Interim Staff Guidance on NUREG-0800
Standard Review Plan Section 11.2 and
Branch Technical Position 11-6
Assessing the Consequences of an
Accidental Release of Radioactive Materials from
Liquid Waste Tanks for Combined License Applications
Submitted under 10 CFR Part 52

Purpose

The purpose of this interim staff guidance (ISG) is to clarify the U.S. Nuclear Regulatory Commission (NRC) guidance and application of Standard Review Plan (SRP) Sections 11.2 and 2.4.13 on the characterization of hydro geological properties of a site associated with the effects of accidental releases of radioactive liquid on existing or likely future uses of ground and surface water resources in meeting the requirements of Title 10 of the *Code of Federal Regulations*, Part 100 (10 CFR 100.10 or 100.20) and Appendix B to Part 20 on effluent concentration limits. The two SRP sections are not internally consistent in identifying acceptable criteria for assessing the consequences of accidental releases of radioactive materials or in providing guidance to the staff and applicants for use in establishing conditions for such releases and in defining acceptable assumptions for describing exposure scenarios and pathways to members of the public.

Background

SRP Sections 2.4.13 and 11.2 with Branch Technical Position (BTP) 11-6 address the radiological consequences of an accidental release of radioactive liquid to the environment. The focus and objective of each guidance document, however, is different.

The focus of SRP Section 2.4.13 is on the hydro geological characterization of the site. The SRP Section 2.4.13 calls for the characterization and identification of site properties that would affect the transport of radionuclide from accidental releases of radioactive liquid in ground and surface waters under most adverse accident conditions and natural phenomena. The staff uses the information obtained from such characterization to develop site-specific hydro geological models, identify critical pathways, and identify features that would be influential in the transport, dispersion, and dilution or concentration of radioactive contaminants. The requirements and acceptance criteria of SRP Section 2.4.13 include 10 CFR 100.10(c) and 100.20(c), General Design Criteria (GDC) 1 and 2, and Regulatory Guide (RG) 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I." The focus of Part 100, Paragraphs 100.10(c) and 100.20(c) is on-site features that have a bearing in analyzing the consequences of a release of radioactive materials into ground and surface water resources, with an emphasis on site information derived from on-site measurements. Compliance with 10 CFR 100.10(c) and 100.20(c) requires that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability for a nuclear power reactor.

To satisfy the hydrological requirements of 10 CFR Part 100, the applicant's Safety Analysis Report needs to consider local geological and hydrological characteristics when determining the acceptability of a nuclear power plant site. The geological and hydrological characteristics of the site have a bearing on the transport and potential consequences of radioactive effluents accidentally released from the facility. Applicants should consider the use of specific provisions if a reactor were to be located at a site where a significant quantity of radioactive effluent could accidentally flow into nearby streams or rivers or find ready access to aquifers and impact members of the public.

The focus of SRP Section 11.2 is on the Liquid Waste Management System (LWMS). The LWMS ensures that liquids and liquid wastes produced during normal operation and anticipated operational occurrences are handled, processed, recycled as coolant, or released in accordance with relevant NRC regulations. Typically, LWMS include tanks, pumps, filters, demineralizers, and additional equipment that are necessary to process and treat liquid wastes. Besides the LWMS, other plant systems have tanks and vessels that contain large amounts of radioactive liquids; such systems include condensate storage tanks and refueling water storage tanks, located outside of containment or outdoors. The requirements and acceptance criteria of SRP Section 11.2 include GDC 60 and 61 of Part 50, Appendix A, and 10 CFR Part 20. Compliance with GDC 60 and 61 requires, in part, that the nuclear power plant design shall include means to control the release of radioactive materials in gaseous and liquid effluents and provide adequate safety during normal reactor operation, including anticipated operational occurrences.

GDC 60 and 61 are applicable because these SRP sections are concerned with tanks and associated components outside of containment or outdoors that could contain radioactive liquids. A single failure of these tanks could release radioactive liquids to surface or ground water and potentially endanger the public. Meeting these criteria provides assurance that releases of radioactive materials due to a single failure of liquid-containing tanks outside of containment or outdoors during normal operations or anticipated operational occurrences will not result in potable water concentrations exceeding the limits specified in Appendix B to 10 CFR Part 20.

