



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

15.6.5 RADIOLOGICAL CONSEQUENCES OF A DESIGN BASIS LOSS-OF-COOLANT
Appendix D ACCIDENT: LEAKAGE FROM MAIN STEAM ISOLATION VALVE LEAKAGE CONTROL
SYSTEM (BWR)

REVIEW RESPONSIBILITIES

Primary - Accident Evaluation Branch (AEB)

Secondary - None

I. AREAS OF REVIEW

A potential source of fission product leakage following a loss-of-coolant accident (LOCA) is the leakage past the main steam isolation valves in a BWR. This leakage is controlled by a main steam isolation valve leakage control system (MSIVLCS). This system may be a positive sealing system or a vacuum type system which collects leakage between the closed isolation valves and releases it to the atmosphere through a filter system. The AEB reviews the method of operation, time of operation, and release paths associated with operation of the MSIVLCS to calculate the fission product releases and their contributions to the doses following a LOCA at the exclusion area and low population zone boundary.

The AEB coordinates its evaluation with other branches that interface with the overall evaluation of the LOCA radiological consequence analysis. The Auxiliary Systems Branch (ASB) reviews the design of the MSIVLCS and essential subsystems in accordance with Regulatory Guide 1.96 (Ref. 1) as part of its primary review responsibility for SRP Section 6.7 to assure the system's ability to function following a postulated LOCA including the loss of offsite power. The Containment Systems Branch (CSB) will verify, upon request by AEB, that for a vacuum type system, the operation of the MSIVLCS does not produce an adverse pressure transient in the secondary containment. The acceptance criteria necessary for the review of these areas and their methods of application are contained in the above referenced SRP section of the corresponding primary branch.

II. ACCEPTANCE CRITERIA

The radiological consequences associated with the operation of the MSIVLCS following a postulated LOCA are combined, under SRP Section 15.6.5, Appendix A,

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

with the consequences from other LOCA fission product release paths to determine the total calculated radiological consequences from the hypothetical LOCA. The acceptability of the site, with respect to the total radiological consequences, is determined by the adequacy of the exclusion area and low population zone boundary distances in conjunction with the operation of dose mitigating ESF systems. For operating license applications, the total doses should be within the exposure guidelines of 10 CFR Part 100, paragraph 11 (Ref. 2), and for a construction permit application, the total doses should be within the guideline values of Regulatory Guide 1.3 (Ref. 3). The acceptability is determined under SRP Section 15.6.5, Appendix A.

III. REVIEW PROCEDURES

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

The applicant's description of the MSIVLCS is reviewed with respect to the system performance and to obtain the information needed to perform the dose calculation. For a positive sealing system, verification of the system operability assuming a single active failure, actuation time, and identification of any potential release paths is obtained from the ASB. If the reviewer finds that no release paths exist and that the system can be actuated prior to the steamline pressure decreasing below the drywell pressure, no further review is required.

For a vacuum-type system, which processes rather than seals the leakage, the AEB reviewer obtains the following information, assuming the most adverse single failure of an active component:

1. release paths and fractions of the leakage through these paths, as a function of time, e.g., steam leakage, releases through a depressurization line, releases through drain lines, etc.,
2. system actuation time,
3. flow rates as a function of time, and
4. release points.

This information should be verified by the ASB (and documented by buckslip to the AEB). Interaction with systems used to mitigate the consequences of containment leakage should be noted. The AEB reviewer should consult with the CSB to assure that the operation of the MSIVLCS does not adversely affect pressure transients in secondary containment regions.

The system is then modeled using a computer code (Ref. 4). The source assumed is the same as that used to estimate the containment leakage dose calculated in SRP Section 15.6.5, Appendix A, but it is assumed to be instantaneously distributed in the drywell free volume at the time of the accident. No credit for leakage of activity from the drywell to the containment (Mark III) or to the suppression pool region (Mark I and II) is assumed, but credit can be taken for radioactive decay of the fission products in the drywell prior to operation

of the MSIVLCS. The main steam isolation valves are assumed to leak at their technical specification limit. No release of activity from the MSIVLCS is assumed up to the time of system actuation. Leakage through valve stems or drain lines to an untreated region is assumed to be released to the atmosphere. Releases through the MSIVLCS which are directed to treated regions are assumed to be direct to the filter intake unless the MSIVLCS flow is mechanically directed to a distribution header. If the latter is the case, then credit for mixing is given on the same basis as for other leakage to this system (see SRP Section 6.5.3).

The resulting doses at the exclusion area and the LPZ boundaries are calculated using the dose model described in Regulatory Guide 1.3 (Ref. 3). The X/Q values to be used for this evaluation are the accident X/Q's used in Section 15.6.5, Appendix A. For systems which are designed for initial releases at significantly later times into the accident, application of worst meteorology at the time of release may have to be considered; this will be handled on a case-by-case basis.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information for an independent staff calculation of the thyroid and whole-body doses due to MSIV leakage and operation of the MSIVLCS as a fission product release path following a postulated LOCA. The doses are reported in the safety evaluation report (SER) in Table 15.____ under SER Section 15.____, "LOCA Radiological Consequences," in accordance with SRP Section 15.6.5, Appendix A. The same SER section also includes the staff's findings with respect to the total calculated doses from all release paths and with respect to the acceptability of the exclusion area and low population zone boundaries on the basis of the total calculated doses in accordance with the guideline values of 10 CFR Part 100.

Following the summary section on the total radiological consequences, separate subsections present the staff's evaluation and findings for each specific fission product release path. For the MSIV leakage and operation of the MSIVLCS reviewed under SRP Section 15.6.5, Appendix D, the staff's review and independent calculations should support a conclusion of the following type:

The staff has reviewed the applicant's analysis and has independently evaluated the radiation doses resulting from main steam isolation valve leakage and operation of the main steam isolation valve leakage control system following a postulated LOCA assuming a single failure that is most adverse from the standpoint of radiological consequences. The analysis included the influence of fission product removal systems, delay times, and various release paths. The results of this calculation are reported in Table 15-____. The review has established that the applicant's design is effective in limiting the radiological consequences due to the main steam isolation valve leakage or due to operation of the MSIVLCS.

The acceptability of the exclusion area and the low population boundaries in meeting the requirements of 10 CFR Part 100 for all release paths following a LOCA is discussed in SRP Section 15.6.5, Appendix A, and the staff's recommendations are contained in the "Evaluation Findings" of that SRP section.

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

V. REFERENCES

1. Regulatory Guide 1.96, "Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants."
2. 10 CFR Part 100, Paragraph 11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."
3. Regulatory Guide 1.3, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors." Revision 2..
4. Computer codes are currently under development. Documentation will be published in a NUREG report.