U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

6.5.5 PRESSURE SUPPRESSION POOL AS A FISSION PRODUCT CLEANUP SYSTEM

REVIEW RESPONSIBILITIES

Primary - Materials and Chemical Engineering Branch (EMCB)[1]

Secondary - Plant Systems Branch (SPLB)[2]
Emergency Preparedness and Radiation Protection Branch (PERB)[3]

I. AREAS OF REVIEW

The pressure suppression pool is reviewed under this plan only when the applicant claims credit for fission product scrubbing and retention by the suppression pool. The pressure suppression pool and the drywell, when considered as a barrier to the release of fission products, are reviewed to assess the degree to which fission products released during postulated reactor accidents will be retained in the suppression pool. Leakage paths that allow fission products to bypass the pool are identified and reviewed, and the maximum fractional bypass leakage is obtained, for use in the evaluation of radiological dose consequences.

1. Fission Product Control Requirements

Sections of the applicant's safety analysis report (SAR) related to accident analyses, accident dose calculations, and fission product control are reviewed to establish whether or not fission product scrubbing of the drywell or reactor compartment atmosphere is claimed or required for mitigation of radiological consequences following a postulated accident.

2. Design Bases

The design bases for the fission product removal function of the suppression pool and the drywell or reactor compartment are reviewed to verify that they are consistent with the assumptions made in the accident evaluations of SAR Chapter 15. The methodology used in this SRP section is not intended for containment venting evaluation. Containment venting will be considered in the evaluation of pressure suppression pools as fission product cleanup systems when the Commission approves the final guidance on containment venting.

3. System Design

The information on the design of the suppression pool is reviewed to familiarize the reviewer with the expected temperature histories, depth of fission product entry expected during postulated accidents, and potential leakage paths through drywell penetrations.

4. Testing and Technical Specifications

The details of the applicant's proposed preoperational tests and, at the operating license stage, the surveillance requirements are reviewed to ensure that the pool depth and amount of leakage bypassing the pool are maintained consistent with the assumptions used in assessing the pool's effectiveness in fission product cleanup.

Review Interfaces:[4]

EMCB also reviews the drywell or containment spray systems for which fission product cleanup credit is claimed as part of its primary review responsibility for SRP Section 6.5.2.

In addition, the EMCB will coordinate other branches' evaluations that interface with the overall review of the system as follows:

1. The Containment Systems and Severe Accident Branch (SCSB) reviews containment leakage assumptions as part of its primary review responsibility for SRP Section 6.2.1.1.C.

2. The SPLB reviews the engineered safety feature atmosphere cleanup systems as part of its primary review responsibility for SRP Section 6.5.1.

II. ACCEPTANCE CRITERIA

The acceptance criteria for the fission product cleanup function of the suppression pool are based on the relevant requirements of the following regulations:

A. General Design Criterion 41 ~~(Ref. 1)~~[5] as it relates to the control of fission products following postulated accidents.

B. General Design Criterion 42 ~~(Ref. 2)~~[6] as it relates to the periodic inspections of engineered safety features.

C. General Design Criterion 43 ~~(Ref. 3)~~[7] as it relates to the periodic functional testing of engineered safety features.

Where it can be shown to be in compliance with these criteria, the suppression pool may be given appropriate credit for fission product scrubbing and retention (except for noble gases, for which no pool retention is allowed) in the staff's evaluation of the radiological consequences of design-basis accidents. Other assumptions concerning the release of radioactivity are to be taken from Regulatory Guide 1.3 ~~(Ref. 4)~~[8], except for Position C.1.f which this SRP section replaces.

Specific criteria that must be met to receive credit include:

1. The drywell and its penetrations must be designed to ensure that, even with a single active failure, all releases from the reactor core must pass into the suppression pool, except for small bypass leakage.

2. The bypass leakage assumed for purposes of evaluating fission product retention must be no less than that accepted in the review under SRP Section 6.2.1.1.C, and must be demonstrated in periodic tests by the license technical specifications also reviewed under that section.

3. For plants that have already received a construction permit, the iodine retention calculated using this section must not be used to justify removal of the standby gas treatment or other filtered exhaust system from status as engineered safety features, and any change in plant design, proposed testing, surveillance or maintenance must be supported by considerations of lowered operator dose and other projected benefits. For such plants, the charcoal filters must be at least maintained to the minimum level of Table 2 in Regulatory Guide 1.52 ~~(Ref. 5)~~[9], Revision 2.

Acceptable methods for computing fission product retention by the suppression pool are given in subsection III, "REVIEW PROCEDURES."

While granting credit for suppression pool scrubbing in the calculations of accident doses, the acceptance criteria of containment leakage in SRP Section 6.2.1.1.C and the acceptance criteria of the engineered safety feature atmosphere cleanup systems in SRP Section 6.5.1 should still be met.