BTP 11-6 of SRP Section 11.2 complements both SRP Sections 2.4.13 and 11.2. In BTP 11-6, the NRC staff considers a gross failure of a tank or component, such as a failure involving the near total loss of the system's inventory of radioactive materials, to be unlikely. However, the malfunction of a tank and its components, a valve misalignment, tank overflow, or an operator error appear more likely and are assumed to be the types of failures warranting an evaluation of their consequences. Although BTP 11-6 designates no specific types of system failures as being representative, the guidance considers that for the evaluation of such systems, the type of malfunctions analyzed should be limited to the postulated failure or rupture of a tank or vessels located outside of containment or outdoors. The evaluation considers the impact of the failure on the nearest potable water supply in the unrestricted area, and the long-term use of water for direct human consumption or indirectly through animals (livestock watering), crops (agricultural irrigation), and food processing (with water being an ingredient).

BTP 11-6 provides specific guidance on how to evaluate the consequence of a radioactive release due to a failure of a tank containing radioactive liquid. This BTP provides guidelines for defining the mechanism of the failure, assumptions used for the analysis, and approach applied in assessing the radiological impact. The objective is to develop an estimate of the amounts of radioactive materials released in an unrestricted area, and to assure that the radiological consequences will not exceed NRC's public dose limit. Licensees use the results of this analysis to develop technical specification limits for liquid holding tanks to comply with 10 CFR 50.36(a).

Issue

The issue is that SRP Sections 2.4.13 and 11.2 with BTP 11-6 address the same topic but with a different regulatory and technical focus, creating guidance that is poorly integrated and confusing to use. The major differences between the two SRPs are:

1. The requirements and acceptance criteria of SRP Section 2.4.13 include 10 CFR Part 100, GDC 1 and 2, and RG 1.113. The focus of Part 100, Paragraphs 100.10(c) and 100.20(c) are on-site features that have a bearing on the analysis of the consequences of a release of radioactive materials into ground and surface water resources, with an emphasis on site information derived from on-site measurements. However, SRP Section 2.4.13 does not address whether the applicant has included design features that would mitigate the impact from the release of radioactivity in the nearest ground or surface water body. Moreover, the SRP guidance places an emphasis on applying very conservative assumptions, such as “most adverse contamination,” “extreme events,” or “the most severe of natural phenomena,” while SRP Section 11.2 and BTP 11-6 do not apply conservative assumptions to the same extent. Finally, BTP 11-6 sets forth minimum requirements and does not prohibit the implementation of more rigorous design codes, standards, or quality assurance measures. Also, it does not require a re-evaluation of LWMS with limiting conditions or controls for operation based on more conservative analysis and assumptions used in calculations demonstrating compliance with its acceptance criteria.

2. SRP Section 11.2 with BTP 11-6 considers site features that are important in assessing the consequence of a release of radioactive materials in the nearest ground or surface water body. These guidance documents also provide guidance on how to model the radioactive source term, consider whether design features are included that might mitigate the impact of a release, and provide acceptance criteria based on annual average effluent concentration limits of Table 2, Column 2, from Appendix B to Part 20. In the context of the BTP 11-6, the acceptance criteria apply at the nearest source of potable water, i.e., point of use in unrestricted areas.

Rationale

The staff finds the current guidance internally inconsistent between the SRP Sections 2.4.13 and 11.2, including BTP 11-6 of SRP Section 11.2, and difficult to implement based on experience with reviews of combined license (COL) applications. To address these inconsistencies and implementation issues the staff needs to:

1. define a consistent set of acceptance criteria in both SRP sections with which to assess the results of a consequence analysis;

2. incorporate in SRP Section 2.4.13 provisions to consider plant design features that may mitigate the impact of a release;

3. re-assess whether the approach applied in SRP Section 2.4.13 provides the means to define conditions that envelope the characteristics of the site in attenuating the transport of radioactivity. Specifically, RG 1.113 warrants average conditions, while SRP Section 2.4.13 relies on most severe conditions;

4. provide guidance in choosing receptors that are accessed by current and likely future water users;

5. provide specific guidance to meet the requirement of measuring on-site hydrogeologic characters specified in Part 100, Paragraph 100.20(c)(3);

6. expand the discussion and guidance for modeling surface or ground water flow and transport processes from the point of release to the nearest receptor, including dispersion and dilution mechanisms; and

7. provide further guidance in justifying and describing the assumed type of event failure and radioactive source term, including radionuclide distributions and concentrations, total inventory of radioactivity, processes by which the radioactivity is assumed to be released to the environment, whether the event considers a surface water or ground water release or both, and justifications for the use of plant design features and mitigating measures that would reduce the radiological impact on ground or surface water users.

