U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

11.5 PROCESS AND EFFLUENT RADIOLOGICAL MONITORING INSTRUMENTATION AND SAMPLING SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of effectiveness of radwaste systems.

Secondary - Organization responsible for the review of instrumentation.

I. AREAS OF REVIEW

The process and effluent radiological monitoring instrumentation and sampling systems (PERMISS) are used to monitor liquid and gaseous process streams and effluents from the liquid waste management system (LWMS), gaseous waste management system (GWMS), and solid waste management system (SWMS). The PERMISS includes subsystems used to collect process and effluent samples during normal operation and anticipated operational occurrences and under post-accident conditions.

The specific areas of review are as follows:

1. The design objectives and criteria for the PERMISS, including the interface with skid-mounted radiation monitoring equipment connected to permanently installed systems. The review identifies the (1) process and effluent streams to be monitored by radiation detection instrumentation or sampled for separate analyses, (2) purpose of each monitoring or sampling function, and (3) parameters to characterize, through monitoring instrumentation or sampling and analysis, radionuclide distributions and concentrations in sampled process and effluent streams (e.g., total gross beta-gamma or alpha activity, radionuclide-specific concentrations, isotopic, total radioactivity level, or groupings of radionuclides).

2. The system description for the PERMISS includes:

   A. Descriptions of radiation measurement instrumentation and related sampling equipment, including redundancy and independence (where applicable); instrumentation range, calibration, and sensitivity; methods for determining alarm/trip setpoints for activating alarms and terminating effluent releases or isolating processes; bases for in-plant effluent dilution; and diversity of components used for normal operations, anticipated operational occurrences, and postulated accidents.

   B. Location of radiation instrumentation, monitors, and direct readouts, including the proposed locations and interface with skid-mounted radiation monitoring equipment.

   C. Location and bases of selected sampling points and sampling stations.

   D. Methods used to convert raw instrumentation readings into meaningful results to identify radioactivity or radionuclide concentrations monitored or sampled for normal operations, anticipated operational occurrences, and postulated accidents.

   E. Measurements, analyses, or determinations made, including the bases for the interpretation of sample analysis results relying on the use of surrogate radionuclides, as easy-to-detect in accounting for the presence of hard-to-detect radionuclides and gross beta-gamma concentrations or via the measurements of specific radionuclides. Instrumentation calibration procedures should consider whether instrumentation response is expected to change given that radionuclide distributions may vary with the operating status of the plant (i.e., normal operation, anticipated operational occurrences, and post-accident conditions).

   F. Types and locations of annunciations and alarms and actions initiated by each, and confirmation that once tripped by an alarm setpoint, the system properly initiates and completes the expected action, such as terminating or diverting a release or process.

   G. Provisions for purging sample lines and minimizing process and effluent volumes to waste collection systems, as well as the bases for the sampling and analysis program, including the frequency of sample collection and analysis.

   H. Expected relationships and interpretation of results between monitoring instrumentation readouts, sample analytical results, and plant operations.

   I. Descriptions of procedures used for calibration, maintenance, operational functional checks, and inspection of monitoring instrumentation and sampling systems.

   J. Layout drawings, piping and instrumentation diagrams (P&IDs), location and designation of effluent release or discharge points, and process and effluent flow diagrams.

   K. Monitoring systems and procedures used for the detection of radioactivity in nonradioactive systems to prevent unmonitored and uncontrolled releases of radioactive material to the environment.

3. The scope and elements of the technical specifications (TS) and standard radiological effluent controls (SREC) as they relate to the plant's Offsite Dose Calculation Manual (ODCM), Radiological Environmental Monitoring Program (REMP), and the Process

Control Program (PCP). The review evaluates the bases of limiting conditions for operations and controls for operation consistent with plant design features associated with the TS and SREC, as well as procedural details and programmatic controls of the ODCM, REMP, and PCP.

4. The quality group classifications of piping and equipment and the bases governing the classification chosen in accordance with the guidelines of Regulatory Guide 1.143. Design and expected temperatures and pressures and materials of construction of permanently installed systems and skid-mounted radiation monitoring and sampling equipment.

5. Design provisions incorporated in equipment and the facility to ease operation and maintenance in accordance with the guidelines of Regulatory Guide 1.143 and as referenced in topical reports, as well as previous experience with similar equipment and methods referenced in the safety analysis report (SAR) or other supporting documents.

6. Design features to reduce radioactivity levels in wastes, minimize, to the extent practicable, contamination of the facility and environment, facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste.

7. For multi-unit stations, descriptions and design features of equipment and components (as permanently installed systems or in combination with skid-mounted radiation monitoring equipment) normally shared between interconnected processing and waste treatment subsystems and release points.

8. Definition of the boundary of the LWMS, GWMS, and SWMS beginning at the interface from plant systems provided for the collection of process streams and radioactive wastes to the point of controlled discharges to the environment as defined in the ODCM and/or PCP at the point of recycling to primary or secondary water system storage tanks in accordance with the guidance of Regulatory Guide 1.143.

9. Design considerations for the use of shielding around portions of sampling equipment expected to exhibit elevated levels of external radiation, placement of such equipment in shielded cubicles, and the use of temporary or permanent shielding mounted on or in the immediate vicinity of such equipment during normal operation, anticipated operational occurrences, and under post-accident conditions.

10. Process used to develop, review, verify, validate, and audit digital computer software used in radiation monitoring and sampling equipment, including software used to terminate or divert process and effluent streams. This aspect addresses software developed by the applicant, purchased through a vendor, or included with the instrumentation.

11. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

12. 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. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

13. Operational Program Description and Implementation. For a COL application, the staff reviews the Radiological Effluent Technical Specifications/Standard Radiological Effluent Controls (RETS/SREC), Offsite Dose Calculation Manual (ODCM) and Radiological Environmental Monitoring Program (REMP) aspects of the Process and Effluent Monitoring and Sampling Program description and the proposed implementation milestones. The staff also reviews final safety analysis report (FSAR) Table 13.x to ensure that the RETS/SREC, ODCM and REMP aspects of the Process and Effluent Monitoring and Sampling Program and associated milestones are included.

Review Interfaces

Other SRP sections interface with this section as follows:

1. The review of the PERMISS, in the context of instrumentation and controls required to actuate engineered safety feature (ESF) systems designed to prevent or mitigate consequences of accidents, which could result in offsite exposures comparable to the guidelines of 10 CFR Part 100, is performed under SRP Sections 7.5 and 13.3.

2. The review of provisions used for sampling during accident conditions (via the post-accident sampling system) and in controlling sample leakage, spillage, and limiting radiation exposure to workers during sampling from process waste systems and effluent streams is conducted under SRP Sections 9.3.2, 12.3-12.4, and 13.3.

3. The review of the TS, as they relate to the SREC, ODCM, and PCP, is performed under SRP Section 16.

4. The review of the quality assurance aspects of the radiological monitoring instrumentation and sampling systems is conducted under SRP Section 17. This review also addresses the process used to develop, review, verify, validate, and audit digital computer software used in radiation monitoring and sampling equipment, including software used to terminate or divert process and effluent streams. This aspect encompasses software developed by the applicant, purchased through a vendor, or included with the instrumentation.

5. The review of the bases of annual average atmospheric dispersion (X/Q) and deposition (D/Q) parameters, as used in the ODCM for estimating doses from gaseous and particulate effluents to members of the public in unrestricted areas, is conducted under SRP Section 2.3.5.

6. The review of the bases of expected radiological source terms, as they relate to process and effluent streams monitored by the PERMISS, is conducted under SRP Sections 11.2 to 11.4.

7. The review of the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena, such as the safe-shutdown earthquake, the probable maximum flood, and tornadoes and tornado missiles, is performed under SRP Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.

8. The review of the acceptability of the seismic and quality group classifications for structures and system components is performed under SRP Sections 3.2.1 and 3.2.2 and Regulatory Guide 1.143.

9. The review of design features and instrumentation used for the protection of potable and sanitary water systems is conducted under SRP Section 9.2.4.

