GE-Hitachi Nuclear Energy Americas LLC

James C. Kinsey
Project Manager, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

MFN 07-450

Docket No. 52-010

August 31, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Economic Simplified Boiling Water Reactor (ESBWR) Chapter 12 Open Items [Radiation Protection] Letter – RAI Number 12.2-9 S02 Items a and b**

Enclosure 1 contains GE-Hitachi Nuclear Energy Americas (GEH) response to the subject NRC RAI transmitted via Reference 1. Enclosure 2 contains the DCD Markups associated with this response.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

MRO

Reference:

1. MFN 07-433 – Letter from US Nuclear Regulatory Commission (NRC) to Robert E. Brown, *Economic Simplified Boiling Water Reactor (ESBWR) Chapter 12 Open Items [Radiation Protection],* dated July 29, 2007

Enclosures:

1. Response to Portion of NRC Economic Simplified Boiling Water Reactor (ESBWR) Chapter 12 Open Items [Radiation Protection] Letter – Radioactive Waste Management Systems – RAI Number 12.2-9 S02 Items a and b
2. DCD Markups

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GEH /San Jose (with enclosures)
RE Brown GEH /Wilmington (with enclosures)
eDRF 000073-6043

Enclosure 1

MFN 07-450

Response to Portion of NRC Economic Simplified Boiling Water Reactor (ESBWR) Chapter 12 Open Items [Radiation Protection] Letter – RAI Number 12.2-9 S02 Items a and b

Radioactive Waste Management Systems

RAI Numbers 12.2-9 S02, Items a. and b.

NRC RAI 12.2-9 S02, Items a. and b.:

RAI 12.2-9, Supplement No. 2, 7/27/2007, ML072080414

Reference: GE Response Letter MFN-06-212, Supplement 2, dated May 22, 2007, which addressed NRC RAI Letter No. 71, dated October 10, 2006.

Please address the following issues relative to the subject RAI:

a. The ESBWR design control document (DCD) should describe the performance requirements of adsorbent media for the eight main charcoal beds and two guard charcoal beds, and for the charcoal filters used in building ventilation exhaust systems. The performance of adsorbent media should be consistent with the method used in demonstrating compliance with the requirements of 10 CFR 20.1301 and 20.1302, and Appendix I to 10 CFR Part 50, as described in DCD Rev. 3, Sections 12.2.2.1 and 12.2.2.2. Please update DCD Tier 2 Table 11.3-1 "Offgas System Design Parameters," to specify the delay time for Krypton and Argon in addition to Xenon which is already included, and Table 12.2-15 "Airborne Sources Calculation," to specify the charcoal filtration efficiency for radioactive iodine.

b. In Revision 3 of DCD Tier 2, Section 11.3.1, the applicant states that the design of OGS follows the guidance of IE Bulletin 80-10 "Contamination of Non-radioactive Systems and Resulting Potential for Unmonitored, Uncontrolled Release to Environment" but does not consider interconnections between plant systems that could become radioactive through improper interfaces with radioactive systems. DCD Rev. 3, Section 11.3.8 does not commit the COL applicant to confirm that the OGS, as installed, fulfills this commitment. Please update the DCD to either (i) make reference to IE Bulletin 80-10 in DCD Sections 11.3.2.2 and 10.4.1.2.3 as they relate to drains designed to capture the contaminated water phase from OGS condensers/coolers, or (ii) create a COL applicant item to address this issue as part of the integration of the final design of the OGS, taking into account specific design features.

GEH Response:

Item a:

Argon and Krypton delay times, Iodine removal efficiency, and a requirement that the adsorbent media and the process offgas equipment meet or exceed these requirements is being added to Table 11.3-1 in DCD Tier 2, Revision 5.

Item b:

A reference has been made in Subsection 11.3.1 to identify IE Bulletin 80-10 compliance regarding interconnections between plant systems. GEH has identified that the air supply system connections to the offgas system are the only areas where non-radioactive systems could become radioactive through improper connections. A reference to IE Bulletin 80-10 is being added to the description of the air supply connection to offgas. A separate COL item to address Bulletin 80-10 radioactive and non-radioactive interfaces is unnecessary as GEH has identified in the attached markups those interface locations in the Gaseous Waste Management System.

DCD Impact:

DCD Tier 2, Subsection 11.3.1 and Table 11.3-1 will be revised as noted on the attached markup and will be reflected in DCD Tier 2, Revision 5.

Enclosure 2

MFN 07-450

DCD Markups

conditions, the leak rates and doses are expected to be less than one-fifth of the design basis numbers.

The average annual exposure at the site boundary during normal operation from all gaseous sources does not exceed the dose objectives of 10 CFR 50, Appendix I (Reference 11.3-1), to individuals in unrestricted areas (Refer to Section 12.2). The radiation dose design basis for the treated offgas is to provide sufficient holdup until the required fraction of the radionuclides has decayed with the daughter products retained by the charcoal.

The gaseous waste management system equipment is selected, arranged, and shielded to maintain occupational exposure as low as reasonably achievable in accordance with NRC RG 8.8 (Reference 11.3-14).

The gaseous waste management system is designed to the requirements of the GDC 60 (Reference 11.3-15) and 64 (Reference 11.3-16).

A list of the OGS major equipment items, including materials, rates, process conditions, number of units supplied, and relevant design codes, is provided in Table 11.3-2.