Accordingly, there is a need to reconcile these differences between SRP sections that have same objectives in assessing potential impacts on members of the public and incorporate current lessons-learned from COL application reviews.

Proposed Interim Staff Guidance

In the near-term, the staff should apply the following interim guidance for the review of COL, certified design applications, and early site permit applications. The interim guidance contains seven major review steps including: 1) Failure Mechanism and Radioactivity Releases, 2) Mitigating Design Features, 3) Radioactive Source Term, 4) Calculations of Transport Capabilities in Ground Water and Surface Water, 5) Exposure Scenarios and Acceptance Criteria, 6) Specifications on Tank Waste Radioactivity Concentration Levels, and 7) Evaluation Findings For Combined License Reviews. The guidance below describes each major review process and identifies the responsible technical discipline for each process. The fourth step is addressed in SRP Section 2.4.13, while all others are covered in SRP Section 11.2 and BTP 11-6.

The reference section identifies regulatory requirements addressed in this ISG and presents regulatory guidance that provides acceptable methods of compliance with NRC regulations. If an applicant applies assumptions and calculation methods that differ from NRC guidance, the applicant should describe in details the bases for the alternate methods and parameters. Also, the applicant should provide sufficient information to enable the staff to conduct an independent evaluation of the results presented in the application.

1. Failure Mechanism and Radioactivity Releases

This process identifies the single liquid waste vessel or tank outside of containment or outdoors that releases the most radioactivity into the environment in the event of failure. The components selected for the analysis should reflect the specific design features of the plant, as described in COL applications (e.g., Final Safety Analysis Report (FSAR) Sections 5, 9, 10, 11, and 12). The Health Physics staff will evaluate the assumed failure and release mechanisms in ensuring that the proposed scenario is consistent with plant design features and that the applicant has applied reasonably conservative assumptions. For example, the staff will assess whether the applicant has considered the following:

- technical justification for defining the limiting event for the consequence analysis, given known plant process systems expected to contain radioactive materials

- all systems with potential sources of radioactivity contained in tanks and vessels located outside of containment and outdoors, with and without due consideration for durable and passive mitigation features

- types of failure mechanisms and descriptions of the types of durable and passive design features applied to mitigating the impacts of such releases

- whether the event results in a prompt release to surface water or a delayed release to ground water

- conditions where both surface and ground water could be impacted by a single event

- radiological impacts on offsite users for a given point of entry of radioactive materials in surface and ground water resources

The staff assesses whether the applicant 1) evaluated and ranked vessels and tanks in terms of radioactivity levels and radionuclide concentrations, and 2) applied a graded approach to considering each type of event, radioactive source terms, design features (durable and passive) assumed in mitigating releases, and potential offsite impacts. For example, the volumes of liquid radioactive waste in tanks and vessels vary among plant systems. LWMS tanks and vessels usually contain less liquid than condensate storage tanks and refueling water storage tanks. For LWMS, the amounts are typically on the order of a few to several thousand gallons, while the volumes of condensate storage tanks and refueling water storage tanks are typically on the order of several hundred thousand gallons. Similarly, the inventories of radioactivity vary, with higher radionuclide concentrations found in LWMS tanks and vessels and lower concentrations observed in condensate storage tanks and refueling water storage tanks. The staff should account for these aspects and their inter-relationships when confirming that the applicant has selected (a) a case that assumes the highest release of radioactivity to the environment, or (b) an event involving other plant systems and inventories of radioactive materials associated with systems that exclude the use of mitigating features.

