Request for Additional Information No. 86 (1216, 1143, 1227, 1106), Revision 0

10/3/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 09.01.01 - Criticality Safety of Fresh and Spent Fuel Storage and Handling
SRP Section: 09.01.02 - New and Spent Fuel Storage
SRP Section: 09.01.03 - Spent Fuel Pool Cooling and Cleanup System
SRP Section: 09.05.04 - Emergency Diesel Engine Fuel Oil Storage and Transfer System
Application Section: FSAR Ch. 9
CIB1 Branch

QUESTIONS

09.01.01-1

Conformance with GDC 62 and 10 CFR 50.68 requires that the control of fission during fuel storage be assured by using a geometrically safe configuration. Neutron moderator materials that have been used in the spent fool pool (SFP) in the past (e.g., Boraflex$^{TM}$) have been tested in radiation fields with dry air, or in borated water solutions without a radiation field, but never both together. A design flaw that was unrealized was that in borated water and in the presence of a radiation field, hydrogen peroxide and peroxide radicals form (as well as other free radicals) that attack the Boraflex$^{TM}$ causing it to decompose and decrease its geometric neutron capture capability. A significant release of silica results from this degradation and challenges the demineralizer capability to remove contaminants that promote stress corrosion cracking. Another material, Boral$^{TM}$ showed attack in the SFP environment after a few years of service. In this case the material blistered and the final cause of this attack is still under investigation. Additionally, elevated concentrations of sulfates have been determined in these SFPs as a result of the action of peroxide on cation resins. Sulfates in acidic environments have been the subject of fuel assembly top nozzle failures (US NRC Information Notice 2002-09) and attack of the Boraflex$^{TM}$ neutron absorber material some nuclear plants. Although Metamic$^{TM}$ is a different type of material from the Boraflex$^{TM}$ or Boral$^{TM}$, it may suffer a similar type of degradation if not shown to be resistant to attack under true conditions experienced by the material in the SFP environment.

Report UN-TR-08-001(P), “Spent and New Fuel Storage Analyses for U.S. EPR Topical Report,” does not address the following questions and require clarification:

For the Metamic$^{TM}$ material proposed as a neutron moderator for the SFP:

a. Provide the test results of the effects of radiation, peroxide and sulfates in boric acid solution, on the integrity of the Metamic$^{TM}$ tested simultaneously (i.e., *in situ*).

b. Determine the effect of sulfates in the SFP (at concentrations as high as 150 ppb the recommended control limit in the EPRI PWR Primary Water Chemistry Guidelines, 2007, Chapter 7.2) acidic environment on the stability of the neutron absorbing material. Provide any supporting documentation.

09.01.01-2

The information provided in the Topical Report Report UN-TR-08-001(P) only addressed the issue of general corrosion rate. Based on the information contained in IN 2002-09, verify that the licensee proposes to use 304L versus 304 stainless steel to avoid the long-term, stress-corrosion cracking issue in the SFP environment. If not, provide the tests or surveillances that will be performed to ensure low concentration of contaminants to avoid stress-corrosion cracking of the 304 stainless steel critical parts.

09.01.02-19

Criticality control requirements in the SFP are identified in 10 CFR 50.68. Neutron absorber materials that have been used in SFP in the past (e.g., Boraflex™) have been tested in radiation fields with dry air or in borated water solutions without a radiation field, but never both together. A design flaw that was unrealized was that in borated water and in the presence of a radiation field, hydrogen peroxide and peroxide radicals form (as well as other free radicals) that attack the Boraflex™ causing it to decompose and decrease its geometric neutron capture capability. The proposed material for neutron absorption in the spent fuel pool, Metamic™, is similarly comprised of an aluminum alloy encasing a boron carbide aluminum powder compressed solid and exposed to the same conditions. NRC Information Notice 2002-09 identifies the incidence of stress-corrosion cracking (SCC) of Type 304 stainless steel in the SFP of a nuclear unit. This is at a temperature of less than 200°C.

Neither report UN-TR-08-001(P), “Spent and New Fuel Storage Analyses for U.S. EPR Topical Report,” nor “AP1000 Response to Requests for Additional Information (NUREG-08009.1.2)” Westinghouse Document ID No. DCP/NRC2167 (June 20, 2008) address the following questions that require clarification:

1. Although specific conductivity is a general measure of contaminant level, it cannot identify intrusion of contaminants that will induce SCC in the harsh SFP environment. Identify the contaminants that a licensee would analyze in the SFP on a routine basis to ensure that corrosive conditions do not exist.

2. Provide the frequency at which contaminant concentrations in the SFP should be analyzed.

3. Provide the limits on the contaminants that a licensee should use to ensure that the level is well below the level at which stress-corrosion cracking of Alloy 6061 and 304 stainless steel occurs.