The OGS is also designed to the requirements indicated in DCD Section 3.2.

In accordance with IE Bulletin 80-10, the OGS interconnections between plant systems are designed to minimize the contamination of non-radioactive systems and uncontrolled releases of radioactivity in the environment (Reference 11.3-13).

A discussion of OGS compliance with 10 CFR 20.1406 (Reference 11.3-17) is located in Section 12.6.

11.3.2 Offgas System Description

Process Functions

Major process functions of the OGS include the following:

- Recombination of radiolytic hydrogen and oxygen into water to reduce the gas volume to be treated and the explosion potential in downstream process components;
- Two-stage condensation of bulk water vapor first using condensate and then chilled water as the coolant reducing the gaseous waste stream temperature to the value shown in Table 11.3-1;
- Dynamic adsorption of krypton and xenon isotopes on charcoal at the approximate temperature shown in Table 11.3-1;
- Monitoring of offgas radioactivity levels and hydrogen gas content;
- Release of processed offgas to the atmosphere; and
- Discharge of liquids to the condenser and/or LWMS.

Process Equipment

Major process equipment of the OGS consists of the following:

- Recombiners, including a preheater section, a catalyst section, and a condenser section;

M = weight of charcoal

Noble Gas Mixture

The fission product noble gas composition used as the nominal design basis is defined in Section 11.1. During normal operation with no fuel leaks, release rate of noble gases (after 30 minute decay) may occur because of minute quantities of uranium contamination. The system is also capable of safe operation at release rates that may occur in the event of gross fuel failures.

Air Supply

The air in-leakage design basis is conservatively assumed to be the total value shown in Table 11.3-1.

An air bleed supply is provided for dilution of residual hydrogen at air in-leakages below the minimum value shown in Table 11.3-1, for valve stem sealing, for recombiner startup, for blocking during maintenance, for instrument operation, for providing an air flow through the standby recombiner when processing offgas, and for purging gas mixtures from process and instrument lines prior to maintenance. These normal air purge flow rates are not used while the system processes reactor offgas. The air is supplied from a compressor that does not use oil for lubrication of the compressor cylinder, as oil compromises the performance of the catalytic recombiners and charcoal adsorbers. During both startup and normal operation, air is bled to the standby recombiner train just downstream of the final SJAE suction valve for train purging after switchover. Flow indicators are provided on all air bleed lines to assure that proper air flow is being delivered to the process line or equipment. The air supply is protected from back flow of process gas by two check valves in series or by a check valve and a pressure control valve in series (Reference 11.3.13).

Range-ability

The process can accommodate reactor operation from 0 to 100% of full power. In normal operation, radiolytic gas production varies linearly with thermal power. The process can accommodate the airflow range shown in Table 11.3-1 for the full range of reactor power operation.

In addition, the process can mechanically accommodate a higher startup airflow upon initiation of the SJAEs. This startup airflow results from evacuation of the turbine condensing equipment while the reactor is in the range of about 3% to 7% of rated power.

Redundancy

Active equipment (e.g., recombiners, dryers and valves) whose operation is necessary to maintain operability of the OGS is redundant. Passive equipment (e.g., charcoal adsorber) is not redundant. Instrumentation that performs an information function, and is backed up by design considerations or other instrumentation, is not redundant. Instrumentation used to record hydrogen concentration or activity release (e.g., flow measurement and hydrogen analyzers) is redundant.

Design provisions are incorporated which preclude the uncontrolled release of radioactivity to the environment as a result of a single equipment failure short of the equipment failure accident

Table 11.3-1

Offgas System Design Parameters*

Design Parameter	Design Value
Design basis noble radiogas release rate	3700 MBq/s (100,000 μCi/s)
Assumed air in-leakage	51 m^3/h standard (30 scfm)
Xenon delay	60-day
Krypton delay	78.6 hours**
Argon delay	27.2 hours****
Iodine removal efficiency	99.99** and ***
Maximum gaseous waste stream temperature	67°C (153°F)
Charcoal temperature (approximate)	35°C (95°F)
Maximum cooler condenser temperature	18°C (65°F)
Chilled water temperature	7°C (45°F)
Gaseous waste stream temperature	35°C (95°F)
Nominal recombiner preheater temperature	177°C (351°F)
Maximum recombiner preheater temperature	210°C (410°F)
Out-of-service hydrogen/oxygen catalytic recombiner minimum temperature	121°C (250°F)
Minimum activated charcoal ignition temperature	156°C (313°F)
Minimum air bleed supply rate	0.17 m^3/min (6 scfm)
Air bleed to standby recombiner train at startup and normal operation	0.17 m^3/min (6 scfm)
Radiolytic gas flow range	0 to 8.6 m^3/min (302 scfm)
Charcoal adsorber vault temperature range	29°C (84°F) to 40°C (104°F)
Charcoal particle size	8 – 16 mesh United States Standard (USS) with less than 0.5% under 20 mesh
Charcoal moisture content	< 5% by weight
Maximum offgas activity input concentration	5.9E+6 Bq/cm^3
Charcoal Guard Bed Mass	33,000 lbs (15 metric tons)
Charcoal Bed Mass	490,000 lbs (222 metric tons)

* For additional information on radioactive releases, refer to Subsection 11.1 or 12.2.
** Offgas processing equipment will meet or exceed these values.
*** No Iodine is assumed to be released.