2. Mitigating Design Features

The Health Physics staff will consider the use of design features, e.g., steel liners or walls in areas housing components, dikes for outdoor tanks, and overflow provisions incorporated to mitigate the effects of a postulated tank failure. The types of failed components are typically waste collector tanks or sample tank, among others. However, the components selected for the analysis should reflect the specific design features of the plant, as described in COL applications (e.g., FSAR Sections 5, 9, 10, 11, and 12). The purpose of this review is to ensure that the analysis considers the proper selection of the failed equipment, appropriate release mechanisms from the selected equipment and buildings and structures housing such systems, and whether the proposed design is capable of retaining the liquid inventory of the failed component and includes provisions to pump the spilled inventory back to proper processing systems. If an analysis takes credit for liquid retention by any design feature, the applicant must make a convincing argument for doing so by demonstrating that such features are durable and passive. Mitigating design features that rely primarily on operator actions for their effectiveness are not acceptable. Applicants can use empirical evidence, operating experience, and modeling results to prove the efficacy of a design feature to retain or retard the release. Based on this proof, the staff determines if the analysis can take credit for the proposed design features. In cases where mitigating design features of tanks and vessels meet the acceptance criteria, the staff might waive the need for a consequence analysis in the context of SRP Section 11.2. However, this provision does not change the requirements of SRP Section 2.4.13 that relate to demonstrating the adequacy of the site's hydro geologic properties, via a consequence analysis that uses combined literature data and site data characterizing transport mechanisms, such as aquifer materials, hydraulic conductivity, porosity, etc. See SRP Section 2.4.13 for details on the type of information and site data that would be acceptable for characterizing the geo-hydro geologic properties of a site.

3. Radioactive Source Term

The Health Physics staff will review the proposed radionuclide distributions and concentrations assumed for the postulated failure of a tank and its components using the information presented by the applicant. The analysis assumes that a system component fails to meet the design bases as required by 10 CFR 50.34(a), and GDC 60 and 61. The staff will evaluate the basis and assumptions used in developing the source term, radionuclide distributions and concentrations to ensure that the highest potential radioactive material inventory is selected among the expected types of liquid and wet waste streams processed by plant systems. The radionuclide inventory for the tank and its components assumed to fail should be based on a conservative estimate of 80% capacity of that tank and its components.

In assigning radionuclide distributions and concentrations for the relevant exposure scenario, the staff should consider whether the site conceptual model defines the release as through a surface water or ground water pathway, and also consider conditions where both types of water resources could be impacted by a single event. For scenarios that include surface water pathways, the source term should consider both short and long-lived radionuclides. The rationale for including both types of radionuclides in surface water release scenarios is that releases to useable water resources and impacts usually occur promptly with minimal time for retardation and usage after the release. For ground water pathways, the source term should consider radionuclides that are expected to persist in ground water, taking into account radioactive half-lives, distribution coefficients, retardation factors, and environmental mobility in ground water. For this type of scenario, the rationale is that releases to useable water resources and impacts to users are assumed to occur over protracted time periods, years to decades, which afford time for the radioactive decay of short-lived radionuclides with half-lives expressed in months or less than a few years. As result, this consideration would include long-lived and mobile radionuclides, such as tritium, C-14, Ni-63, Sr-90, Tc-99, I-129, Cs-137, among others, and both parent and progeny radionuclides. Attachment A presents a list of radionuclides which should be considered when defining source terms for surface water and ground water release pathways.

The staff will confirm that the inventory of radioactive material and radionuclide distribution corresponds to the highest expected concentrations and inventory of radioactivity in selected systems and components, and that the listed radionuclides are consistent with the proposed release mechanism and exposure pathways at the point of entry into the nearest source of potable water located in an unrestricted area.

4. Calculations of Transport Capabilities in Ground Water or Surface Water

The Hydrologic Engineering staff will make independent calculations of transport mechanisms and potential contamination pathways of the surface and ground water environment under accidental conditions with respect to existing and future water users. The staff should direct special attention to proposed facilities with permanent dewatering systems to assure that pathways created by those systems are identified. The staff should also account for the impacts of plant structures and facilities that would influence the direction and travel path of surface and ground water flows. The staff's analysis should account for both parent radionuclides and progeny radionuclides that would be generated subsequently during ground water transport. If applicable, the effects of chelating agents and other chemicals known to enhance the mobility of radionuclides in ground water should be considered if it is known that such chemicals are present at existing sites. Such chemicals could be associated with the use of cleaning chemicals in non-nuclear plant systems, and applications and spills of such chemicals in areas of the site with ground water flow pathways to offsite locations. In cases where a ground water modeling approach is adopted to predict future ground water flows, the staff should rely on the modeling guidance described in SRP Section 2.4.12. The staff will choose the release scenario leading to the most adverse contamination of ground or surface water Confirmatory analyses will be conducted using a screening analytical model, or consider the use of a site conceptual model, given the availability of site-specific data.