4. Visual observation will not determine if SCC has initiated or if it is progressing. Provide the methodology to ensure that early detection of SCC will occur so that timely corrective actions can be taken to prevent lack of sufficient absorber.

5. Discuss whether periodic nondestructive examination or destructive examination (for stress corrosion cracking or inter-granular attack) of test coupons would be useful in determining absorber material long-term integrity.

09.01.02-20

The ALARA description of 10 CFR 20.1101 relates to design of a leak detection system that will minimize dose to the public as well as protection of workers from direct exposure to the spent fuel. The history of SFP leak off channels has demonstrated that build up of boric acid residues (due to evaporation at low leak rates) has created blockage of these channels making them ineffective to monitor SFP leaks. Additionally, these blockages have allowed back up of leaking SFP water leading to leaks in areas that were not anticipated. When the line was no longer free-flowing, the leakage was assumed to have ‘stopped.’ In several cases, this has resulted in an unplanned and unmonitored release of radioactivity directly to the environment.

Furthermore, plants that have groundwater in-leakage into the sumps in the fuel storage buildings often have any leakage from the pool masked by that water which has no plant-related activity. This groundwater in-leakage will dilute the radioactivity concentration from the SFP leak, causing the detection levels required to be significantly lower. The location of the sump described in this FSAR is below grade; groundwater in-leakage is a likely issue.

Sufficient water supply to the SFP is needed to ensure that there is always sufficient water coverage of the fuel to shield workers from spent fuel and minimize the direct radiation dose at the site boundary to be in conformance with 10 CFR 20.1101. Also, a source of make-up cooling water that can supply the SFP during accident conditions is required per GDC 61.

Please identify:

1. Provide the actions that will be taken with the frequency of the actions, in order to prevent build up of boric acid deposits in leak off channels so that the leak monitoring from the spent fuel areas may be accurately assessed.

2. Provide the routine analyses that will be performed with the frequency in order to accurately assess and diagnose a leak rate from the SFP.

3. Provide additional details about the size and configuration of these leak off channels that show how monitoring will be accomplished.

4. Show in a diagram, if possible, the materials of construction of the leak-off channels and all surfaces with which the SFP liquid comes into contact.

5. Describe the actions should be taken by a licensee to monitor groundwater in-leakage.

6. IIdentify the "redundant seismic Category I emergency water make-up supply" in the FSAR Tier 2 Section 9.1.2.1 that ensures conformance with GDC 61.

09.01.02-21

The regulatory requirements for control of radioactive releases are described in 10 CFR 50, Appendix A GDC-60, 10 CFR 20.1101, 10 CFR 20.1302, and 10 CFR 20, Appendix B Table 2. FSAR Tier 1, Chapter 5 Table 5.0-1 "Site Parameters for the US EPR," identifies a list of radionuclides that can potentially contaminate the groundwater. Several of the radionuclides listed have half-lives that are so short that there is no reasonable pathway for them to find their way into groundwater even during a severe accident. [Notably $^{138}$Cs (33 m), $^{83}$Br (2.4 h), $^{84}$Br (32 m), $^{85}$Br (2.9 m), $^{93}$Y (10 h), $^{92}$Y (3.5 h), $^{91m}$Y (49 m)]. Additionally, $^{130}$I is listed but it is neither an activation nor a fission product and has no credible formation mechanism in the RCS.

In contrast, certain radionuclides known to exist in the plant systems and normal effluents are not listed. Specifically, $^{124, 125, 126, 127}$Sb, $^{108m}$Ag, $^{121, 123, 125, 126, 127}$Sn, $^{99}$Tc, $^{94}$Nb, $^{95m}$Nb, $^{93m}$Nb and $^{93}$Zr are not included in this table.

1. Provide the criteria used to determine the radionuclides listed in this table.

2. Provide the methodology used to consider the half-life of the radionuclide and potential chemical/physical pathway to the environment when the listed radionuclides were included.

3. Confirm that the identified radio-nuclides listed above were excluded. If they were justify their exclusion.

09.01.03-1

GDC 61 requires that the flow rate of the cooling and purification system be appropriately sized to maintain temperatures and radiation levels at acceptable values. The current design does not appear to be consistent with typical industry practice where demineralizer filters use a large micron size on the demineralizer inlet and a smaller micron size on the demineralizer outlet. This arrangement provides for continuous flow while removing large particles (on the inlet) that would plug the demineralizer resin pathways, and removing resin fines and small particulate from returning to the SFP. This design also minimizes the change out of the inlet filter by not overwhelming it with small (from fuel clad corrosion product spallation) and large particulate (atmospheric depositions not removed by the skimmer pumps).

Therefore, the staff requests the applicant to justify the reversing of the filter sizes from the typical design configuration.