Technical Rationale:[10]

The technical rationale for application of the above acceptance criteria to the suppression pool as a fission product cleanup system is discussed in the following paragraphs:

1. GDC 41 requires, in part, that systems be provided as necessary to control fission products which may be released into the reactor containment to reduce the concentration and quality of fission products released to the environment following postulated accidents. The radiological consequences of accidents in Chapter 15 of the safety

analysis report (SAR) are dependent on the quantity and quality of fission products released from containment. If Chapter 15 analysis takes credit for the suppression pool, then this system is relied upon to provide an effective means for removal of fission products released within the drywell during a design basis accident. Fission products are entrained in the suppression pool and are unavailable for leakage from containment. Compliance with GDC 41 ensures that the suppression pool will adequately meet its post accident safety function of fission product cleanup.

2. GDC 42 requires that the system be designed to permit appropriate periodic inspection of important components. If taken credit for in Chapter 15 Accident Analysis, the suppression pool is relied upon to entrain fission products following design basis accidents. Inspection of important components of the suppression pool will validate the safety analysis assumptions regarding the system's effectiveness in fission product cleanup and assure the integrity and capability of the system to remove fission products following a design basis accident.

3. GDC 43 requires that the system be designed to permit appropriate periodic testing of important components. The capability of the suppression pool to clean up fission products is dependent upon the functionality of system components. Examples of functional testing performed on the suppression pool system components include: drywell leak testing, vacuum breaker operability tests, vacuum breaker position indicator and alarm testing, and water level instrument testing. The periodic functional testing of the suppression pool system components validates the safety analysis assumptions regarding the system's effectiveness in fission product cleanup and provides assurance of operability and the capability to remove fission products following a design basis accident.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes specific aspects of this SRP section as are appropriate for a particular plant. The judgment on which areas need to be given attention and emphasis in the review is based on a determination of whether the material presented is similar to that recently reviewed on other plants and whether items of special safety significance are involved.

The first step in the review is to determine whether or not the suppression pool is to be used for mitigating radiological consequences. If no credit is claimed for fission product removal in the accident analyses, no further review is required under this SRP section.

If the suppression pool is intended as an engineered safety feature for mitigation of radiological doses, then the reviewer estimates its effectiveness in removing fission products from fluids expelled from the drywell or directly from the pressure vessel through the depressurization system.

If the values in Regulatory Guide 1.3, Position C.1.a, are utilized in the calculations of fission product removal, then deposition by plateout should not be considered as an additional removal mechanism. Deposition by plateout is already accounted for in the Regulatory Guide values.[11]

1. Pool Decontamination Factor

The decontamination factor (DF) of the pool is defined as the ratio of the amount of a contaminant entering the pool to the amount leaving. Decontamination factors for each fission product form as functions of time can be calculated by the SPARC code (Reference 6)[12]. An applicant may use the SPARC code or other methods to calculate the retention of fission products within the pool, provided that these methods are described in the SAR adequately to permit review. If the time-integrated DF values claimed by the applicant for removal of particulates and elemental iodine are 10 or less for a Mark II or a Mark III containment, or are 5 or less for a Mark I containment, the applicant's values may be accepted without any need to perform calculations (References 7 and 8)[13]. A DF value of one (no retention) should be used for noble gases and for organic iodides. The applicant should provide justification for any DF values greater than those given above.

If the SPARC code is used for the calculation of fission product decontamination, the review should be coordinated with the branch that is responsible for establishing the input parameters for the calculations.

2. Pool Bypass Fraction

The fraction of the drywell atmosphere bypassing the suppression pool by leaking through drywell penetrations is obtained as a product of the review under SRP Section 6.2.1.1.C. If B is the bypass fraction and DF is the time-integrated pool decontamination factor, then the overall decontamination, D, to be used for accident dose calculations, may be taken as:

$$D = \frac{DF}{1 + B(DF-1)}$$

The reviewer should clearly distinguish that fraction of B, which may be further treated by the standby gas treatment system, from that fraction of B which also bypasses the secondary containment building.

3. Other Containment Atmosphere Cleanup Systems

Drywell or containment spray systems for which fission product cleanup credit is claimed are reviewed under SRP Section 6.5.2, and credit for both suppression pool and spray cleanup can be given as a result of the separate reviews.

4. Technical Specifications

The technical specifications are reviewed to ensure that they require periodic inspection to confirm suppression pool depth and surveillance tests to confirm drywell leak tightness, consistent with the bypass fraction used in computing the overall decontamination.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[14]

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided by the applicant and that the review and any calculations support conclusions of the following type, to be included in the staff's safety evaluation report:

The staff has reviewed the fission product scrubbing function of the pressure suppression pool and finds that the pool will reduce the fission product content of the steam-gas mixture flowing through the pool following accidents that blow down through the suppression pool. The staff estimates that the pool will decontaminate the flow by a factor of _____ for molecular iodine vapor and by a factor of _____ for particulate fission products. No significant decontamination of noble gases and organic iodides will occur in the pool. The system is largely passive in nature, and the active components are suitably redundant so that its fission product attenuation function can be accomplished assuming a single failure. The applicant's proposed program for preoperational and surveillance tests will ensure a continued state of readiness, and that bypass of the pool is unlikely to exceed the assumptions used in the dose assessments.