The evaluation of the consequence analysis will commence with the simplest models considering, for example, advection and radioactive decay only, and then compare the results against the effluent concentration limits (ECLs) identified in 10 CFR Part 20, Appendix B, Table 2, Column 2. For example, the staff may apply simplified calculation procedures and models, such as those contained in RG 1.113 and NUREG/CR-3332 using demonstrably conservative coefficients and assumptions and physical conditions (such as lowest recorded river flow) likely to give the most adverse dispersion of liquid effluents. The staff will compare the applicant's model, assumptions, and results with its own to assure that the results are comparably conservative. The estimation of liquid effluent dispersion will reflect potential changes in water withdrawal rates that might result from variations by known future users of surface and ground water.

If the predicted radionuclide concentrations are greater than the ECLs, then the staff should undertake further analyses using progressively more realistic and less conservative modeling techniques that consider site-specific information and associated parameters. For example, NUREG/CR-6805 specifies that the modeling process consists of conceptual and mathematical components, and that a conceptual model embodies the descriptive (both in qualitative and quantitative) component of the model. Model conceptualization is the process where data describing field conditions are analyzed and synthesized in a systematic way to describe ground water flow and contaminant transport processes at a site. A conceptual model illustrates hydrologic and hydro geologic characteristics, ground water flow boundaries, and flow directions as well as the proposed plant facilities relative to hydrogeology including pumping wells, plant location, dewatering, and excavation depth. The model conceptualization may help in determining which types of models are most appropriate for the site. See SRP Section 2.4.12 for details on the type of information and site data that would be considered in the development of a site conceptual model.

5. Exposure Scenarios and Acceptance Criteria

The Health Physics staff will review the exposure scenario associated with the release of radioactivity. The primary scenarios include:

a. Exposure pathway case 1 – Assumes that members of the public consume drinking water withdrawn near or at the point of entry in an unrestricted area, including from a ground water well or a surface water body, in a ground water recharge zone within a lake or river, and from a downstream water supply system drawing water from a river. This scenario also considers the use of water in indirect human consumption through animals (livestock watering), crops and pasture irrigation, and food processing (with water being an ingredient), taking into account local or regional land-use practices.

b. Exposure pathway case 2 – Assumes that members of the public consume only fish and other aquatic biota impacted by the release of radioactivity in a surface water body. This scenario would consider a food chain for particular invertebrates and bio-accumulation of radioactivity for a given aquatic environment. The food chain might consider, for example, invertebrates, clams, mussels, and fish consumed locally by members of the public or regionally (for commercial fishing), taking into account local or regional land-use practices.

The staff will review the supporting basis for the selected scenario and reasonableness of assumptions applied in modeling the scenario and selection of model parameters. The staff will confirm the appropriateness of the scenario and acceptability of underlying assumptions using the information provided by the applicant and information obtained from the results of land-use census, if available, or information gleaned from local or regional sources.

The basis for acceptance is that the staff's review shows that the postulated event would not result in radionuclide concentrations in surface or ground water exceeding the ECLs of 10 CFR Part 20, Appendix B, Table 2, Column 2; or in a maximum water concentration that when consumed on an annual basis will not exceed a dose limit of 1 mSv (100 mrem) from all relevant pathways. The Health Physics staff calculates this dose at the nearest source of potable water, as described in the application and information describing current local or regional practices.

6. Specifications on Tank Waste Radioactivity Concentration Levels

The Health Physics staff will evaluate the proposed technical specification limiting the radioactivity content of liquid-containing tanks and vessels to ensure that the technical specification is consistent with the safety evaluation. Chapter 16 of the SRP identifies the requirements for this technical specification. Chapter 16, Section 5.5, "Programs and Manuals," of the FSAR addresses this commitment in COL applications. The maximum inventory of radioactive materials is based on that quantity of radioactivity, in the event of an uncontrolled release of radioactivity, that will not exceed the ECLs of 10 CFR Part 20, Appendix B, Table 2, Column 2; result in a maximum water concentration that when consumed on an annual basis will not exceed a dose limit of 1 mSv (100 mrem) from all relevant pathways at the nearest current or likely future potable water supply system, located in an unrestricted area. In addition, this requirement is supported in the Offsite Dose Calculation Manual (ODCM), which describes the methods and assumptions used in calculating doses to members of the public. The milestones for the development and implementation of a plant-and site-specific ODCM are addressed in FSAR Sections 11.5 and 13.4 of COL applications.