10. The review of the "as low as is reasonably achievable" (ALARA) provisions of Regulatory Guides 8.8 and 8.10 in system design and operation to assure compliance with the occupational dose limits of 10 CFR 20.1201 and 10 CFR 20.1202, and Table 1 of Appendix B to 10 CFR Part 20 is conducted under SRP Chapter 12.

11. For COL reviews of operational programs, the review of the applicant's implementation plan is performed under SRP Section 13.4, "Operational Programs."

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

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

1. 10 CFR 20.1302 and 10 CFR 20.1301(e), as they relate to the monitoring of radioactivity in plant radiological effluents to unrestricted areas. These criteria apply to all effluent releases resulting from operation during normal plant operations and anticipated operational occurrences.

2. 10 CFR 50.34a, as it relates to equipment design and procedures used to control releases of radioactive material to the environment within the numerical guidance provided in Appendix I to 10 CFR Part 50.

3. 10 CFR 50.36a, as it relates to operating procedures and equipment installed in the radioactive waste system pursuant to 10 CFR 50.34a to ensure that releases of radioactive materials to unrestricted areas are kept ALARA.

4. Appendix I to 10 CFR Part 50, as it relates to numerical guides for design objectives to meet the requirements of 10 CFR 50.34a and 10 CFR 50.36a, which specify that radioactive effluents released to unrestricted areas will be kept ALARA.

5. 10 CFR 20.1406, as it relates to the design and operational procedures in minimizing contamination, facilitating eventual decommissioning, and minimizing the generation of radioactive waste.

6. General Design Criterion (GDC) 60 of Appendix A to 10 CFR Part 50, as it relates to controlling effluent releases from the LWMS, GWMS, and SWMS and designing these systems to handle radioactive materials produced during normal plant operation, including operational occurrences.

7. GDC 63 and 64, as they relate to designing the LWMS, GWMS, and SWMS to monitor radiation levels and radioactivity in effluents, as well as radioactive leakages and spills, during routine operation and anticipated operational occurrences.

8. Requirements specified in 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) for monitoring gaseous effluents from all potential accident release points, consistent with the requirements of GDC 63 and 64.[1]

9. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations;

10. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

1. Provisions should be made for the installation of instrumentation and monitoring equipment and/or sampling and analyses of all normal and potential effluent pathways for release of radioactive materials to the environment, including nonradioactive systems that could become radioactive through interfaces with radioactive systems. For GDC 64 and the requirements specified in 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii), the system designs should meet the provisions of Regulatory Guide 1.21 (Position C and Appendix A), Regulatory Guide 1.97 (Position C and Table 1 or 2, as applicable), Regulatory Guide 4.15 (Position C), and Appendix A to Regulatory Guide 1.33. SRP Branch Technical Position (BTP) 7-10 (see SRP Section 7.5) provides additional guidance on the application of Regulatory Guide 1.97.

    A. The gaseous and liquid process streams or effluent release points should be monitored and sampled according to Tables 1 and 2 of this SRP.

    B. For both boiling water-reactors (BWRs) and pressurized-water reactors (PWRs), liquid waste and gaseous waste (contained in tanks) should be sampled on a batch basis before their release, in accordance with Regulatory Guide 1.21. Open structures, such as PWR turbine buildings or atmospheric vents for liquid waste tanks containing treated or processed liquid waste and located outside of buildings, do not require continuous gaseous effluent monitors. For liquid and gaseous effluents that cannot be easily monitored or sampled on a batch basis, one of the following representative sampling methods should be provided:

[1] For Part 50 applicants not listed in 10 CFR 50.34(f), the applicable provisions of 50.34(f) will be made a requirement during the licensing process.

i. Use of a continuous proportioning sampling system, with at least two sample collection tanks. The system should be designed to collect a sample at a fixed ratio established between the sample collection flow rate and the effluent stream discharge flow rate.

ii. Use of a periodic automatic grab sampling system, with at least two sample collection tanks. The system should be designed to collect a sample at a fixed volume established at a rate that is proportional to the effluent stream discharge flow rate.

iii. For radioactive materials, other than noble gases in gaseous effluents, a continuous sampling system should be used with replaceable particulate filters and radioiodine adsorbers. The system should be designed to automatically take representative samples at a known flow rate established in accordance with American National Standards Institute/Health Physics Society (ANSI/HPS) N13.1-1999.

iv. For intermittently operating effluent release points, the system should be designed to automatically take samples whenever flow is in the effluent stream using a known ratio between the discharge and sampling stream flow rates.

v. Periodic sampling and analysis frequencies and types of radiological analyses should be specified for all samples described above in the SREC, ODCM, and/or PCP.

2. Provisions should be made for the installation of instrumentation and monitoring equipment and/or periodic or continuous sampling and analysis of radioactive waste process systems. For GDC 60 and 63, as they relate to radioactive waste systems, detection of excessive radiation levels, and initiation of appropriate safety actions, the design of systems should meet the guidelines of Appendix 11.5-A, Regulatory Guide 1.21 (Position C, as applicable), Regulatory Guide 1.97 (Position C and Table 1 or 2, as applicable), Regulatory Guide 4.15 (Position C), and Appendix A to Regulatory Guide 1.33. SRP BTP 7-10 (see SRP Section 7.5) provides additional guidance on the application of Regulatory Guide 1.97.

   A. Provisions should be made to ensure representative sampling from radioactive process streams and tank contents. Recirculation pumps for liquid waste tanks (collection or sample test tanks) should be capable of recirculating at a rate of not less than two tank volumes in 8 hours. For gaseous and liquid process stream samples, provisions should be made for purging sampling lines and for reducing the plate-out of radioactive materials in sample lines. Provisions for gaseous sampling from ducts and stacks should be consistent with ANSI/HPS N13.1-1999.

   B. When practicable, provisions should be made to collect samples from process waste streams at central sample stations to reduce leakage, spillage, and radiation exposures to operating personnel in accordance with SRP Section 9.3.2 and 10 CFR 20.1406.

   C. Provisions should be made to purge and drain sample streams back to the system of origin or to an appropriate waste treatment system.

3. Provisions should be made for administrative and procedural controls for the installation of necessary auxiliary or ancillary equipment, for the inclusion of special features in instrumentation and radiological monitoring sampling systems, and for the analysis of process and effluent streams. For GDC 63 and 64 (including the requirements specified

in 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii)), as they relate to radioactive waste process systems and effluent discharge paths, the design of systems and the implementation of administrative and procedural controls should meet the guidelines of Appendix 11.5-A, Regulatory Guide 1.21 (Position C), Regulatory Guide 4.15 (Position C), and Appendix A to Regulatory Guide 1.33.

Instrumentation, sampling, and monitoring provisions should conform to the following:

A. Sampling frequencies, required analyses, instrument alarm/trip setpoints, calibration and sensitivities, and provisions for preparing composite samples for low-level radioactivity analyses should conform to Regulatory Guides 1.21, 1.33, and 4.15. The plant's SREC, ODCM, and/or PCP should indicate sampling frequencies and required analyses.

B. Provisions should be made for the necessary instrumentation and facilities to perform gross beta-gamma and gross alpha measurements, isotopic or radionuclide-specific analyses, and other routine analyses in conformance with Regulatory Guides 1.21, 1.33, and 4.15.

C. Provisions should be made to perform routine instrument calibration, maintenance, and inspections in conformance with Regulatory Guides 4.15 and 1.33. Instrumentation calibration procedures should consider whether instrumentation response is expected to change given that radionuclide distributions may vary with the operating status of the plant (i.e., normal operation, anticipated operational occurrences, and post-accident conditions). The plant's SREC, ODCM, and/or PCP should indicate the frequency of such actions. Provisions should also be made to replace or decontaminate instrumentation or sampling equipment without opening the process system or losing the capability of isolating the effluent stream.

D. Isolation valves, dampers, or diversion valves with automatic control features should fail in the closed or safe position. The plant's SREC, ODCM, and/or PCP should establish setpoints for actuation of automatic control features initiating actuation of isolation valves, dampers, or diversion valves. The bases for establishing instrumentation alarm or system activation setpoints should be provided, taking into consideration the following:

    i. For liquid effluents, in-plant effluent dilution factors and dilution factors beyond the point of discharge to the site boundary and nearest offsite dose receptors

    ii. For gaseous and particulate effluents from plant stacks and building vents, atmospheric dispersion (χ/Q) and deposition (D/Q) factors to the site boundary and offsite dose receptors

E. Non-ESF instrumentation provisions for automatic termination or diversion of releases should conform to the design guidance contained in Appendix 11.5-A. SRP Sections 7.6 and 13.3 address the review the ESF instrumentation provisions for automatic termination or diversion of releases.

