U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER^{TM} iPWR DESIGN

11.1 COOLANT SOURCE TERMS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for review of coolant source terms associated with normal operations, anticipated operational occurrences, and accident conditions

Secondary - None

I. AREAS OF REVIEW

At the early site permit (ESP) or standard design certification (DC) stage of review, the staff reviews the information in the applicant's final safety analysis report (FSAR) on the sources of radioactivity that are processed by radioactive waste management systems (RWMS) in treating liquid and gaseous wastes. At the combined license (COL) stage of review, the staff confirms that the information accepted at the standard DC stage is appropriately incorporated in the relevant sections of COL applications.

This design-specific review standard (DSRS) addresses the review of coolant source terms used to evaluate radioactive waste management systems in small integrated pressurized-water reactors (iPWRs); however, this review standard is applicable to all small modular pressurized-water reactors (PWRs). The review does not address an evaluation of plant and process equipment, neutron-activated components, in-core neutron detectors, or spent-fuel, but relies on plant operating characteristics and RWMS design parameters in calculating radionuclide concentrations in primary and secondary coolant. Two source terms are reviewed: radioactive materials expected during normal operations and anticipated operational occurrences (AOOs) and design basis source terms. For the purpose of this DSRS section, radionuclide concentrations in primary and secondary coolant are expected to be representative of operating experience and plant conditions over the life of the plant in estimating radioactivity levels in process and effluent streams. The resulting radionuclide concentrations are not intended to be used as the sole basis for the design of the plant and RWMS.

The design basis coolant source term is used to derive inventories of radioactivity in system components, assess the adequacy of shielding in maintaining doses to workers and public as low as reasonably achievable (ALARA), define ambient radiation exposure levels and zones, and confirm the proper placement of radiation monitoring equipment in plant areas and operating conditions. The design basis source term represents a conservative characterization of primary and secondary coolant concentrations. The source term is based on a combination of assumptions of failed fuel fractions (e.g., 0.25 to 1 percent), technical specification limits for halogens (I-131 dose equivalent) and noble gases (Xe-133 dose equivalent), presence of activation and corrosion products, and steam generator technical specification limits on primary-to-secondary leakage. This information may be used, in part, to support the

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development of other source terms, such as in framing assumptions for design basis accidents in evaluating radiation doses for equipment qualifications, and radiation protection measures for other materials stored in spent-fuel pools. For these specific applications, the requirements and guidance, and the staff's evaluation process are addressed in DSRS Section 12.2, "Radiation Sources," DSRS Section 15.0.3, "Design Basis Accident Radiological Consequences of Analyses for Advanced Light Water Reactors," and DSRS Section 3.11, "Environmental Qualification of Mechanical and Electrical Equipment," respectively. The results of the staff's evaluation and findings are presented in the corresponding sections of the safety evaluation report (SER).

The coolant source term for normal operation is based on operating experience of plants with similar type of fuels used in large PWRs. The normal operation source terms are used to assess the performance of RWMS and other systems under normal operating conditions and AOOs. The main difference in the two source terms (normal operation versus design basis) is the adjustment made in deriving radionuclide concentrations in primary and secondary coolants. See DSRS Section 12.2 for details on the development of the design basis source term.

1. The staff's review of the radioactive coolant source terms includes consideration of parameters used to determine the concentration of radionuclides in the reactor coolant; fraction of fission product activity released to the reactor coolant; and concentrations of all non-fission products in the reactor primary and secondary coolant. Small iPWRs generally have systems common to all PWRs, but differ in some aspects, such as the ratio of the mass of the primary coolant system to that of the fuel. Nevertheless, the generation of fission and activation products, fuel enrichment, fuel cladding and defects, presence of radioactivity in primary and secondary coolant, type coolant purification systems used, and RWMS used to process liquid and gaseous wastes are essentially identical to large PWRs. The following sources of radioactivity are considered in the evaluation of effluent releases:

   A. Gaseous wastes (noble gases, radio-iodine, particulates, carbon-14, and tritium), consisting of offgases from the primary coolant, steam generator blowdown treatment system; offgases from the main condenser evacuation system; leakage to containment, fuel handling, service, auxiliary, and turbine building drains; noble gases stripped from the primary coolant during normal operation and at shutdown; and cover and vent gases from tanks and equipment containing radioactive materials. The presence and concentration of radioactive materials in primary coolant is also expected to account for the type of primary coolant chemistry being proposed, such as lithium hydroxide with or without boron, and zinc and hydrogen injection, as defined by the applicant.