7. Evaluation Findings for Combined License Reviews

The staff will document the results of the evaluation of site characteristics against the relevant regulatory criteria. The evaluation supports the staff's conclusions as to whether the regulations are met and whether the applicant appropriately used applicable NRC guidance. The reviewer states what was done to evaluate the applicant's safety analysis report. The staff's evaluation may include verifying the applicant's results, determining whether the applicant followed applicable regulatory guidance, performing independent calculations, and confirming all stated assumptions and data. The reviewer may state that certain information provided by the applicant was not considered essential to the staff's review and was not reviewed by the staff. While the reviewer may summarize the information offered by the applicant in support of its application, the reviewer should articulate the bases for the staff's conclusions and acceptance of the results and supporting information. The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following types to be included in the staff's Safety Evaluation Report.

The following statements should be preceded by a summary of the site characteristics and parameters used for the plant, where items a, b, and c below are applicable to SRP Section 2.4.13, while items c, d and e below are for SRP Section 11.2:

a. As set forth above, the applicant has presented and substantiated information relative to the accidental releases of radioactive liquid effluent in ground and surface waters important to the siting of this plant. The staff has reviewed the available information provided and, for the reasons given above, concludes that the identification and consideration of the potential effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources in the vicinity of the site are acceptable and meet the requirements of 10 CFR 100.10(c) or 10 CFR 100.20(c), as applicable, with respect to determining the acceptability of the site.

b. The staff finds that the applicant has considered the appropriate site phenomena in establishing the transport of radioactive liquid effluent in ground and surface waters that are important to safety of ground and surface water resources in the vicinity of the site. The staff has generally accepted the methodologies used to determine the potential effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources, as documented in safety evaluation reports for previous licensing actions. The staff concludes that the identified design bases meet the requirement(s) of 10 CFR 100.10(c) or 10 CFR 100.20(c), with respect to establishing the effects of accidental releases of radioactive liquid effluents in ground and surface waters using site-specific information and relevant data from the literature.

c. The scope of the review included the calculation of radionuclide concentrations in the applicable failed components based upon the expected pressurized-water reactor fuel failure rate or boiling-water reactor fuel release rate for the plant, and the effect of site hydrology for those systems that have not been provided with special design features to mitigate the effects of failures. Radionuclide concentrations at the nearest potable water supply were found to be acceptable. The basis for acceptance has been that the staff's review shows that the postulated failure of a tank and its associated components would not result in radionuclide concentrations in surface or ground water exceeding the ECLs of 10 CFR Part 20, Appendix B, Table 2, Column 2; or in a maximum water concentration that when consumed on an annual basis will not exceed a dose limit of 1 mSv (100 mrem) from all relevant pathways, at the nearest source of potable water, as described in the application.

d. For cases where special design features were incorporated to mitigate the consequences of a failure of a tank and its associated components, tanks for which special design features were incorporated to mitigate the consequences of failures, such as steel liners or walls or dikes surrounding the failed tanks and their components and tank overflow provisions, were evaluated and found to be acceptable. The basis for the staff's acceptance was the capability of these design provisions to prevent the release of radioactivity from entering a potable water supply system using durable and passive features requiring no operator interventions. Therefore, the staff concludes that the design provisions incorporated by the applicant are acceptable in mitigating the effects of the failure of a tank and its associated components involving radioactive liquids, as described in the application.

e. For either case, the staff concludes that the postulated failure of a tank and its associated components has been evaluated and the design is acceptable and meets the requirements of GDC 60 and 61 for the control of releases of radioactive materials to the environment and provides an adequate level of safety during normal reactor operation, including anticipated operational occurrences. Such a release will not result in radionuclide concentrations in surface or ground water exceeding the ECLs of 10 CFR Part 20, Appendix B, Table 2, Column 2; or in a maximum water concentration that when consumed on an annual basis will not exceed a dose limit of 1 mSv (100 mrem) from all relevant pathways, at the nearest source of potable water, as described in the application.

Final Resolution

In the long-term, the ISG noted above will be formally incorporated in future updates of RG 1.206 and SRP Sections 2.4.13 and 11.2 (NUREG-0800). The updates will include revisions of the areas of review, review interface, acceptance criteria, technical rationale, review procedures, and evaluation findings. The revisions will consider the incorporation of SRP provisions and acceptance criteria of BTP 11-6 into SRP Sections 2.4.13 and 11.2 for internal consistency in guiding the staff and applicants. Once implemented, this step would replace and supersede BTP 11-6. As part of these updates, the staff will determine the extent to which these revisions apply to the evaluation findings associated with the review of early site permit applications and design certification applications.