F. The process used to develop, review, verify, validate, and audit digital computer software used in radiation monitoring and sampling equipment, including software used to terminate or divert process and effluent streams. This aspect addresses software developed by the applicant, purchased through a vendor, or included with the instrumentation.

4. Provisions should be made for monitoring instrumentation, sampling, and sample analyses for all identified gaseous effluent release paths in the event of a postulated accident. For GDC 64, as it relates to potential gaseous effluent release paths, the design of systems should meet the provisions of NUREG-0718 and NUREG-0737 (item II.F.1 and Attachments 1 and 2), 10 CFR 50.34(f)(2)(vxii) and 10 CFR 50.34(f)(2)(vxxii), Appendix 11.5-A, and Regulatory Guide 1.97 (Position C). SRP BTP 7-10 (see SRP Section 7.5) provides additional guidance on the application of Regulatory Guide 1.97. In addition, the design of the gaseous waste collection and processing system should meet the guidelines referenced in SRP Sections 9.3.2, 11.3, and 13.3, as well as the following conditions:

   A. Administrative controls and procedures in conformance with Acceptance Criterion 3 of this SRP section are to be in effect to minimize inadvertent or accidental releases of radioactive gaseous and particulate effluents.

   B. Gaseous and particulate radiological effluent monitors are to be provided for the automatic termination of releases in the event that effluent release setpoints are exceeded, as provided in Acceptance Criterion 1 of this SRP section and as established in the plant's SREC, ODCM, and/or PCP.

5. Provisions should be made for monitoring instrumentation, sampling, and sample analysis for all identified liquid effluent release paths in the event of a postulated accident. These provisions should be in accordance with GDC 64 and the requirements of 10 CFR 50.34(f)(2)(vxii) and 10 CFR 50.34(f)(2)(vxxii), as they relate to postulated accidents and identified liquid effluent release paths. In addition, the design of the liquid waste collection and processing system should meet the guidelines referenced in SRP Sections 9.3.2, 11.2, and 13.3, as well as the following conditions:

   A. Administrative controls and procedures in conformance with Acceptance Criterion 3 of this SRP section are to be in effect to minimize inadvertent or accidental releases of radioactive liquids.

   B. Liquid effluent radiological monitors are to be provided for the automatic termination of releases in the event that effluent release setpoints are exceeded, as provided in Acceptance Criterion 1 of this SRP section and as established in the plant's SREC, ODCM, and/or PCP.

6. Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestone for the RETS/SREC, ODCM and REMP aspects of the Process and Effluent Monitoring and Sampling Program are reviewed in accordance with 10 CFR 20.1301 and 20.13.2, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR Part 50, Appendix I, Section II and IV. Its implementation is required by a license condition.

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. 10 CFR 20.1302 specifies, in part, that licensees conduct surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the radioactive dose limits contained in 10 CFR 20.1301 applicable to members of the public.

   10 CFR 20.1302 relates to the manner in which compliance with dose limits to individual members of the public will be achieved. This section specifies that surveys of radiation levels are conducted to demonstrate compliance with the dose limits specified in

10 CFR 20.1301. These surveys use the equipment that constitutes the process and effluent radiological monitoring instrumentation and sampling systems. Regulatory Guides 1.21, 1.33, and 4.15, as well as industry standards (i.e., ANSI N42.18-2004 and ANSI/HPS N13.1-1999) provide additional guidance on measuring, evaluating, and reporting the results of surveys.

Meeting the above requirements provides reasonable assurance that the dose limits to individual members of the public specified in 10 CFR 20.1301 and 10 CFR 20.1301(e) will not be exceeded. The review conducted in this SRP section, with supporting information drawn from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrate compliance with these requirements.

2. 10 CFR 50.34a specifies that an application to construct or operate a nuclear power plant describe the design of equipment installed to maintain control of radioactive materials in plant effluents produced during normal operation, including anticipated operational occurrences.

   10 CFR 50.34a relates to SRP Section 11.5 because processes to monitor and survey radioactive materials in liquid and gaseous effluent streams released to the environment provide crucial information for establishing controls over these effluents. As described in this SRP section, 10 CFR 50.34a specifies the equipment used to monitor and survey effluents. Regulatory Guide 1.143 provides additional guidance on radioactive waste management SSCs.

   Meeting the requirements of 10 CFR 50.34a provides reasonable assurance that the level of radiation in effluents from nuclear power plants will meet the ALARA criterion and dose objectives of Appendix I to 10 CFR Part 50. The review conducted in this SRP section, with supporting information from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrated compliance with these requirements.

3. 10 CFR 50.36a specifies, in part, that licenses for nuclear power reactors will include TS requiring that operating procedures be developed for the equipment specified in this regulation.

   In accordance with 10 CFR 50.36a, licensees must include TS (as TS and SREC) as part of the operating procedures related to radiological monitoring and sampling equipment and as part of the requirements for administrative controls and surveillance. The ODCM or PCP consolidate the plant's TS and related radiological effluent controls, as stated in Generic Letter 89-01 and NUREG-1301 for PWRs and NUREG-1302 for BWRs.

   Meeting the requirements of 10 CFR 50.36a provides reasonable assurance that the levels of radioactivity in effluents from nuclear power plants will meet the ALARA criterion and result in doses to members of the public that are a small fraction of the 10 CFR 20.1301 limits. The review conducted in this SRP section, with supporting information from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrate compliance with these requirements.

4. Appendix I to 10 CFR Part 50 provides numerical guides for the ALARA criterion for radioactive materials released by light-water-cooled nuclear power reactors.

   10 CFR 50.34a and 10 CFR 50.36a contain provisions designed to ensure that releases of radioactive materials, as liquid and gaseous effluents, from nuclear power reactors to unrestricted areas during normal operation, including anticipated operational occurrences, are ALARA. Appendix I provides specific numerical criteria and guidance for meeting this requirement.

Meeting the requirements of the ALARA criterion provides reasonable assurance that offsite doses to any individual from normal operation and from anticipated operational occurrences will not result in exposures in excess of the numerical guides specified in Section II of Appendix I to 10 CFR Part 50. The review conducted in this SRP section, with supporting information drawn from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrate compliance with these requirements.

5. Compliance with GDC 60 requires that the nuclear power plant design include mechanisms to control the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences.

   GDC 60 applies to SRP Section 11.5 because mechanisms to control the release of radioactive effluents must include, among other components, equipment and related operating procedures to provide monitoring, sampling, and surveillance of effluent streams that may contain radioactive materials. Regulatory Guide 1.143 includes guidance on the design of radioactive waste management SSCs.

   Meeting the requirements of GDC 60 provides reasonable assurance that releases of radioactive materials during normal operation and anticipated operational occurrences will not result in offsite radiation doses that exceed the limits and design objectives specified in the regulations. The review conducted in this SRP section, with supporting information drawn from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrate compliance with these requirements.

6. Compliance with GDC 63 and 64 requires installation of systems to (1) monitor radioactive waste facilities for excessive radiation levels and (2) survey radioactive effluent discharge paths and the plant environs for radioactivity released during normal operation, anticipated operational occurrences, and postulated accidents.

   GDC 63 and 64 relate directly to SRP Section 11.5 because they focus on monitoring radiation levels within the plant, as well as radioactivity levels in effluent streams and the plant environs, during normal operation, anticipated operational occurrences, and postulated accidents. The requirements specified in 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) are consistent with the requirements of GDC 64. Regulatory Guides 1.21, 1.33, and 4.15 provide guidance on radiological monitoring programs for normal operation and anticipated operational occurrences, while ANSI N42.18-2004 and ANSI/HPS N13.1-1999 provide guidance on the selection and use of continuous radiation monitoring equipment and methods in sampling airborne radioactive materials in nuclear facilities. The regulatory guides cited above also provide guidance on the requirements of quality assurance programs.