   B. Liquid wastes(dissolved or entrained noble gases, radio-iodine, particulates, carbon-14, and tritium), consisting of primary coolant processed to remove radioactive materials and, if applicable, to control boron concentration (shim bleed); leakage collected in equipment and floor drains from buildings housing equipment and components that contain radioactive process fluids; steam generator blowdown (if applicable); condensate demineralizer regenerant solutions; contaminated liquids from anticipated plant operations, such as resin sluices, filter backwashes, decontamination solutions, and sample station drains; and detergent wastes.

C. Liquid wastes (dissolved or entrained noble gases, radio-iodine, particulates, carbon-14, and tritium), consisting of steam generator blowdown discharges and releases from steam generator blowdown treatment systems based on secondary coolant concentrations expected during normal operations, AOOs, and design basis, or at default activity levels or steam generator leakage rates derived from technical specifications for secondary coolant.

2. Additional Information for Title 10 of the *Code of Federal Regulations* (CFR), Part 52 Applications: Additional information will be provided by the applicant depending on the type of application being submitted for review. For a COL application, the additional information depends on whether the application references an ESP, a DC, both or neither. Information requirements are prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

3. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

   For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. The review should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the Part 52 process for seeking exemptions, changes, and departures is observed in changing FSAR Tier 1 and Tier 2 information. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC and how they are being addressed under plant and site-specific conditions.

4. ESP Application Reviews: For an ESP application, submitted under 10 CFR Part 52, Subpart A, the review is limited to the information forming the basis of the radioactive effluent source terms, as defined by selected reactor technologies (e.g., based on one certified design, or a plant parameter envelope approach based on two or more certified designs) in bounding radioactive liquid and gaseous effluents for all defined release points.

Review Interfaces

Other DSRS sections interface with this section as follows:

1. The reviewer responsible for review of effectiveness of the radwaste systems will use the primary and secondary coolant concentrations calculated above as inputs in evaluating the performance of the liquid waste management system (LWMS), under DSRS Section 11.2, and the gaseous waste management system (GWMS), under DSRS Section 11.3. The purpose of the evaluation is to determine if these systems can adequately treat primary and secondary coolants such that the associated radioactive liquid and gaseous effluents meet the numerical design objectives of Appendix I to 10 CFR Part 50, and liquid and gaseous effluent concentration limits and unity-rule of Part 20, Appendix B, Table 2 at the point of release in unrestricted areas.

2. The reviewer responsible for review of effectiveness of the radwaste systems will coordinate with the review of radiation protection design features under DSRS Section 12.2, for the selection of primary coolant concentrations used in the design basis source term.

3. The reviewer responsible for review of effectiveness of the radwaste systems - monitoring instrumentation - will review under DSRS Section 11.5, "Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems," the monitoring and control provisions for all identified effluent release points. The review will also consider monitoring and sampling methods used for the detection of radioactivity in non-radioactive systems to prevent unmonitored and uncontrolled releases of radioactive materials to the environment.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. 10 CFR Part 20, as it relates to determining the operational source term that is used in calculations associated with potential radioactivity in liquid and gaseous effluents to unrestricted areas. While Part 20 is not applicable to an ESP application, an ESP applicant is required to provide information characterizing anticipated levels of radioactivity in effluents under 10 CFR 52.17(a)(1).