09.01.03-2

GDC 61 requires that provisions for containment of the fuel and cooling water for the spent fuel be assured. Minimizing general corrosion and potential stress corrosion cracking is an important aspect of maintaining structural integrity of all Spent Fuel Pool metallic components. SRP Section 9.1.3 also recommends that appropriate instrumentation and sampling be provided to monitor the water purity and need for demineralizer resin replacement, including the chemical and radiochemical limits such as conductivity, gross gamma and iodine activity, demineralizer differential pressure, pH and crud level, which are used to initiate corrective action. FSAR Tier 2 Section 9.1.3.3.1 indicates the Fuel Pool Purification System will be periodically sampled for chemical impurities, and FSAR Tier 2 Table 9.3.2-1 identifies two grab sample points in the FPPS and two grab sample points in the Fuel Pool Cooling System. However, the FSAR does not provide the required chemical parameters and impurity levels for the spent fuel pool and FPPS. Therefore, the staff requests the following additional information:

1. Provide the normal operating limits for impurities and chemical parameters for the spent fuel pool and FPPS.
2. Confirm that the recommended chemistry limits and sampling periodicity for the SFP and FuelPPS are consistent with those recommended by the most recent revision of the EPRI PWR Primary Water Chemistry Guidelines.
3. Provide the parameters that will be sampled in the FPPS and FPCS.

09.01.03-3

NUREG-0800 Section 9.1.3 provides guidelines for verifying that the Fuel Pool Purification System has the capability for processing the refueling canal coolant during refueling operations.

FSAR Tier 2 Section 9.1.3.3.1 states that during an outage, when the Reactor Building pool is filled, it is possible to purify one or several compartments of the Reactor Building pool at the same time. The system is generally aligned using the Reactor Building purification pump and FPPS ion exchanger and filters. However, since the FSAR did not specifically address the capability to purify the refueling canal (in the Reactor Building), the staff requests that the applicant provide a discussion of the FPPS's capability to purify the water in the reactor building portion of the refueling canal during refueling outages.

09.05.04-1

GDC 17 requires an independent and redundant onsite electric power system for the functioning of SSCs important to safety. RG 1.137 provides the regulatory position on diesel engine fuel oil quality as it relates to GDC 17. FSAR Tier 2 Section 9.5.4.3.1 commits to meeting the new fuel quality requirements of RG 1.137. The Standard Review Plan, NUREG-0800, Section 9.5.4 recommends that the quality requirements for both new and stored fuel be evaluated against RG 1.137 Regulatory Position C.2.

Position C.2.a of RG 1.137 recommends the cloud point to be less than or equal to the 3-hour minimum soak temperature at which the fuel oil is stored. The Diesel Fuel Oil Testing Program does not specify minimum cloud point temperature even though the main tank room of the Emergency Power Generating Building has a design minimum temperature of 15°C (59°F) (FSAR Tier 2 Section 9.4.9.1). Provide in the FSAR the minimum cloud point for the Diesel Fuel Oil Testing Program.

09.05.04-2

RG 1.137 Position C.2.a recommends that fuel contained in a supply tank not meeting the applicable specification requirements should be replaced in a short period of time (about a week). LCO 3.8.3 D specifies a completion time of 30 days to restore the stored fuel oil to within limits before the associated emergency diesel is declared inoperable. Justify the 30-day completion time to restore fuel oil to within limits.

09.05.04-3

Position C.2.a of RG 1.137 recommends that in the event that tests for viscosity or for water and sediment for fuel oil contained in the supply tanks exceed specified limits, the associated diesel should be declared inoperable. Technical Specification 3.8.3 C.1 only enters a limiting condition for operation (LCO) if particulate values exceed the limit. Provide the justification for not entering a LCO when viscosity or water exceeds specified limits.

09.05.04-4

RG 1.137 Position C.2.e recommends the draining of accumulated condensate from day tanks monthly. It is not clear if Surveillance Requirement SR 3.8.3.5, which drains accumulated water from fuel storage tanks every 92 days, applies to the day tanks. Identify the surveillance requirement that governs draining accumulated water from the day tanks. If the frequency exceeds that recommended by RG 1.137, provide justification.

09.05.04-5

RG 1.137 Position C.2.f recommends the draining, removing accumulated sediment and cleaning the fuel oil storage tanks every 10 years. Discuss Identify the part of the Diesel Fuel Oil Testing Program that tracks this maintenance requirement.

09.05.04-6

RG 1.137 Position C.2 states that Appendix B to ASTM N195 should be used as the basis of the program to ensure the quality of the fuel oil. Appendix B requires testing the supply tanks at least once every three months using ASTM D2274 “Oxidation Stability of Distillate Fuel Oil (Accelerated Method).” Neither the Diesel Fuel Oil Testing Program nor the Surveillance Requirements specify this testing. Provide justification for not periodically testing the stored fuel in accordance with ASTM D2274.