   In addition to Regulatory Guide 4.15, the review addresses the process used to develop, review, verify, validate, and audit digital computer software used in radiation monitoring and sampling equipment, including software used to terminate or divert process and effluent streams. This aspect addresses software developed by the applicant, purchased through a vendor, or included with the instrumentation.

   Meeting the requirements of GDC 63 and 64 provides reasonable assurance that the levels of radioactivity in effluents from nuclear power plants will not exceed specified limits and design objectives. The review conducted in this SRP section, with supporting information drawn from SRP Sections 11.2, 11.3, and 11.4, evaluates the method used to demonstrate compliance with these requirements.

7. The requirements specified in 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii) include provisions for monitoring gaseous effluents from all potential accident release points.

In examining the applicant's system for sampling process streams and effluents under accident conditions, the reviewer considers Regulatory Guides 1.97 and 1.101; NUREG-0737, items II.B.2 and II.B.3 (Clarification Items 1, 3, 6, and 11), item II.F.1, Attachment 1, and the August 16, 1982, letter from D.G. Eisenhut; SRP Section 9.3.2; and the applicant's emergency plan and implementation procedures. SRP BTP 7-10 (see SRP Section 7.5) provides additional guidance on the application of Regulatory Guide 1.97. Provisions for the following should be included:

A. Purging sample lines

B. Minimizing sample loss or distortion in sample chemical and physical composition

C. Preventing blockage of sample lines

D. Appropriate disposal of samples

E. Flow restrictions or remotely operated isolation valves to limit reactor coolant loss from rupture of sample lines

The following conditions also apply:

F. Samples be representative of reactor primary coolant, reactor steam, secondary coolant, and secondary steam in the core area or system sample streams.

G. Sample lines should be as short as possible to minimize the volume of fluid taken from containment process or effluent streams.

H. If inline monitoring is used, the licensee must provide backup provisions for grab sampling.

If the provisions do not address post-accident sampling, refer instead to the "Notice of Availability for Referencing in License Amendment Applications Model Safety Evaluation on Technical Specification Improvement to Eliminate Requirements on Post Accident Sampling Systems Using the Consolidated Line Item Improvement Process." Under this notice, the applicant must do the following:

A. Maintain contingency plans for obtaining and analyzing highly radioactive samples of reactor coolant, containment sump, and containment atmosphere.

B. Maintain a capability for classifying fuel damage events at the Alert Level threshold (typically at the 300 microcuries per milliliter (uCi/mL) iodine dose equivalent).

C. Maintain the capability to monitor radioiodines that have been released to offsite environs.

8. 10 CFR 20.1301(e) requires that facilities licensed by the U.S. Nuclear Regulatory Commission comply with the U.S. Environmental Protection Agency's (EPA) generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are part of the fuel cycle. The EPA annual dose limits are 0.25 millisievert (mSv) (25 millirem (mrem)) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ.

Meeting the requirements of 10 CFR 20.1301(e) requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents, external radiation exposures from buildings, storage tanks, radioactive waste

storage areas, and N-16 skyshine from BWR turbine buildings. The EPA standards apply to the entire site or facility, which may have either single or multiple units. SRP Sections 11.2, 11.3, and 11.4 address sources of radioactivity and doses associated with liquid and gaseous effluents and solid wastes. SRP Section 12.3-12.4 addresses sources of radiation and external radiation exposures from buildings, storage tanks, radioactive waste storage areas, and N-16 skyshine from BWR turbine buildings.

III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case.

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

The information describing the design features of the PERMISS provided in the SAR, the DC application, the update of the final safety analysis report, or the COL application to the extent not addressed in a referenced certified design, including referenced sections of SRP Sections 11.1, 11.2, 11.3, 11.4, and 12.3-12.4, is reviewed for completeness in accordance with Regulatory Guide 1.70 or 1.206.

1. In the review of the PERMISS, the reviewer compares the listing of process and effluent monitors contained in the SAR with the principal release points identified in SRP Sections 11.2 to 11.4 to ensure that all major process streams and release pathways are being monitored during normal operation, anticipated operational occurrences, and postulated accidents. The comparison will include radiation monitoring systems that are used for plant safety and protection, monitoring plant operation (including the operation of the LWMS, GWMS, and SWMS), monitoring and controlling liquid and gaseous effluent releases to unrestricted areas, and instrumentation used for monitoring intersystem leakage among plant subsystems. In addition, the review addresses the monitoring of nonradioactive systems that could become contaminated with radioactivity through interfaces with radioactive systems. At a minimum, the review includes the following:

   A. The types and numbers of instruments, number of instrumentation channels, and location of probes, detectors, sampling points, and process and effluent sampling stations. The bases for the selection of these sampling or monitoring points are compared with the general principles and criteria for obtaining valid samples of radioactive materials from liquid and gaseous process and effluent streams. The review also considers the methods and materials used in gaseous and particulate sampling equipment and the guidance for sampling from ducts and stacks contained in Regulatory Guide 4.15, ANSI N42.18-2004, and ANSI/HPS N13.1-1999.

   B. To ensure representative sampling, the review compares equipment design features, layout, piping, and description of sampling methods to the guidelines in Regulatory Guides 1.21, 1.143, and 4.15, ANSI N42.18-2004, and ANSI/HPS N13.1-1999.

   C. The review includes an independent evaluation, on an audit basis, of radioactivity levels and radionuclide concentrations in process and effluent streams using the models of NUREG-0016 or NUREG-0017 and Regulatory Guide 1.112 to verify estimates of expected levels.

D. The reviewer compares the sampling frequencies, types of analyses required, and monitoring instrument sensitivities and ranges with those recommended in Regulatory Guides 1.21 and 1.97. The reviewer also compares the applicant's monitoring instrumentation specifications and performance criteria with those contained in ANSI N42.18-2004 and in Appendix 11.5-A. SRP BTP 7-10 (see SRP Section 7.5) provides additional guidance on the application of Regulatory Guide 1.97.

E. In the review of the P&IDs for the liquid and gaseous waste treatment systems, the reviewer verifies that specifically identified radioactive release points have provisions for automatic termination of releases in the event that they exceed a predetermined alarm level. The reviewer compares the provisions for instrumentation with automatic termination of releases to the design guidance in Appendix 11.5-A.

F. The reviewer evaluates the location of the radiation monitors, collocated sampling points, shown on the P&IDs, and the readouts, annunciators, and alarms discussed in SAR Chapter 7 to ensure that plant operators will be advised of system performance and instrumentation responses to effluent releases consistent with the release limits specified in the plant's SREC, ODCM, and/or PCP.

G. The reviewer compares the proposed calibration methods (i.e., electronic and via the use of the National Institute of Standards and Technology traceable radioactive standards) and frequency of calibrations with the guidelines in Regulatory Guides 1.21, 1.33, and 4.15. The review of instrumentation calibrations considers whether instrumentation response is expected to change given that radionuclide distributions may vary with the operating status of the plant (i.e., normal operation, anticipated operational occurrences, and post-accident conditions).

H. The reviewer confirms that adequate documentation exists to confirm the verification and validation of digital computer software used in radiation monitoring and sampling equipment, including software used to terminate or divert process and effluent streams. This evaluation includes software developed by the applicant, purchased through a vendor, or included with the instrumentation.

I. The reviewer ensures that the design allows detectors to be replaced or decontaminated without opening the boundary of the process system or without losing the capability to isolate the system or divert effluents to tanks or standby treatment systems (as appropriate).

J. The reviewer evaluates, on a case-by-case basis, the use of special system design features or reliance on applicable topical reports, as well as data referenced in the SAR that are applied as technical bases beyond the NRC guidance.