2. 10 CFR Part 50.34(a) and (b), 10 CFR Part 52.47(a)(5), and 10 CFR 52.79(a)(3), as they relate to the kinds and quantities of radioactive materials expected to be produced and released during normal operations and AOOs.

3. 10 CFR Part 50, Appendix I, as it relates to determining the operational source term that is used in calculations associated with potential radioactivity in liquid and gaseous effluents considered in the context of numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as is reasonably achievable" for radioactive material contained in light-water reactor effluents.

4. General Design Criterion 60 (GDC) as it relates to determining the operational source term that is used in calculations associated with potential radioactivity in liquid and gaseous effluents released into unrestricted areas, such that a nuclear power unit design shall include means to control suitably the release of radioactive materials in gaseous and liquid effluents produced during normal reactor operation and AOOs. While GDC 60 is not applicable to an ESP application, an applicant is required to provide information characterizing anticipated levels of radioactivity in effluents under 10 CFR 52.17(a)(1).

5. GDC 61 as it relates to characterizing the amounts of radioactive materials stored and handled in RWMS for the purpose of assessing radiological safety under normal operations and postulated accident conditions.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the U.S. Nuclear Regulatory Commission's (NRC's) regulations identified above are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the intent of 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.17(a)(1)(xii) and 10 CFR 52.79(a)(41), for ESP and COL applications, respectively.

In general, coolant source terms used as the design basis for expected releases have been found acceptable if these values are determined using models and parameters that are consistent with Regulatory Guide (RG) 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," NUREG-0017 (PWR-GALE86 code), and the guidance provided in American Standard National Institute/American Nuclear Society (ANSI/ANS) 18.1-1999 once adjusted to reflect the design features of iPWRs.

These models and parameters are based on operating experience with large, existing PWRs. Differences in design features and operating characteristics of iPWRs should be evaluated and used to make specific adjustments to the parameters used in NUREG-0017 and PWR-GALE86 or in ANSI/ANS 18.1-1999. Differences may also exist in the operational configuration and sequence of treatment of waste management systems for various process streams and effluent releases. The use of PWR-GALE86 in place of the earlier PWR-GALE code documented in NUREG-0017 is endorsed by Interim Staff Guidance (ISG), DC/COL-ISG-5 (July 2008). Whenever adjustments are made to parameters used in the PWR-GALE code, applicants should provide sufficient information for the staff to conduct an independent evaluation of the applicant's use of alternative code parameters.

The relevant RGs and ISG are as follows:

1. RG 1.110, as it relates to the cost-benefit analysis for radioactive waste management systems and equipment.

2. RG 1.112, as it relates to the method of calculating releases of radioactive materials in liquid and gaseous effluents from nuclear power plants.

3. RG 1.140, as it relates to the design, testing, and maintenance of normal ventilation exhaust system air filtration and adsorption units at nuclear power plants.

4. DC/COL-ISG-5 on NUREG-0800, Standard Review Plan (SRP) Section 11.1, "GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents to Support Design Certification and Combined License Applications."

Specific DSRS acceptance criteria are as follows:

1. All normal operation and AOO sources of radioactive liquid and gaseous effluents delineated above in Subsection I will be considered.

2. For each source of liquid and gaseous waste considered above in Subsection I.1, the volumes, concentrations, or release rates of radioactive materials given for normal operation and AOOs should be developed using methods that are consistent with those given in NUREG-0017, GALE86, or ANSI/ANS 18.1-1999.

   Differences in calculation methods and selection of code parameters chosen because of differences in design and operating features between an iPWR and a large PWR should be documented. The applicant should provide sufficient information for the staff to conduct an independent evaluation of the applicant's use of alternative code parameters.

