of microbiological growth in the pool during the course of a few years in the late 1980's.

The investigation into the pipe freezing event also identified concerns with inoperable HVAC systems, fuel pool water inventory monitoring, possible siphoning paths from the fuel pool through the original (but no longer used) decay heat removal and filtration system, and a lack of management attention to the decommissioning effort. Fuel pool integrity continues to be examined and water inventory better documented.

CORRECTIVE ACTIONS

1. The Service Water system was shut-down to preclude additional water leakage into the Offgas Filter building, which also stopped water ingress into the Sphere

2. Pool gates were installed to protect the fuel stored in the Spent Fuel Pool section, which was vulnerable to a loss of integrity of the Fuel Transfer Tube (inside the Sphere)

3. Heat was applied to the Fuel Transfer Tube inside the containment to preclude freezing and a surveillance was established to assure that the tube was adequately heated and monitored. This eventually included remote monitoring via CCTV and thermocouple read-out.

4. Water in the sphere was pumped to radwaste for processing.

5. An in-house investigation was conducted to determine the cause of the event and to recommend corrective actions.

6. In-progress system walk-downs were accelerated to identify additional sources of piping inside the Sphere which could possibly be charged with water and be subjected to freezing and rupture. Several pipes associated with Service Water and Contaminated and Clean Demineralized Water were cut and capped, and additional (less vulnerable) pipes have been identified for future cut and caps.

7. A procedure controlling the fuel pool gates is being written to provide more positive control over when they can be removed. Gate installation will provide additional separation between the majority of the fuel and the transfer tube.

8. A new Unit 1 organization has been formed to dedicate resources to the decommissioning effort, in place of utilizing management personnel with shared responsibilities with the operating units on-site.

9. Emphasis on decommissioning activities has been heightened

10. Water inventory monitoring of the fuel pool has been improved

11. In-progress efforts aimed at achieving SAFSTOR status have been accelerated and intensified to assure compliance with the program and the NRC. SER on SAFSTOR.

RESULTS OF ROOT CAUSE ANALYSIS

The removal of heat from the Sphere was the result of the limited scope of the engineering studies which only evaluated the potential impact on four systems and the Sphere structure itself. The assumptions that other systems had been appropriately isolated and drained were incorrect. This resulted from:

1. Deficiencies in personnel knowledge and training concerning the transfer tube

2. Deficiencies in communications between Station and Engineering personnel regarding which systems and components had been drained and where they should be isolated

3. Inadequate application of 10 CFR 50.59

4. The absence of a formal review and approval of the engineering studies by either the station or engineering.

The root cause of other decommissioning issues identified as a result of the investigation into the pipe freezing and water spills is related to organizational and priority deficiencies associated with the decommissioning effort. Unit 1, an early generation nuclear unit, is not closely related to the other Dresden or CECo units in design or level of available documentation on system design or operation. The early retirement of Unit 1 (due to age and design concerns) compared to the Units 2 & 3 resulted in a lack of focused attention on the multi-unit site. Decommissioning was being addressed by existing staff without adequate guidance, oversight, or expectations and generally decommissioning assumed lower priority in staff assignments compared to issues associated with the operating units on-site. The "Order to Authorize Decommissioning of Dresden Nuclear Power Station, Unit 1, and Amendment No. 37 to License No. DPR-2" were received on September 3, 1993.

SUMMARY OF DRESDEN UNIT-1 DECOMMISSIONING CORRESPONDENCE

The decision to retire the unit was announced on August 31, 1984. In July 1986, Dresden received a license amendment bringing the unit to a possession-only status. Decommissioning plans and revisions were submitted in December 1987, April 1988, and February 1992. The "Order to Authorize Decommissioning of Dresden Nuclear Power Station, Unit 1, and Amendment No. 37 to License No. DPR-2" were received on September 3, 1993.

POTENTIAL EFFECT ON THE FUTURE OF DECOMMISSIONING ACTIVITIES

✓ The NRC is likely to take a much closer look at some of the older fuel storage systems in the industry, in particular those of shut-down plants. Emphasis is likely to be on water mass balance and inventory, and trending of water additions to fuel pool systems.

✓ Depending upon the vulnerability of the fuel pool to leakage, for units in SAFSTOR, adequate demineralization may be required to limit the total amount of Cesium activity suspended in the pool water. Leaking fuel pins can result in a significant amount of Cesium inventory in the water if it is not removed through demineralization.

✓ The NRC is likely to scrutinize decommissioning submittals with much more detail. This will probably include follow-on visits to spot check key details of a proposed decommissioning plan.

✓ The decommissioning process itself may change based upon some of the lessons learned by key NRC officials during their visit to Dresden and some other shut-down plants. Identification of areas of risk, and lessons learned could make decommissioning issues clearer, and the information exchange process quicker.

✓ A possible lesson learned is that the industry may see more emphasis on the prompt dismantlement option of decommissioning vice the SAFSTOR option. Prompt dismantlement allows a utility to "gear up" and "put the unit to rest" quickly, thereby providing less long term risk for the utility to manage. Closure of waste disposal sites, however, is a major deterrent to prompt dismantlement.

- ✓ **The industry may see an accelerated and greater emphasis on alternate fuel storage systems such as dry fuel storage, especially for utilities with older or obsolete design fuel pools.**

REFERENCES

1. Nuclear Network Operating Report (O.E.) 6539

2. U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 "Termination of Operating Licenses for Nuclear Reactors"

3. NRC Bulletin 94-01 "Potential Fuel Pool Draindown Caused by Inadequate Maintenance Practices at Dresden Unit 1"

Author Biography

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