2. The reviewer evaluates programs and procedures described in the applicant's proposed TS/SREC, ODCM, REMP, and PCP for the PERMISS. The reviewer determines that the applicant's TS/SREC, ODCM, REMP, and PCP meet the requirements of 10 CFR 50.34a and 10 CFR 50.36a; the Appendix I to 10 CFR Part 50 dose objectives for maximally exposed offsite individual doses (Section II); Sections III and IV of Appendix I to 10 CFR Part 50 regarding the implementation of Appendix I criteria; effluent concentration limits of Appendix B (Table 2) to 10 CFR Part 20; and dose limits of 10 CFR 20.1302 for members of the public and 10 CFR 20.1301(e) for assessing total dose from all sources of radioactivity and radiation. The format and content of the

TS/SREC, ODCM, REMP, and PCP should be consistent with the requirements of Generic Letter 89-01 and the guidance of NUREG-1301 or NUREG-1302 and NUREG-0133 for either type of plant, Radiological Assessment BTP (Revision 1, November 1979), and Regulatory Guides 1.21, 1.33, 4.1, 4.8, and 4.15. The review includes the evaluation of the following operational documents:

A. TS/SREC—Review of the TS (i.e., administrative controls section) proposed by the applicant for process and effluent control is performed for input to the review of SRP Section 16.0 and in this SRP section for the SREC. The reviewer determines that the elements and scope of the programs identified in the administrative controls section of the TS agree with the requirements identified as a result of the staff's review. The review includes the evaluation or development of appropriate limiting conditions for operation or controls and their bases, consistent with the plant design. For the SREC, the review determines whether the following elements are addressed and that they meet regulatory requirements and guidance noted above for liquid and gaseous effluents. The review addresses surveillance requirements and controls; operational conditions of radiation monitoring and sampling equipment; required number of operational channels; conduct and frequencies of channel checks, source checks, channel calibrations, and channel functional checks; compliance with action statements and remediation whenever the number of operational channels and applicability are less than the required minimum; sampling and analysis programs for continuous and batch mode releases, including provisions for the collection of grab and composite samples; and derivations of the lower limit of detections by categories of effluents or radionuclides and types of radiological analyses. The programs identified in the administrative controls section of the TS and elements of the SREC are reviewed using the provisions of Generic Letter 89-01 and NUREG-1301 or NUREG-1302.

B. ODCM—The ODCM is reviewed to determine whether descriptions of the methodology and parameters used for calculating offsite doses to members of the public, resulting from gaseous and liquid effluent releases, meet the regulatory requirements and guidance noted above. The procedural details and programmatic elements of the ODCM should be based on the guidance of NUREG-1301 or NUREG-1302 and NUREG-0133. The ODCM should describe the methods used to calculate doses in accordance with the guidance of Regulatory Guides 1.109 and 1.111 or 1.113 using appropriate computer codes (e.g., LADTAP II (NUREG/CR-4013) and GASPAR II (NUREG/CR-4653)).

The ODCM should (1) identify all liquid and gaseous effluent release points and the types and locations of installed radiological instrumentation used to monitor and control effluent releases, (2) describe parameters and provide justification of values used to derive effluent release rates and alarm setpoints, including the bases of dilution factors for liquid effluents (in-plant and beyond the point of release) and atmospheric dispersion (X/Q) and deposition (D/Q) factors for gaseous and particulate effluents, (3) provide specifications for maximum radioactivity levels in tanks containing liquids and descriptions of protective measures applied to spills and leaks from such tanks, (4) identify locations of offsite dose receptors and the basis for their selection using the results of annual land use census surveys, (5) describe criteria used to determine the operability of waste treatment systems and requirements in conducting dose projections, such as whenever treatment systems are not fully utilized, or in assessing monthly, quarterly, and yearly doses, and (6) define administrative and operational procedures associated with the implementation of the ODCM.

The review evaluates the description of programs and procedures addressing quality assurance and quality control supporting the implementation of the

ODCM, the description of information to be contained in annual radiological effluent release reports, the listing of requirements mandating reports to the NRC, and the process for initiating and documenting changes to the ODCM and its supporting procedures.

The review of the ODCM may be conducted as part of the review of SRP Section 11.4, depending on where the applicant has located the procedural details and programmatic controls of the ODCM in the PCP, given the provisions of Generic Letter 89-01 and NUREG-1301 or NUREG-1302.

C. REMP—The REMP is reviewed to determine whether the program provides the means to monitor and quantify radiation and radioactivity levels in the environs of the plant associated with gaseous and liquid effluent releases and the direct external radiation from contained sources of radioactive materials in tanks and equipment and in buildings. The REMP demonstrates compliance with the regulatory requirements and guidance noted above. The procedural details and programmatic elements of the REMP should be based on the guidance of NUREG-1301 or NUREG-1302, Radiological Assessment BTP (Revision 1, November 1979), and Regulatory Guides 1.21, 4.1, 4.8, and 4.15.

The REMP should describe a process and methods for monitoring, sampling, and analyzing environmental samples representative of expected radionuclide distributions and concentrations in environmental media and associated exposure pathways. The REMP should identify the type, number, sampling locations, sample volume or weight, and sampling and analytical frequencies of environmental samples. The types of samples should include cow or goat milk and milk products, surface and ground water, fish and invertebrates, meat and poultry and meat products, fruits and vegetables, leafy vegetables, grains, other local food products, sediments and soils, and air. The selection of sampling locations and types of samples, including control sample locations, should be based on the results of a yearly land use census to ensure that changes in exposure pathways are identified and that modifications are made to the monitoring program to reflect such changes. In assessing direct external radiation exposures, the REMP should identify sources of radiation and radioactivity, such as tanks and equipment, waste storage buildings, and BWR turbine buildings; types of measurement methods used at each location; and locations of monitoring stations around plant facilities, including those used to monitor nearest dose receptors. The REMP should define the detection limits and reporting levels for all expected radionuclides and environmental samples and external radiation monitoring methods. The review evaluates information describing participation in an interlaboratory comparison program to assess the precision and accuracy of measurements of radioactivity in environmental samples as part of the quality assurance program.

The review of the REMP evaluates (1) administrative and operational procedures associated with its implementation, (2) descriptions of programs and procedures addressing quality assurance and quality control supporting its implementation, (3) description of information to be contained in annual radiological environmental operating reports, (4) listing of requirements mandating reports to the NRC, and (5) process for initiating and documenting changes to the REMP and its supporting procedures.

The review of the REMP is conducted as part of the review of this SRP section, depending on where the applicant has located the procedural details and programmatic controls of the REMP in the ODCM and/or PCP, given the provisions of Generic Letter 89-01 and NUREG-1301 or NUREG-1302.

D. PCP—The PCP and associated plant TS are reviewed to determine whether they identify all regulatory requirements, follow NRC guidance, and contain all appropriate operational elements. The review of the PCP may be conducted as part of the review of SRP Section 11.4 or as part of the review of this SRP section, depending on where the applicant has located the procedural details and programmatic controls of the PCP, given the provisions of Generic Letter 89-01 and NUREG-1301 or NUREG-1302. SRP Section 11.4 addresses the review and evaluation of the PCP and identifies the regulatory requirements associated with the handling, processing (e.g., dewatering, solidification, and compaction), characterization, packaging, and shipment of radioactive wastes to authorized low-level waste disposal sites or licensed waste processors.

3. The PERMISS is reviewed to ensure that the design includes provisions to prevent and collect leakage and spillage associated with sample collection, processing, storage, and operation of skid-mounted monitoring and sampling equipment that conform to the guidelines of Regulatory Guide 1.143 and the requirements of 10 CFR 20.1406.

   The review considers information describing design features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of extraneous radioactive wastes associated with the operation of the PERMISS as a result of operator error and processing equipment failures or malfunctions. In addition, the review may also consider the information contained in the DC application, the update in the SAR, or the COL application to the extent not addressed in a referenced certified design. The NRC guidance includes the following:

   A. Memorandum from Larry W. Camper to David B. Matthews and Elmo E. Collins, dated October 10, 2006; and NUREG/CR-3587, as they relate to the design issues that need to be addressed to meet the requirements of 10 CFR 20.1406

   B. Liquid Radioactive Release Lessons Learned Task Force, Final Report, Sections 2.0 and 3.2.2, Office of Nuclear Reactor Regulation, September 1, 2006

   C. Regulatory Guide 1.143

   D. SRP Section 9.2.4

   E. Relevant NRC bulletins, circulars, and notices (e.g., Inspection and Enforcement (IE) Bulletin No. 80-10; IE Circular Nos. 77-14, 79-07, 79-21, and 81-09; and IE Information Notice Nos. 86-43 and 91-40)

4. To determine compliance with the EPA generally applicable environmental radiation standards of 40 CFR Part 190, as implemented under 10 CFR 20.1301(e), the review confirms that the ODCM includes the appropriate methodology to account for all sources of radiation and radioactivity as potential contributors to doses to members of the public from the site, which may have either single or multiple units. The review focuses on methods used to assess the total dose from sources of radioactivity, external radiation exposures from waste processing buildings, waste storage buildings, waste storage tanks, temporary waste storage or staging areas, and N-16 skyshine for BWR turbine buildings. The source terms and associated doses from liquid and gaseous effluents associated with the operation of the LWMS, GWMS, and SWMS are evaluated under SRP Sections 11.2 to 11.4. Doses associated with external radiation from buildings and contained sources of radioactivity are evaluated under SRP Section 12.3-12.4.

