Mail message FJC Fermi-2 AIT Status

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MESSAGE

From: Charles A. Willis (CAW)
To: FJC FRANK CONGEL
Date: Saturday, January 8, 1994 1:53 pm
Subject: Fermi-2 AIT Status

On Christmas day, the Fermi-2 turbine failed, damaging quite a bit of equipment and spilling a large quantity of contaminated water into the turbine building and radwaste building basements. No one was hurt and the reactor was safely shut down so there was and is no off-site radiological hazard.

The problems at this time are to move the water out of the basements so the equipment can be returned to service. There is a need to do this quickly so the exposure of safety systems to out-of-specification water is minimized. Also, the licensee wants to minimize releases as a part of the PR effort.

A problem that I did not discover until Friday afternoon is that the plant now seems to be in a condition that exceeds the conditions addressed in the FSAR. That is, in the FSAR, Section 17.7.3, analysis of the "Postulated Radioactivity Releases Due to Liquid-Containing Tank Failures," the licensee assumed the failure of all equipment in the Radwaste building with all the liquid being dumped into the Radwaste Building basement and eventually leaking out into the environment. Their conservative analysis showed that this event would not produce concentrations in excess of the MPCs at the nearest drinking water intake (that for Monroe, MI). The problem is that the amounts on radioactive materials now present in the Radwaste Building basement may be a hundred or more times the amounts assumed in the FSAR. I have not yet repeated the calculations for the present conditions but I suspect that even these higher levels of activity would not cause the calculated concentrations to exceed the MPCs at the drinking water intake. In any event, the situation will require further attention, beyond the expected quibbles with Stu Bland, et al. about how to do the effluent dose calculations, the review of temporary modifications, etc.

There are some questions about EP that I have not been asked to address. If they seem significant, I will be in contact with Rich Emch.

We are lookin at the occupational ALARA plans/considerations for the proposed temp. modifications. Again, if we seem to need help, I will be in touch with Jim Wigginton.

CC: LJC2, RLE, THE, JEW2

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To → McCormick-Barger

Radiological Consequence Assessment

General

The actual releases to the environment during the accident produced radiation levels at the site boundary that were a small fraction of the relevant NRC criteria and a small fraction of the doses postulated in the FSAR.

The water released to the buildings on site has produced no off-site radiation dose. Off-site doses could result if the water were released, either accidentally or deliberately. The water may be released deliberately in such a manner that NRC requirements for normal operations are met (i.e. no member of the public could receive a dose greater than one percent of the average person's dose from nature). Detailed plans for deliberate releases have not been developed so actual expected doses have not been calculated.

Precautions are being taken to preclude accidental releases. Nevertheless, various accident scenarios have been postulated and the consequences assessed. It was concluded that the potential accidents associated with the processing of the water from the Fermi II turbine failure will not produce doses in excess of the relevant NRC criteria. Generally, this means that, even in the unlikely event of an accidental release, no member of the public will be exposed to concentrations of radioactive materials that, if used as drinking water, would produce doses of as much as 17 percent of the dose the average person receives from nature.

Doses associated with possible releases are discussed in the following paragraphs.

Release from the Condensate Storage Tank (CST)

The CST contains an estimated 531,840 gallons [2,013 cubic meters, m^3] of slightly contaminated water. The storage space is needed for more seriously contaminated water, such as that from the radioactive waste building basement, so consideration is being given to releasing the water from the CST to the environment. This would not be considered an accident so the criteria for the release of water during normal operations would apply.

Isotopic analysis showed the concentration of radioactivity in the CST water to be about 0.000033 microcuries per milliliter ($\mu Ci/mL$) [1.2 megabequerels per cubic meter, MBq/m^3]. The dose is dominated by two nuclides of cesium (Cs) (^{134}Cs and ^{137}Cs) which are present at a concentration of 0.000018 $\mu Ci/mL$ [0.67 Mbq/m^3] dose-equivalent ^{137}Cs. To meet the NRC dose criterion, the concentration must be reduced by a factor of 18,000 before it reaches fish. For Fermi II, the lake provides dilution by a factor of 5 ("near field" dilution) so an additional factor of

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3600 is needed. This can be provided by demineralization, dilution, or some combination of the two. At a flow rate of 17,000 gallons per minute (gpm) [1.07 cubic meters per second, m^3/s] (normal decant flow from the reservoir to the lake) this dilution could be achieved in 79 days.

Plans for release of the water from the CST to the lake are not complete but if the release is to take place, a more complete isotopic analysis will be necessary, especially to determine the concentrations of the beta emitting nuclides {e.g.tritium (^3H), iron-55 (^{55}Fe) & strontium-90 (^{90}Sr)}. Tentative plans call for the reduction of the Cs concentration with demineralizers, which can reduce concentrations by a factor of 100 or more.

Thus, following processing through demineralizers and sampling to ensure compliance with regulatory requirements,the water from the CST should be acceptable for release as a part of normal operations of the plant.

Accidental Release of the Water from the Radioactive Waste Building Basement

The turbine failure released a large quantity of contaminated water into the Radioactive Waste Building basement. A postulated accident of this nature is addressed in the FSAR but the FSAR accident scenario entailed the assumption of the failure of the building and the release of the activity to the ground water. The NRC acceptance criterion for this accident is that the concentration of radioactivity at the nearest drinking water intake shall not exceed the permissible concentrations for public exposure. The concentrations for the FSAR accident, calculated in accordance with the NRC's Standard Review Plan, Section 15.7.3, were below the criterion by a factor of 319.

