ENCLOSURE 4

APP-GW-GLY-125 Revision 0,
"Responses to NRC Request for Addition Information (RAI) Letter No. 02 for WCAP-17938,"

(Non-Proprietary)

RAI Response Number: RAI - ICC&NMI – 036
Revision: A

Question:

In RAI-ICC&NMI-034 the staff requested that the applicant describe how gas evolution is addressed in the proposed design of the neutron shield material inside the blocks. In the response, dated July 14, 2016, the applicant provided information that addressed gas evolution as it pertains to the component (i.e., neutron shield block) design, "...internal gas generation doesn't over pressurize the blocks..." and "...blocks maintain their integrity...". The applicant's response also estimated the volume of off-gas from the neutron shield block system as approximately [ ]^{a,c} on average. The applicant did not provide information that assesses the potential impact of the released gases on structures, systems, and components (SSCs) in any part of the containment or the containment system.

Therefore, the staff requests that the applicant assess and identify the gases released (e.g., types and quantities) and their potential impact on SSCs in any part of the containment or the containment system. The staff also requests that the applicant identify the temperature and pressure conditions associated with the estimated gas quantities. As part of the response, the applicant should assess any impacts on safety analysis (both for design basis accidents and severe accident) due to the presence of the released gases inside containment. The applicant should also assess whether the intent of 10 CFR 50 Appendix A General Design Criteria 4 and Standard Review Plan Section 6.2.5 Acceptance Criteria are satisfied. The applicant should ensure that SSCs are designed to accommodate the effects associated with normal operation, that materials within the containment that would yield hydrogen gas are identified and that their use is limited as much as practicable, and that concentrations of combustible gases in any part of the containment are below a level which would support combustion or detonation.

Westinghouse Response:

As it was previously discussed in RAI-ICC&NMI-034, the predicted gas evolution data for the neutron shielding is based on testing performed on similar [

]a,c The VLS design also includes Passive Autocatalytic Recombiners (PARs), which prevent hydrogen concentration in containment from reaching flammability limits.

The neutron shielding is located in the reactor vessel cavity and reactor vessel nozzle gallery. These areas are serviced by ventilation air from the VCS (Containment Ventilation System, Reference 6) that provide cooling air to the reactor cavity, nozzle gallery, and reactor vessel supports. One of the functions of the VCS is to mix the containment building atmosphere to support uniform purging of airborne contamination by the VFS (Containment Air Filtration System, Reference 7).

The VCS air enters the lower reactor cavity from an adjoining corridor and flows up the cavity past the LNS and the UNS. The air rising up from the bottom of the cavity is directed into the four reactor vessel supports. The inside of the supports contain cooling pathways that discharge the air from the top of the vessel supports into the nozzle gallery. In the nozzle gallery the air is mixed and forced out between the openings around the reactor coolant hot and cold legs. [ ][a,c] mixes the neutron shielding off gases with containment air preventing a localized flammable hydrogen concentration forming in the reactor cavity and nozzle gallery.

The neutron shielding design and configuration satisfy the intent of 10 CFR 50 Appendix A General Design Criteria (GDC) 4 and Standard Review Plan (SRP) Section 6.2.5. SRP Section 6.2.5 states in its introductory paragraph that it covers DCD information concerning control of combustible gases in containment following a "beyond design basis accident" only. With respect to beyond design basis accidents, hydrogen gas generation is dominated by clad oxidation and is controlled post-accident with hydrogen igniters distributed throughout containment. The amount of gas produced by the neutron shield blocks in a typical fuel cycle, [ ][a,c] do not impact the severity of the beyond design basis event and may be considered negligible to the overall amount of hydrogen gas generated via clad oxidation. The quantities of hydrogen produced during a severe accident, as well as additional hydrogen mixing and combustion analysis details, are located in Reference 8.

The AP1000 monitors hydrogen gas during normal operation as previously noted and described in DCD Section 6.2.4.5.2. The containment VCS, VFS, and PARS systems are designed to prevent the accumulation of hydrogen gas during normal operation as described above. When considering the evolution of hydrogen gas from the neutron shielding system, the intent of 10 CFR 50 Appendix A General Design Criteria 4 and Standard Review Plan Section 6.2.5 Acceptance Criteria with respect to hydrogen gas related events are satisfied as described in the preceding paragraphs.

Reference 1: [ ][a,c]

Reference 2: [ ][a,c]

Reference 3: APP-VFS-M3-001, "Containment Air Filtration System, System Specification Document", Rev. 1

Reference 4: APP-VLS-M3-001, "Containment Hydrogen Control System: System Specification", Rev. 4

Reference 5: APP-VLS-M3C-001, "AP1000 Containment Hydrogen Generation for DBAs", Rev. 2

Reference 6: APP-VCS-M3-001, "Containment Recirculation Cooling System, System Specification Document", Rev. 1

Reference 7: APP-VFS-M3-001, "Containment Air Filtration System, System Specification Document," Rev 1

Reference 8: APP-GW-GL-022, "AP1000 Probabilistic Risk Assessment – Hydrogen Mixing and Combustion Analysis" Rev 1

Design Control Document (DCD) Revision:

The following revision will be made to DCD Subsection 9.5.1.2.1.1, under the "Control of Combustible Material" subheading:

Control of Combustible Materials

The plant is constructed of noncombustible materials to the extent practicable. The selection of construction materials and the control of combustible materials are in accordance with BTP CMEB 9.5-1 and Section 3.3 of NFPA 804 (Reference 2) as specified in WCAP-15871 (Reference 20).

The storage and use of hydrogen are according to NFPA 50A and NFPA 50B (Reference 2). Hydrogen lines in safety-related areas are designed to seismic Category I requirements.

Ventilation systems are designed to maintain the hydrogen concentration in the battery rooms well below 2 percent by volume, as described in subsections 9.4.1 and 9.4.2.

<u>The containment recirculation cooling system (VCS, Section 9.4.6) provides sufficient air flow through the reactor vessel cavity to mix any off-gassing from the neutron shield blocks with the containment volume. The containment air filtration system (VFS, Section 9.4.7) provides periodic flow of outdoor air to purge and filter the containment atmosphere. The mixing flow rate and containment purging maintains the hydrogen concentration in containment well below 2 percent by volume.</u>

The turbine lubrication oil system, located in the turbine building, is separated from areas containing safety-related equipment by 3-hour rated fire barriers.

Outdoor oil-filled transformers are separated from plant buildings according to NFPA 804 (Reference 2). The diesel fuel oil storage tanks and the diesel fuel oil transfer pump enclosure are located in the yard area more than 50 feet from any safety-related structure. Potential oil spills from the storage tanks are confined by a diked enclosure. A diesel generator fuel day tank is located within each diesel generator room and is enclosed in a 3-hour fire rated barrier.

The diesel fuel supply for the ancillary diesel generators is in the same room as the diesel generators. The ancillary diesel generator room is separated from the rest of the annex building by a 3-hour rated fire barrier.

The diesel fuel supply for the diesel-driven fire pump is in the diesel-driven fire pump enclosure. The diesel pump enclosure is located in the yard more than 50 feet from safety-related structures. The enclosure includes a fire detector which produces an audible alarm locally with both visual and audible alarms in the main control room and security central alarm station. The fire is extinguished by operation of an automatic sprinkler system or manually, using hose streams or portable extinguishers.
Quantities and locations of other combustible materials are identified in the fire protection analysis (see Appendix 9A).

Topical Report (TR) Revision:

None

Supporting Reference Revision:

None