3. Decontamination factors used to reduce gaseous effluent releases to the environment, such as noble gases decay tanks, iodine removal systems, and high-efficiency particulate air (HEPA) filters for building ventilation exhaust systems and containment internal cleanup systems should be consistent with those given in RG 1.140. The building mixing efficiency for containment internal cleanup should be consistent with NUREG-0017, GALE86, or ANSI/ANS 18.1-1999, or the basis for different containment cleanup parameters should be documented. The review should evaluate the types and characteristics of filtration systems and adsorbent media proposed to treat gaseous process and effluent streams, including type of charcoal media (grade, mesh size, and bulk density), number and volume of charcoal decay tanks, dynamic adsorption coefficients for charcoal media and retention times, removal efficiencies for HEPA filtration systems, taking into account the expected physical, chemical, and radiological properties of gaseous process and effluent streams and processing flow rates.

4. Decontamination factors applied to reduce liquid effluent releases to the environment should be consistent with those given in NUREG-0017, GALE86, or ANSI/ANS 18.1-1999. The review should evaluate the types and characteristics of filtration systems, ion-exchange resins, and adsorbent media proposed to treat liquid process and effluent streams, including number and volume of ion-exchange resin column or activated charcoal bed, types and volumes of ion-exchange resins or activated charcoals, removal efficiencies and decontamination factors, taking into account the expected physical, chemical, processing flow rates, and radiological properties of liquid process and effluent streams.

5. RWMS system augmentations used in cost-benefit calculations are consistent with the guidance of RG 1.110. The requirements to conduct a cost-benefit analysis and acceptable cost-benefit ratios in assessing the acceptability of such analyses are given in Section II.D of Appendix I to 10 CFR Part 50. Section II.D of Appendix I requires that the applicant demonstrates that the plant design includes all items of reasonably demonstrated technology, when added to RMWS in order of diminishing return, will effect a reduction in releases of radioactive materials and cumulative population doses within an 80-km (50-mile) radius of the plant.

6. Liquid and gaseous effluent concentration limits at the boundary of the unrestricted area do not exceed the values specified in Table 2 of Appendix B to 10 CFR Part 20 and the unity-rule for radionuclide mixtures.

7. The primary and secondary coolant source terms, used in characterizing liquid and gaseous effluents, result in doses meeting the design objectives in unrestricted areas as set forth in Appendix I to 10 CFR Part 50, Sections II.A to II.C.

8. In evaluating the coolant source terms, the applicant should provide the relevant information in the application as required by 10 CFR 50.34(b)(3), 10 CFR 50.34a, and 10 CFR 52.79(a)(3). The FSAR should include all the basic data listed in Appendix B (PWRs) to RG 1.112 in order to calculate releases of radioactive materials in liquid and gaseous effluents. An acceptable method for satisfying the criteria given in Items 1 through 5 consists of using the PWR- GALE code, once adjusted to reflect the design features of iPWRs. Differences in design features and operating characteristics of iPWRs should be evaluated and used to make specific adjustments to the parameters used in NUREG-0017 and PWR-GALE86 or in ANSI/ANS 18.1-1999. Differences may also exist in the operational configuration and sequence of treatment among RWMS equipment for various process streams and in treating effluents prior to being released to the environment. Whenever adjustments are made to parameters used in the PWR-GALE code, applicants should provide sufficient information for the staff to conduct an independent evaluation of the applicant's use of alternative code parameters.

9. The design basis coolant source terms is based on an assumed design basis fuel leakage levels (e.g., 0.25 to 1 percent of the fuel producing power in a PWR, or technical specification limits for halogens (I-131 dose equivalent) and noble gases (Xe-133 dose equivalent). The fuel leakage (failed fuel fraction) used for the design basis source term should be consistent with the guidance of DSRS Section 12.2 and should be based on experience with similar PWR fuels under similar operating conditions, including technical specifications for primary and secondary coolant concentrations.

10. When the applicant's calculational technique or any source term parameter differs from that given in NUREG-0017, GALE86, or ANSI/ANS 18.1-1999, they should be described in detail and the bases of the alternate methods and/or parameters used should be provided to allow the staff to conduct an independent evaluation.