Applicability

This ISG is applicable to all license applications submitted under the requirements of 10 CFR Part 52.

References:

1. 10 CFR Part 100.10, Subpart A, “Factors to be considered when evaluating sites.”

2. 10 CFR Part 100.20, Subpart B, “Factors to be considered when evaluating sites.”

3. NUREG-0800, SRP Section 11.2, “Liquid Waste Management System,” March 2007.

4. NUREG-0800, SRP Section 2.4.1, “Hydrologic Description,” March 2007.

5. NUREG-0800, SRP Section 2.4.12, “Groundwater,” March 2007.

6. NUREG-0800, SRP Section 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters,” March 2007.

7. NUREG-0800, SRP Section 11.2, “Liquid Waste Management System,” BTP Section 11-6 “Postulated Radioactive Releases Due to Liquid-Containing Tank Failures,” March 2007.

8. 10 CFR 20.1406, “Minimization of Contamination.”

9. 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."

10. 10 CFR 50.34(a), “Design objectives for Equipment to Control Releases of Radioactive Material in Effluents Nuclear Power Reactors.”

11. 10 CFR 50.36(a), “Technical Specifications on Effluents from Nuclear Power Reactors.”

12. 10 CFR Part 50, Appendix A, GDC 2, “Design Bases for Protection against Natural Phenomena.”

13. 10 CFR Part 50, Appendix A, GDC 60, “Control of Releases of Radioactive Materials to the Environment.”

14. 10 CFR Part 50, Appendix A, GDC 61, “Fuel Storage and Handling and Radioactivity Control.”

15. RG 1.113, “Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I.”

16. RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition).”

17. RG 1.143, “Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Reactor Power Plants.”

18. RG 1.132, “Site Investigations for Foundation of Nuclear Power Plants.”

19. RG 1.135, “Normal Water Level and Discharge at nuclear Power Plants.”

20. RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life Cycle Planning.”

21. NUREG-0868, “A Collection of Mathematical Models for Dispersion in Surface and Ground Water,” February 1982.

22. NUREG/CR-3332, “Radiological Risk Assessment, A Textbook on Environmental Dose Analysis,” September 1983.

23. NUREG/CR-6805, “A Comprehensive Strategy of Hydro geologic Modeling and Uncertainty Analysis for nuclear facilities and Sites.”

Attachment A
Source Term Radionuclides

Table 1, below, contains a list of radionuclides that should be included, at a minimum, in any assessment of an accidental release of radioactive material from liquid waste tanks. The list includes all those non-gaseous radionuclides listed in ANSI/ANS 18.1, 1999, Radioactive Source Term for Normal Operation of Light Water Reactors. This standard is the basis in developing the predicted reactor coolant and steam concentrations and annual effluent releases presented in FSAR Chapter 11 and contained radioactive sources in plant systems presented in FSAR Chapter 12. In addition to those radionuclides, the table also includes I-129 and Tc-99 because they are fission products that can escape into the reactor coolant and, when released into the environment, move readily with groundwater, with little retardation and radiological decay.

Table 1. Source Term Radionuclides

H-3	Ru-103
P-32 BWR only	Ru-106
Cr-51	Rh-103m BWR only
Mn-54	Rh-106 BWR only
Mn-56	Ag-110m
Fe-55	Te-129m
Fe-59	Te-129 PWR only
Co-58	Te-131 PWR only
Co-60	Te-131m
Ni-63 BWR only	Te-132
Cu-64 BWR only	I-129
Zn-65	I-131
Br-84 PWR only	I-132
Rb-88 PWR only	I-133
Rb-89 BWR only	I-134
Sr-89	I-135
Sr-90	Cs-134
Sr-91	Cs-136
Sr-92 BWR only	Cs-137
Y-90 BWR only	Cs-138 BWR only
Y-91	Ba-140
Y-92	La -140
Y-93	Ce-141
Y-91m PWR only	Ce-143 PWR only
Zr-95	Ce-144
Nb-95	Pr-144 BWR only
Mo-99	W-187
Tc-99m	Np-239
Tc-99	