5. Operational Programs. The reviewer verifies that the RETS/SREC, ODCM and REMP aspects of the Process and Effluent Monitoring and Sampling Program are fully

described and that implementation milestones have been identified. The reviewer verifies that the program and implementation milestones are included in FSAR Table 13.x. The implementation of the RETS/SREC, ODCM and REMP aspects of the Process and Effluent Monitoring and Sampling Program is included in the license condition on operational programs and implementation.

Implementation of this program will be inspected in accordance with NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections."

6. 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 final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). 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 should be added to the DC FSAR.

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

   For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

The staff concludes that the designs of the PERMISS (as permanently installed systems or in combination with skid-mounted systems) include the equipment necessary to monitor process and effluent streams and control releases of radioactive materials associated with the operation of the LWMS, GWMS, and SWMS. The designs are found to be acceptable and meet the applicable requirements of 10 CFR 20.1301 and 20.1302, 10 CFR 20.1301(e), and 10 CFR 20.1406; 10 CFR 50.34a, 10 CFR 50.36a, 10 CFR 50.34(f)(2)(xvii), and 10 CFR 50.34(f)(2)(xxvii); 10 CFR Part 50 Appendix I dose objectives; and GDC 60, 63, and 64.

This conclusion is based on the following:

1. The PERMISS includes the instrumentation for monitoring and sampling radioactivity for contaminated liquid, gaseous, and solid waste process and effluent streams. The staff evaluated the provisions proposed to sample and monitor all appropriate process streams and effluent release points, including nonradioactive systems that could become contaminated through interfaces with radioactive systems, in accordance with GDC 64 and the requirements specified in 10 CFR 50.34(f)(2)(vxii) and 10 CFR 50.34(f)(2)(vxxii).

2. The PERMISS includes provisions for automatic termination of effluent releases and ensures control over discharges, in accordance with GDC 60. The provisions proposed for sampling and monitoring liquid, gaseous, and solid waste process streams, under the PCP, are in accordance with GDC 63. The provisions for sampling process and effluent streams and conducting analysis of samples, including the proposed analytical

programs, are in accordance with the guidelines in Regulatory Guides 1.21, 1.33, 4.1, 4.8, and 4.15 for routine plant operation and anticipated operational occurrences.

3. The provisions for sampling and monitoring process and effluent streams and conducting analysis of samples, including the proposed analytical programs, during postulated accidents are in accordance with the requirements of 10 CFR 50.34(f)(2)(vxii) and 10 CFR 50.34(f)(2)(vxxii), and the guidelines in Regulatory Guide 1.97 and Appendix 11.5-A, as supported by the reviews and evaluations conducted under SRP Sections 13.3 and 7.5. The applicant identified the specific revision of Regulatory Guide 1.97 applicable to the application, as described in SRP BTP 7-10 (see SRP Section 7.5).

4. The review evaluated P&IDs, process flow diagrams, and descriptions of proposed sampling points for the liquid, gaseous, and solid waste systems, provisions for local ventilation, and locations of monitoring and sampling points relative to effluent release points, as shown on site plot diagrams.

5. The staff reviewed the applicant's quality assurance provisions for the PERMISS, the quality group classifications used for system components, and the seismic design applied to structures housing these systems. The design of the systems and structures housing these systems meets the guidance of Regulatory Guide 1.143. The elements of the quality assurance program are consistent with the NRC guidance contained in Regulatory Guides 1.21, 1.33, 4.1, 4.8, and 4.15; Generic Letter 89-01; Radiological Assessment BTP (Revision 1, November 1979); and NUREG-1301 or NUREG-1302 and NUREG-0133.

6. The staff reviewed the provisions incorporated in the applicant's design to (1) control the release of radioactive materials in wastes caused by spills, leaks, and inadvertent tank overflows, (2) avoid the contamination of nonradioactive systems, (3) prevent uncontrolled and unmonitored releases of radioactive materials in the environment, and (4) avoid interconnections with potable and sanitary water systems. On the basis of this review, the staff concludes that the applicant's proposed measures are consistent with the guidance of Regulatory Guide 1.143 and the requirements of GDC 60 and 64.

7. The staff concludes that the TS/SREC, ODCM, PCP, and REMP describing administrative programs and operational procedures associated with their implementation are consistent with the requirements of Generic Letter 89-01 and Radiological Assessment BTP (Revision 1, November 1979), and the guidance of NUREG-1301 or NUREG-1302) and NUREG-0133, and Regulatory Guides 1.21, 1.33, 4.1, 4.8, and 4.15.

8. The staff reviewed the sources of radiation and radioactivity and associated doses to members of the public and concludes that the total annual dose from all sources of radioactivity and radiation from the site, which may have either single or multiple units, including liquid and gaseous effluents, external radiation exposures from buildings and storage tanks, and N-16 skyshine from BWR turbine buildings as a source of external radiation, will not exceed the EPA generally applicable environmental radiation standards of 40 CFR Part 190, as implemented under 10 CFR 20.1301(e).

9. The applicant met the requirements of 10 CFR 20.1406 with respect to describing how the facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste.

10. The applicant described the RETS/SREC, ODCM and REMP aspects of the Process and Effluent Monitoring and Sampling Program and its implementation which is included in the license condition on operational programs and implementation.

The applicant described the [specify applicable operational program] and its implementation in conformance with [specify applicable regulation]. [For program implementation not specified by regulation, add a statement indicating that the program and its implementation milestones are included within the license condition on operational program implementation.]

11. 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 SRP section.

    In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

VI. REFERENCES

1. 10 CFR Part 20, "Standards for Protection Against Radiation."

2. 10 CFR 20.1201, "Occupational Dose Limits for Adults."

3. 10 CFR 20.1202, "Compliance with Requirements for Summation of External and Internal Doses."

4. 10 CFR 20.1301, "Dose Limits for Individual Members of the Public."

5. 10 CFR 20.1302, "Compliance with Dose Limits for Individual Members of the Public."

6. 10 CFR 20.1406, "Minimization of Contamination."

7. 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."

8. 10 CFR 50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents—Nuclear Power Plants."

9. 10 CFR 50.34(f)(2)(xvii) and 10 CFR 50.34(f)(2)(xxvii), under "Additional TMI-Related Requirements."

10. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

11. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

12. 10 CFR Part 50, Appendix A, General Design Criterion 63, "Monitoring Fuel and Waste Storage."

13. 10 CFR Part 50, Appendix A, General Design Criterion 64, “Monitoring Radioactivity Releases.”

14. 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.”

15. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

16. 10 CFR Part 100, “Reactor Site Criteria.”

17. Generic Letter 89-01, “Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (Generic Letter 89-01),” January 31, 1989.

18. Regulatory Guide 1.21, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants.”

19. Regulatory Guide 1.33, “Quality Assurance Program Requirements (Operation).”

20. Regulatory Guide 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition).”

21. Regulatory Guide 1.97, “Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident.” [Additional guidance on the application of Regulatory Guide 1.97 is provided in Standard Review Plan Branch Technical Position 7-10.]

22. Regulatory Guide 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I.”

23. Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.”

24. Regulatory Guide 1.112, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluent from Light-Water-Cooled Power Reactors.”