Technical Rationale

The technical rationale for application of these acceptance criteria is to define the primary and secondary coolant source terms as precursors in calculating radioactivity levels in liquid and gaseous effluents. In addition, this information is used to assess the adequacy and performance of RWMS in treating process streams and controlling amounts of radioactivity discharged in the environment. The technical rationale for the above considerations is discussed in the following paragraphs:

1. 10 CFR Part 50, Appendix I, provides numerical guidance on offsite individual doses due to liquid and gaseous effluents and air doses (as beta and gamma absorbed dose rates) due to gaseous effluents. It also provides an acceptance criterion for cost-benefit analysis as it relates to population doses due to liquid and gaseous effluents (Section

II.D of Appendix I). Conformance with Section II.D of Appendix I demonstrates that the plant design includes all items of reasonably demonstrated technology, when added to RMWS in order of diminishing return, will effect a reduction in releases of radioactive materials and cumulative population doses to ALARA levels.

The calculations using the GALE86 computer code and the source term parameters given in NUREG-0017 take into account current technology and the availability of equipment based on that technology to reduce radioactivity levels in liquid and gaseous process streams. The assumptions used in the calculations, based on the performance of such equipment, have an impact on design parameters used in modeling the performance of radwaste management systems reviewed in DSRS Section 11.2, "Liquid Waste Management Systems," and in Section 11.3, "Gaseous Waste Management Systems." However, the GALE86 code is based on a large PWR, and the proportions and scale of iPWRs may differ substantially. If GALE86 is modified to effectively model an iPWR, the modifications should be described in sufficient detail that they can be reviewed. If an alternate calculational model is developed, it should also be described in detail, and the sources of all parameters used in the model should be described to allow the staff to conduct an independent evaluation.

Meeting the coolant source term calculation criteria of DSRS Section 11.1 provides reasonable assurance that the system designs reviewed in DSRS Sections 11.2 and 11.3 will meet the effluent concentration limits in unrestricted areas and unity-rule specified in 10 CFR Part 20 (Appendix B, Table 2), the requirements and ALARA objectives of 10 CFR 50.34a as they relate to the adequacy of design information for radwaste management systems; GDCs 60 and 61 of 10 CFR Part 50, Appendix A; and individual dose limits of 10 CFR Part 50, Appendix I.

2. GDC 60 requires, in part, that the nuclear power unit design include means to control suitably the release of radioactive materials in gaseous and liquid effluents produced during normal reactor operation and AOOs.

   GDC 60 specifies that sufficient holdup capacity be provided for retention of gaseous and liquid effluents containing radioactive materials, particularly where unfavorable site environmental conditions can be expected to impose unusual operational limitations upon the release of such effluents to the environment. The holdup capacity also provides time to allow the shorter-lived radionuclides to decay before they are further processed or released to the environment. Acceptable holdup times are used in the source term calculations provided in NUREG-0017, GALE86, or ANSI/ANS 18.1-1999.

   Meeting the requirements of GDC 60 provides reasonable assurance that releases of radioactive materials during normal operation and AOOs of radwaste processing systems will not result in offsite radiation doses exceeding the numerical design objectives specified in 10 CFR Part 50, Appendix I, and the effluent concentration limits for unrestricted areas specified in 10 CFR Part 20 (Appendix B, Table 2) and unity-rule for mixtures of radionuclides.

3. GDC 61 requires, in part, that inventories of the amounts of radioactive materials contained in RWMS be determined for the purpose of assessing radiological safety under normal operations and postulated accident conditions.

GDC 61 specifies that systems containing radioactive materials be designed to assure adequate safety under normal operations and postulated accident conditions. NUREG-0017 and PWR-GALE86 or in ANSI/ANS 18.1-1999 describe acceptable methods in determining the inventories of radioactive materials in RWMS components during normal operations and assumed to fail during postulated accidents.

Meeting this requirement of GDC 61 provides reasonable assurance that the necessary information is available to identify the amounts of radioactive materials contained in RWMS and assess the radiological impacts during postulated accidents, as required in DSRS Sections 2.4.13, 11.2 (Branch Technical Position (BTP) 11-6) and 11.3 (BTP 11-5), and analysis of RG 1.143 in assigning the safety classifications to RWMS for design purposes.