The staff concludes that the pressure suppression pool as a fission product cleanup system is acceptable and meets the requirements of General Design Criterion 41 with respect to the iodine removal function following a postulated loss-of-coolant accident, General Design Criterion 42 with respect to the capability for periodic inspection of the system, and General Design Criterion 43 with respect to the capability for periodic testing of the system.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[15]

V. IMPLEMENTATION

The following guidance is provided to applicants and licensees about the staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[16] Except in those cases in which the applicant proposes an acceptable alternative method for complying with the specified portions of the Commission's regulations, the methods described herein are to be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[17]

~~Implementation of the acceptance criteria of subsection II and the review procedures in subsection III is as follows:~~

~~(1) Operating plants and applicants for operating licenses pending at the date of issue of this SRP section need not comply with the provisions of this SRP section, but may do so voluntarily.~~

~~(2) Future applicants will be reviewed according to the provisions of this SRP section.~~[18]

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 41, "Containment Atmosphere Cleanup."

2. 10 CFR Part 50, Appendix A, General Design Criterion 42, "Inspection of Containment Atmosphere Cleanup Systems."

3. 10 CFR Part 50, Appendix A, General Design Criterion 43, "Testing of Containment Atmosphere Cleanup Systems."

4. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors."

5. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Postaccident Engineered-Safety-Feature~~d~~[19] Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

6. P. C. Owczarski, R. I. Shreck, and A. K. Postma, "Technical Bases and Users Manual for the Prototype of a Suppression Pool Aerosol Removal Code (SPARC)," U.S. Nuclear Regulatory Commission Report, NUREG/CR-3317, 1985.[20]

~~8~~7.[21] R. S. Denning et al., "Radionuclide Release Calculations for Selected Severe Accident Scenarios," U.S. Nuclear Regulatory Commission Report, NUREG/CR-4624, Volume 1, July 1986.[22]

~~7~~8. P. C. Owczar~~k~~ski[23] and W. K. Winegardner, "Capture of Iodine in Suppression Pools," 19th DOE/NRC Nuclear Air Cleaning Conference, Seattle, 1986.[24]

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current PRB names and abbreviations	Editorial change made to reflect current PRB names and responsibilities for SRP sections.
2.	Current PRB names and abbreviations	Editorial change made to reflect current PRB names and responsibilities for SRP sections.
3.	Current PRB names and abbreviations	Editorial change made to reflect current PRB names and responsibilities for SRP sections.
4.	SRP-UDP format item, Reformat Areas of Review	Added "Review Interfaces" heading to AREAS OF REVIEW. Interfaces with SRP Sections 6.2.1.1.C, 6.5.1 and 6.5.2 have been developed based on existing interfaces described within the text of SRP Section 6.5.5.
5.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
6.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
7.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
8.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
9.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
10.	SRP-UDP format item.	Technical Rationale were developed and added for the following Acceptance Criteria: GDCs 41, 42, 43, and the specific criteria necessary to meet the relevant requirements of the above GDCs. The SRP-UDP program requires that Technical Rationale be developed for the Acceptance Criteria.
11.	**Integrated Impact 1336**	Added a new paragraph to the Review Procedures to address NRC staff concerns regarding double counting of fission product removal by plateout when using Regulatory Guide 1.3 in conjunction with the procedures in the SRP.
12.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
13.	SRP-UDP format item.	Format change to make the citation of references consistent with the SRP-UDP format guidance.
14.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
15.	10 CFR 52 applicability related change	Standard design certification (DC) terminology was added to Evaluation Findings section as required by the SRP-UDP Program.

Item	Source	Description
16.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
17.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
18.	SRP-UDP Guidance, editorial	Removed sentences that would be redundant to new standard implementation statment.
19.	Editorial	The regulatory guide title was corrected by changing the word "featured" to "feature".
20.	SRP-UDP Format item.	This reference is cited in the Review Procedures section regarding the calculation of decontamination factors and was not verified as being the most current reference in use by the staff.
21.	SRP-UDP format item, Reformat References	Reordered and renumbered References 7 and 8 in accordance with SRP-UDP guidance.
22.	SRP-UDP Format item.	This reference is cited in the Review Procedures section regarding the calculation of decontamination factors and was not verified as being the most current reference in use by the staff.
23.	Editorial	Spelling of author's name was corrected from "Owczarkski" to"Owczarski".
24.	SRP-UDP Format item.	This reference is cited in the Review Procedures section regarding the calculation of decontamination factors and was not verified as being the most current reference in use by the staff.

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Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
1336	Revise the Review Procedures to address the potential for errors in the calculation of fission product removal from containment.	Subsection III, Review Procedures