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

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

27. Regulatory Guide 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition).”

28. Regulatory Guide 4.1, “Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.”

29. Regulatory Guide 4.8, “Environmental Technical Specifications for Nuclear Power Plants.”

30. Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination)—Effluent Streams and the Environment.”

31. Regulatory Guide 8.8, “Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.”

32. Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable.”

33. ANSI/HPS N13.1-1999, “Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities.”

34. ANSI N42.18-2004, “Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents,” 2004.

35. NUREG-0016, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors” (BWR-GALE Code).

36. NUREG-0017, “Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors” (PWR-GALE Code).

37. NUREG-0133, “Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.”

38. NUREG-0718, “Licensing Requirements for Pending Applications for Construction Permits and Manufacturing Licenses.”

39. NUREG-0737, “Clarification of TMI Action Plan Requirements,” 1980.

40. NUREG-1301, “Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors.” [This NUREG includes Generic Letter 89-01.]

41. NUREG-1302, “Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors.” [This NUREG includes Generic Letter 89-01.]

42. NRC Inspection Manual Chapter IMC-2504, “Construction Inspection Program - Non-ITAAC Inspections,” issued April 25, 2006.

43. Radiological Assessment Branch Technical Position, Rev. 1, November 1979.

44. IE Circular No. 77-14, “Separation of Contaminated Water Systems from Uncontaminated Plant Systems,” November 22, 1977.

45. IE Circular No. 79-21, “Prevention of Unplanned Releases of Radioactivity,” October 17, 1979.

46. IE Circular No. 81-09, “Containment Effluent Water that Bypasses Radioactivity Monitor,” July 10, 1981.

47. IE Information Notice No. 79-07, “Rupture of Radwaste Tanks,” March 23, 1979.

48. IE Information Notice No. 86-43, “Problems with Silver Zeolite Sampling of Airborne Radioiodine,” June 10, 1986.

49. IE Bulletin No. 80-10, “Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment,” May 6, 1980.

50. IE Information Notice No. 91-40, “Contamination of Nonradioactive System and Resulting Possibility for Unmonitored, Uncontrolled Release to Environment,” June 19, 1991.

50. Memorandum from Larry W. Camper to David B. Matthews and Elmo E. Collins, dated October 10, 2006, “List of Decommissioning Lessons Learned in Support of the Development of a Standard Review Plan for New Reactor Licensing” (ADAMS Accession No. ML0619201830).

51. NUREG/CR-3587, “Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors.”

52. Liquid Radioactive Release Lessons Learned Task Force, Final Report, September 1, 2006, Sections 2.0 and 3.2.2, U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation (ADAMS Accession No. ML062650312).

53. Memorandum from D.G. Eisenhut, NRR, to Regional Administrators, August 16, 1982, “Proposed Guidance for Calibration and Surveillance Requirements for Equipment Provided to Meet Item II.F.1, Attachments 1, 2, and 3, NUREG-0737,” with enclosures.

54. Notice of Availability for Referencing in License Amendment Applications Model Safety Evaluation on Technical Specification Improvement to Eliminate Requirements on Post Accident Sampling Systems Using the Consolidated Line Item Improvement Process (ADAMS Accession No. ML003750475).

55. NRC Inspection Manual Chapter IMC-2504, “Construction Inspection Program - Non-ITAAC Inspections,” issued April 25, 2006.

TABLE 1

Provisions for Monitoring and Sampling Gaseous Streams(*)

No.	Process Systems	Reactor Type	Monitor Provisions: In Process Cont[i]	Monitor Provisions: In Effluent ACF[j]	Monitor Provisions: In Effluent Cont[i]	Sample Provisions: In Process Grab[k]	Sample Provisions: In Effluent Grab[k]	Sample Provisions: In Effluent Cont[l]
1.	Waste Gas Holdup System[a]	P&B	NG	NG	(NG)		(NG,H3)	(I)
2.	Condenser Evacuation System[b]	P&B	NG	(NG)[n]	(NG)	I	(NG,H3)	(I)
3.	Vent & Stack Release Point System[c]	P&B	–	–	NG		H3	(I)
4.	Containment Purge Systems[d]	P&B	NG	NG[m]	(NG)	I	(NG,I,H3)	(I)
5.	Auxiliary Building Ventilation System	P&B	_	_	(NG)	I	(NG,H3)	(I)
6.	Fuel Storage Area Ventilation System[e]	P&B	(NG)	NG[m]	(NG)	I	(NG,H3)	(I)
7.	Radwaste Area Vent Systems	P&B	_	_	(NG)	I	(NG,H3)	(I)
8.	Turbine Gland Seal Condenser Vent System	P&B	_	_	(NG)	I	(NG,H3)	(I)
9.	Mech. Vacuum Pump Exhaust (Hogging System)	P&B	_	_	(NG)	I	(NG,H3)	(I)
10.	Evaporator Vent Systems	P&B	_	_	(NG)	I	(NG,H3)	(I)
11.	Pretreatment Liquid Radwaste Tank Vent Gas Systems	P&B	_	_	(NG)	(I)	(NG,H3)	(I)
12.	Flash Tank and Steam Generator Blowdown Vent Systems	P	_	_	(NG)	I	(NG,H3)	(I)
13.	Turbine Building Vent Systems	B	_	_	(NG)	I	(NG,H3)	(I)
14.	Pressurizer & Boron Recovery Vent Systems	P	_	_	(NG)	I	(NG,H3)	(I)
15.	Waste compactors, shredders, etc. (as permanently installed or mobile systems)	P&B	R	–	I	I	I	(I)

(*) For key to legend, see notes on page following Table 2.

TABLE 2

Provisions for Monitoring and Sampling Liquid Streams (*)

No.	Process Systems	Reactor	Monitor Provisions			Sample Provisions		
			In Process	In Effluent		In Process	In Effluent	
		Type	Cont[i]	ACF[j]	Cont[i]	Grab[k]	Grab[k]	Cont[l]
1.	Liquid Radwaste (Batch) Effluent System	P&B	(R)	R	R	S&A	S&A,H3	_
2.	Liquid Radwaste (Continuous) Effluent System	P&B	R	R	R	_	S&A,H3	S&A
3.	Service Water System and/or Circulating Water System	P&B	_	_	(R)	_	S&A,H3	S&A
4.	Component Cooling Water System[f]	P&B	(R)	(R[m])	(R)	S&A	S&A,H3	(S&A)
5.	Spent Fuel Pool Treatment System[g]	P&B	(R)	(R)	(R)	S&A	(S&A,H3)	(S&A)
6.	Equipment & Floor Drain Collection and Treatment Systems[h]	P&B	_	(R)	(R)	_	(S&A,H3)	(S&A)
7.	Phase Separator Decant & Holding Basin Systems	P&B	_	(R)	(R)	_	(S&A,H3)	(S&A)
8.	Chemical & Regeneration Solution Waste Systems	P&B	_	(R)	(R)	_	(S&A,H3)	(S&A)
9.	Laboratory & Sample System Waste Systems	P&B	_	(R)	(R)	S&A	(S&A,H3)	(S&A)
10.	Laundry & Decontamination Waste Systems	P&B	_	(R)	(R)	_	(S&A,H3)	(S&A)
11.	Resin Slurry, Solidification, & Baling Drain Systems	P&B	(R)	-	(R)	_	(S&A,H3)	(S&A)
12.	Radwaste Liquid Tanks (outside the buildings)	P&B	_	_	(R)	S&A	(S&A,H3)	_
13.	Storm & Underdrain Water System	P&B	_	_	_	_	(S&A,H3)	(S&A)
14.	Tanks and Sumps Inside Reactor Building	P&B	_	(R)	(R)	_	(S&A,H3)	(S&A)
15.	Boron Recovery System Liquid Effluent	P	_	(R)	(R)	_	(S&A,H3)	(S&A)
16.	Steam Generator Blowdown (Batch) Liquid Effluent System	P	(R)	R	R	S&A	(S&A,H3)	(S&A)
17.	Steam Generator Blowdown (Continuous) Liquid Effluent System	P	(R)	R	R	_	(S&A,H3)	(S&A)
18.	Secondary Coolant Treatment Waste & Turbine Building Drain Systems	P	_	(R)	(R)	_	(S&A,H3)	(S&A)
19.	Ultrasonic Resin Cleanup Waste Systems	B	_	(R)	(R)	_	(S&A,H3)	(S&A)
20.	Noncontaminated Wastewater & PWR Turbine Building Clean Drain System	P&B	_	_	_	_	(S&A,H3)	(S&A)
21.	Reverse Osmosis Systems	P&B	R	R	R	S&A	(S&A,H3)	(S&A)
22.	Mobile Liquid and Wet Waste Processing Systems	P&B	R	R	R	S&A	(S&A,H3)	(S&A)

(*) For key to legend, see notes on next page.