III. REVIEW PROCEDURES

These review procedures are based on the identified DSRS acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's proposal and how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. Programmatic requirements. Commission regulations and policy mandate a number of specific "programs" applicable to certain structures, systems, and components (SSCs). This DSRS Section does not directly address SSCs. The NRC regulations, under 10 CFR 50.36a and 10 CFR Part 50, Appendix I, require that each operating license contain a technical specification (TS) that defines "…the limits, operating conditions, and other requirements imposed upon facility operation for the protection of public health and safety…" The applicant's analysis developed in Section 11.1 of the application must be consistent with guidance for development of TS and the associated offsite dose calculation manual and process control program, as mandated operational programs under SRP Section 13.4.

2. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933 current on the date six months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.

3. In the review of the mathematical models and parameters given in the application to calculate primary and secondary coolant concentrations, the reviewer compares parameters and calculations given in the application with the models and parameters given in NUREG-0017, GALE86, or ANSI/ANS 18.1-1999, modified as necessary to reflect the design and operating parameters of the iPWR. If the application includes

models or parameters to estimate reactor coolant concentrations that differ from the guidance, the parameters and calculations used should be substantiated by the applicant. The preferred method of substantiation is by presentation of operating data

from similar reactors with information justifying the basis for any adjustments taking into account the design features of plant-specific conditions.

4. The reviewer performs an independent calculation of the primary and secondary coolant concentrations using the guidance provided in ANSI/ANS 18.1-1999, modified as necessary to reflect the parameters of plant-specific conditions.

5. In the calculation, the reviewer will use the applicant's values as given in the application for the following key parameters: design core thermal power level, steam flow rate, mass of primary coolant, mass of liquid in steam generators, steam generator blowdown rates, and coolant purification rates, among others. RG 1.112 (Appendix B, PWRs) and NUREG-0017 provide guidance on plant data needed to develop input parameters for the PWR-GALE code. The staff may use alternate parameters for the purposes of assessing whether the applicant's values provide a reasonable level of conservatism in assumptions and results. Note: The source terms referenced in this section are used for both the review of the application and environmental report, and for the staff's preparation of the SER and environmental impact statement.

6. Review Procedures Specific to 10 CFR Part 52 Application Type

   A. Early Site Permit Reviews. Subpart A to 10 CFR Part 52 specifies the requirements applicable to the Commission's review of an ESP application. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site.

      For review of an ESP application, staff will evaluate the postulated design parameters associated with the normal operational and AOO source terms. The staff should confirm the approach used by the applicant in developing the annual average liquid and gaseous effluent source terms. For a coolant source term based on a single type of reactor design, the staff will confirm that the applied source term is consistent with that presented in the current revision of the design certification for the selected reactor technology. For a coolant source term based on two or more types of reactor designs, the staff will confirm that the source term, as a plant parameter envelope, is consistent with that presented in the current revision of each DC and conservatively bounding over all expected radionuclides and estimated releases.

      In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the ESP at the COL stage. Accordingly, the reviewer should ensure that all physical attributes of the site that could affect the design basis of SSCs that are important to safety or risk-significant are reflected in the site characteristics, design parameters, or terms and conditions stipulated in the ESP.

B. Standard Design Certification Reviews. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the application meet the acceptance criteria. The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they would need to be added to the DC application.

C. Combined License Reviews. For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an ESP or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

For reviews of a COL application relying on a DC, 10 CFR 52.63 precludes the staff from imposing new requirements on DCs unless it is deemed necessary to bring the certification into compliance with NRC regulations, provide adequate protection of public health and safety, or preserve common defense and security. Accordingly, the reviewer should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the Part 52 process for seeking exemptions, changes, and departures is observed in changing FSAR Tier 1 and Tier 2 information.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's safety review and analysis, as augmented by the application of programmatic requirements in accordance with the staff's technical review approach described in the DSRS Introduction, support conclusions of the following types to be included in the staff's SER. The reviewer also states the bases for those conclusions.