The water from the current turbine failure is contained in the building. The top of the water table around the Radioactive Waste Building is some 12 feet [3.7 meters, m] above the top of the water in the basement so if there were a leak, there would be a flow of ground water into the building. Furthermore, people who work in the building report that the basement has been dry for an extended period of time. Thus, a major release of the water from the basement is not expected but could occur as a result of another event such as an earthquake. Therefore, the consequences of such a release have been evaluated.

Because of the limited access to the flooded parts of the basement, there is considerable uncertainty about the amount of radioactivity in the basement. The water volume is estimated to be about 600,000 gallons [2,270 m^3]. The radioactivity has been measured in samples from one location in the basement and found to be about 0.0004 $\mu Ci/mL$ [15 MBq/m^3]. This is not a concentration that presents a serious hazard to people who work with it, but it is well above the NRC's permissible concentration

for public exposure (10 CFR 20 Appendix B, Table II, Column 2) so precautions are being taken to avoid its release. The analysis did not determine the concentration of beta emitters so, for this analysis, the ^{3}H concentration is taken as equal to that in the reactor coolant and (in accordance with the Offsite Dose Calculation Manual) the total activity is increased by 10% to account for the possible contribution of other beta emitters such as ^{55}Fe and ^{90}Sr.

If the Radioactive Waste Building basement were to fail, ground water would leak into the building until the water level inside became the same as that outside. To compensate for the uncertainty in our knowledge of the contents of the basement, this dilution was not taken into account in our analysis. Once the water level inside and outside the building became equal, there would be transfer of the contaminated water into the ground water. The contamination would then migrate to the lake. Hydrologic analyses reported in the FSAR indicate that it would take about 5 years [32,000,000 seconds] for the contamination to reach the lake. This time period would be sufficient for radiological decay to effectively eliminate the short-lived radionuclides such as iodine-131 (^{131}I) and chromium-51 (^{51}Cr). During this migration, the concentrations of the radionuclides would be reduced by attachment of the radionuclides to the soil and by dilution by ground water but, as an added conservatism, this reduction has not been taken into account in this analysis. Even so, the calculated radionuclide concentration would be less than 5 times the NRC's permissible concentration for public exposure in drinking water (MPC) when the contaminated water reached the lake. The hydrological dispersion analysis reported in the FSAR shows that there will be a factor of at least 77 dilution between the point at which the water would enter the lake and the nearest drinking water intake. Thus, at the drinking water intake, the concentration would be less than 7 percent of MPC (10 CFR 20 Appendix B, Table II, Column 2).

Thus, the accidental release of the contaminated water in the Radioactive Waste Building to the ground water would not exceed the NRC accident criteria.

Accidental Release from the Condenser

In order to regain use of the equipment in the Radioactive Waste Building, the contaminated water is being transferred to the condenser hot well for temporary storage. The transfer piping is entirely within the Radwaste and Turbine buildings so any spill in this process would be contained and would not result in radiation exposure off site. Possible releases from the condenser could reach the environment and so must be considered. The following two scenarios were assessed: (1) small leaks to the condenser tubes, and (2) catastrophic failure of the condenser.

A small leak to a condenser tube would not be a direct release to

the environment but could contaminate the circulating water and the reservoir. The reservoir is connected to the lake only by the decant system so releases to the lake can be controlled. Control of contamination in the reservoir would constitute an operational problem so provisions are included to detect and plug leaks before problems arise.

A catastrophic failure of the hot well is highly improbable, but could occur, possibly as a result of a seismic event. A release to the environment would not occur unless both the hot well and the turbine building failed. If the contaminated water were released, it would enter the groundwater. From this point the sequence of events and the resulting concentrations would be essentially the same as those from the failure of the Radioactive Waste Building as discussed in the preceding section.

Thus, the possible release of the contaminated water from the hot well does not constitute an undue hazard to the public nor constitute an accident not encompassed by the accidents addressed in the FSAR.

Spills at the Surface

In the cleanup of the Fermi II facility, it will be necessary to transfer and process substantial quantities of contaminated water. Radioactivity levels range from "undetectable" (less than about 0.0000001 μCi/mL [0.0037 MBq/m^3]) to about 0.017 μCi/mL [630 MBq/m^3] in the reactor coolant. Almost all this water is contaminated enough to produce detectable levels of surface contamination if the water were spilled. Furthermore, spills would tend to increase the exposure of workers in the plant. Consequently, procedures that are being developed for handling this contaminated water must include provisions for minimizing the likelihood of spills. These procedures are reviewed by NRC staff members prior to implementation.

Special attention must be paid to possible spills that could release substantial quantities of contaminated water to the ground surface. Water spilled on the surface is a special concern because it could run to the lake with the extended time delay associated with the movement with ground water. Furthermore, the NRC criterion of complying with the off-site MPCs would be applied at the point where the contaminated water entered the lake (rather than at the drinking water intake). Since (1) most of the water is contaminated to levels above the off-site drinking water MPC values, and (2) there is little opportunity for dilution or for decontamination of uncontained spills, uncontained spills generally are unacceptable. Therefore, plans for moving, processing or storing contaminated water will be required to include provisions for containing any and all spills. These provisions may include keeping the operation inside existing buildings with established integrity, or building berms, dikes or dams that will contain any

substantial spill.

Conclusion

Based on our review of the licensee's "Temporary Modification Requests" and "Safety Analyses" as well as our independent analyses of potential accidents, it is concluded that the contaminated water can be processed within regulatory limits and without introducing the possibility of an accident that either exceeds the NRC radiological criteria or is more severe than accidents addressed in the FSAR.