Notes for Table 1 and Table 2

a - For example, offgas storage tank systems, cover gas decay systems, chilled charcoal adsorption systems, offgas cryogenic units, and delay pipes and tanks.

b - For example, main condenser steam jet air ejector systems and mechanical vacuum pump systems.

c - For example, free standing stacks, roof vents, building vents, system exhausters, process vents, ventilation vents, and portable local exhaust ventilation systems.

d - For example, containment relief systems, containment normal purge, containment low-volume purge, containment leak testing systems, drywell purge, cleanup purges.

e - Includes spent fuel pool and refueling pool ventilation systems, if separate from the fuel storage area ventilation system.

f - Also called closed cooling water systems and component cooling loop systems.

g - Includes refueling pool cleanup systems.

h - Includes suppression tanks, reactor drain tanks, equipment and drain sumps collecting leakage, drainage, sampling, and condensate.

i - Continuous radiation monitor.

j - Automatic control feature. For example, the continuous liquid effluent radiation monitor (see note m, below) should be equipped to alarm at a setpoint established in the TS, SREC, or ODCM and should automatically terminate effluents in the discharge line by closing an isolation valve (see SRP Acceptance Criteria 3.D and 3.D).

k - Sample point should be available to obtain grab samples for laboratory analyses as indicated by notations.

l - Continuous sampler (see SRP Acceptance Criterion 1.B).

m - The automatic control feature may be alternatively provided by a process continuous radiation monitor located at a point upstream of the systems' effluent continuous radiation monitor.

n - For BWRs only.

P - Typical system names applicable to PWRs.

B - Typical system names applicable to BWRs.

NG - Noble gas radioactivity.

I - Iodine radioactivity, radioactivity of other radionuclides in particulate form, and alpha emitters.

H3 - Tritium.

R - Gross radioactivity (beta radiation, gamma radiation, or total beta plus gamma).

S&A - Sampling and analysis of radionuclides, to include gross radioactivity, identification and concentration of principal or significant radionuclides, and concentration of alpha emitters, as defined in the SREC and ODCM using NRC guidance.

( ) - Monitoring or sampling provisions indicated within parentheses are required only for systems not monitored, sampled, or analyzed (as indicated) prior to release.

APPENDIX 11.5-A

DESIGN GUIDANCE FOR RADIOLOGICAL EFFLUENT MONITORS PROVIDING SIGNALS FOR INITIATING TERMINATION OF FLOW OR OTHER MODIFICATION OF EFFLUENT STREAM PROPERTIES

1. Background

The primary design function of a radiological effluent monitor is the detection and measurement of radioactive materials released in gaseous or liquid effluent streams of light-water-cooled nuclear power reactors. An additional design function of some monitors is to provide a signal to automatically terminate or otherwise modify the effluent stream. Examples of this function are the termination of exhaust airflow by closure of containment ventilation or purge isolation valves and diversion of building ventilation exhaust streams from an untreated discharge path to an alternative treatment system, such as a standby gas treatment system for a boiling-water reactor (BWR) plant.

Depending on plant design and onsite meteorology, such an action may be necessary to mitigate the consequences of a design-basis accident (DBA). The need for such mitigation is determined by calculating the offsite doses that would result from the DBA. In other plant designs, radiological effluent monitors are used to actuate systems to modify or terminate releases for other purposes (e.g., to terminate releases from anticipated operational occurrences to ensure that offsite doses are maintained within the limits specified in the plant technical specifications (TS) and standard radiological effluent controls (SREC)).

The design and quality assurance criteria applied to the design, procurement, installation, testing, and operation of radiological effluent monitors installed in light-water-cooled nuclear power reactors should provide assurance that the monitors will perform all of their design functions.

If the DBA analysis indicates that the actuation of an engineered safety feature (ESF) system is required to mitigate the consequences of a DBA and a signal from a radiological effluent monitor is necessary to actuate the ESF system, then the monitor should be designed and qualified to the design and quality assurance criteria applicable to the ESF system. Conversely, if an automatically functioning device or system is used to reduce radioactive releases to ensure that offsite doses are maintained within the limits of the plant's TS and SREC (i.e., not for the purpose of mitigating the consequences of a DBA), then a monitor providing the actuation signal should be designed and qualified to criteria consistent with those of the actuated system.

This appendix neither establishes, nor changes in any manner, the design and quality assurance criteria established elsewhere for ESF or ESF-related systems or monitors.

The design guidance set forth in this appendix provides reasonable assurance that monitors used to provide initiation signals for actuation of systems to control the release of radioactive materials in effluents, but not required to mitigate the consequences of a DBA, are designed, constructed, installed, tested, and maintained on a level commensurate with their intended function.

This appendix sets forth minimum requirements and is not intended to prohibit the implementation of equivalent design codes, standards, or quality assurance measures other than those indicated herein.

2. Definitions

Radiological Effluent Monitor: A device that removes a representative sample from the effluent stream, detects and quantitatively measures the radioactive materials present in the sample, discharges the sampled medium back to the effluent stream, and transmits the measurement data to a central point.

Monitoring System. A system consisting of one or more remote monitors; a centrally located cabinet or console where data from the monitors is received, recorded, and displayed; and the necessary interconnecting cables, power supplies, pumps, motors, alarms, recorders, display panels, relays, and other auxiliary components.

3. Design Guidance

Design and quality assurance criteria for radiological effluent monitors should be consistent with the design and quality assurance criteria applicable to the systems actuated by a signal from the monitors.

Monitors providing signals for the actuation of ESF systems should be designed and qualified to the design and quality assurance criteria applicable to ESF systems. Criteria for ESF-related monitors are found in the appropriate sections of the Standard Review Plan under Chapter 7. This position does not affect or modify existing criteria for ESF-related systems.

Monitors providing signals for the actuation of non-ESF systems should be designed and qualified to the design and quality assurance criteria applicable to the actuated system or to the criteria shown in Table 1 of this appendix.

4. Implementation

This section provides information to applicants and licensees regarding the staff's plans for using this appendix.

Except in those cases in which the applicant proposes an alternate method for complying with specified portions of the Commission's regulations, the criteria described herein will be used to evaluate applications for construction permits, operating licenses, standard DCs, and COLs.

These criteria do not apply to operating plants.

TABLE 1

Design Guidance for Radiological Effluent Monitors
(Instrumentation Installed in Light-Water-Cooled Nuclear Power Plants)

Category	Design Criteria	Quality Assurance Criteria
Effluent radiological monitoring instrumentation providing a signal for the actuation of a system used to reduce releases of radioactive materials in effluents within limits specified in plant's SREC. (Not required to initiate actuation for an ESF system.)	Review: Reviewed under SRP Section 11.5	Review: Reviewed under SRP Sections 11.5 and 17.
	Reviewed by: 1, 2, 3, and 4.	Reviewed by: 2, 3, 4, and 5.
	Criteria: Manufacturer's standard per ANSI N42.18-2004.	Criteria: Quality assurance set forth in Regulatory Guide 1.143, Section IV.

Notes:

1. Organization responsible for the review and assessment of the performance of the process and effluent radiological instrumentation and sampling systems and associated standard Radiological Effluent Controls, including the Offsite Dose Calculation Manual and/or the Process Control Program.

2. Organization responsible for the review of system specifications and plant systems interface elements of the process and effluent radiological instrumentation and sampling systems, including system functional performance.

3. Organization responsible for the review of the instrumentation and controls elements of the process and effluent radiological instrumentation and sampling systems, including system functional performance.

4. Organization responsible for the review of emergency planning.

5. Organization responsible for the review of quality assurance.