The staff concludes that sufficient information has been provided by the applicant so that the requirements of 10 CFR Part 50, Sections 50.34 and 50.34a have been met. The reviewer responsible for review of effectiveness of radwaste systems will provide a summary statement on the acceptability of source terms used as design parameters for the waste management systems will be made under application Sections 11.2, "Liquid Waste Management Systems," and 11.3, "Gaseous Waste Management Systems."

The staff concludes that the liquid and gaseous source terms are acceptable and that their use in calculating doses associated with liquid and gaseous effluents will meet the regulatory requirements under 10 CFR Part 20 for effluent concentration and dose limits for members of the public, and 10 CFR Part 50, Appendix I design objectives and ALARA provisions. The review includes the bases of the source terms for both the design basis and normal operations and AOOs. The staff confirmed that the source terms were developed using the guidance provided in RG 1.112, NUREG-0017 and ANSI/ANS-18.1-1999, and that specific adjustments were made in consideration of the specific design and operating features of iPWR reactors. The staff confirmed that the applicant has provided sufficient information in justifying changes in the use of input parameters for iPWR reactors.

The staff concludes that the liquid and gaseous source terms are acceptable and that their use in calculating doses associated with accident conditions will meet that regulatory requirement of GDC 61. Meeting this requirement of GDC 61 provides the means to determine the amounts of radioactive materials contained in RWMS and assess the radiological impacts during postulated accidents, as required in DSRS Sections 2.4.13 and 11.2 (BTP 11-6) and 11.3 (BTP 11-5), and analysis of RG 1.143 in assigning the safety classifications of RWMS for design purposes.

For an ESP application, the staff's finding are presented in DSRS Sections 11.2 and 11.3 in addressing the requirements of 10 CFR Part 20 for effluent concentration limits and dose limits for members of the public, and 10 CFR Part 50, Appendix I design objectives and ALARA provisions.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this DSRS section. For reviews of a COL application relying on a DC, the staff's findings confirm that plant design features of the certified design are maintained in the COL application and that, if requested, the Part 52 process for seeking exemptions, changes, and departures has been observed in changing relevant information in FSAR Tier 1 and Tier 2.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower^{TM}-specific DC, COL, or ESP applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower^{TM} and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System Accession No. ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor reviews, including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower^{TM} -specific DC, COL, or ESP applications submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the Standard Review Plan (SRP) revision in effect six months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9) as long as the mPower^{TM} DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47 (a)(9). Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new

design assumptions. The same approach may be used to meet the requirements of 10 CFR 52.17 (a)(1)(xii) and 10 CFR 52.79 (a)(41), for ESP and COL applications, respectively.

VI. REFERENCES

1. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs)," current revision.

2. DC/COL-ISG-5, "Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water-Reactors and Pressurized-Water-Reactors to Support Design Certification and Combined License Applications," July 2008.

3. RG 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

4. RG 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water- Cooled Nuclear Power Reactors."

5. RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors."

6. 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

7. 10 CFR Part 20, "Standards for Protection Against Radiation."

8. 10 CFR Part 20, Appendix B, "Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

9. 10 CFR Part 50, Section 50.34, "Domestic Licensing of Production and Utilization Facilities - Contents of Applications; Technical Information."

10. 10 CFR Part 50, Section 50.34a, "Domestic Licensing of Production and Utilization Facilities - Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents - Nuclear Power Reactors."

11. RG 1.143,"Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light Water Cooled Nuclear Reactor Power Plants."

12. 10 CFR Part 50, Appendix A, GDC 60, "Control of Releases of Radioactive Materials to the Environment."

13. 10 CFR Part 50, Appendix A, GDC 61, "Fuel Storage and Handling and Radioactivity Control."

14. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

15. ANSI/ANS-18.1-1999, “American National Standard Radioactive Source Term for Normal Operation of Light Water Reactors.”