



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

SECTION 12.4

DOSE ASSESSMENT

REVIEW RESPONSIBILITIES

Primary - Radiological Assessment Branch (RAB)

Secondary - None

I. AREAS OF REVIEW

The following areas of the applicant's safety analysis report (SAR) relating to in-plant and onsite radiation dose assessment are reviewed:

1. The expected occupancy of plant radiation areas, including numbers of personnel and times of occupancy. The estimated annual occupancy for each radiation zone and the dose rates at the points of occupancy and basis for the occupancy and the dose rate values (preliminary safety analysis report, PSAR and update in final safety analysis report, FSAR).
2. The objectives and criteria for design dose rates in-plant and at onsite areas (PSAR and update in FSAR).
3. The estimated annual man-rem doses associated with major functions such as operation, radwaste handling, normal maintenance, refueling, and in-service inspection and the average individual radiation exposure resulting from these activities (PSAR and update in FSAR).
4. The estimated annual dose at the boundary of the restricted area and to construction workers at a multi-unit plant due to radiation from onsite sources (PSAR and update in FSAR).
5. The description of any measures taken to reduce particular estimated man-rem doses for specific functions in cases where the dose would appear to result in excessive personnel costs to correct overexposures (PSAR and update in FSAR).

II. ACCEPTANCE CRITERIA

The descriptive information in the SAR is considered to be sufficient if it meets the minimum information needs set forth in Section 12.4 of the "Standard Format and Contents of Safety Analysis Reports for Nuclear Power Plants," Revision 2. The dose limits in 10 CFR

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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 Revision 2 of 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.

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§ 20.101 for exposure of individuals to radiation in restricted areas, and in 20.103 for exposure of individuals to concentrations of radioactive materials in restricted areas are upper limits and the plant must be designed so that they are not exceeded. The dose assessment is a key factor in determining if the plant design and proposed methods of operation assure that occupational radiation exposures (ORE) will be as low as is reasonably achievable (ALARA). Acceptability will be based on the thoroughness with which the applicant displays and demonstrates that occupancy factors, dose rates in various occupied areas, and number of personnel needing to be involved are evaluated for the various areas of the plant, as specifically designed, and for the various functions that will be carried out. Occupancy factors will be acceptable if it is demonstrated that they are based on operating experience, coupled with the applicant's plan for operating the proposed plant, or that they are based on a thorough analysis of the future plant operation. Estimates should be included for special high dose accumulating operations such as normal maintenance, radioactive material handling, refueling, and in-service inspection. All assumptions used in the assessment should be included.

Dose rates in areas for which occupancies are given will be acceptable if they are based on generally used calculational procedures with realistic source, attenuation, and distance factors. Specific acceptance criteria are being developed.

Estimates of the number of personnel involved in various operations and various areas of the plant will be acceptable if they make realistic assumptions on use of the plant work force and include input from experience at operating reactors. The sources of this data should be cited.

All applicants are to demonstrate that the designs and the operating plans have made reasonable efforts to assure that occupational radiation exposures will be ALARA. In addition, applicants for licenses for boiling water reactor (BWR) plants are to demonstrate that they have made reasonable efforts to assure that occupational radiation exposures due to N-16 sources in turbine buildings will be ALARA. For BWR sites expected to contain more than one unit, where one or more units may be operating while others are under construction, the applicant is to provide an analysis to demonstrate that he has made reasonable efforts to assure that onsite population exposures due to such sources will be ALARA, including that to the expected construction force. The requisite analysis will be acceptable if the applicant demonstrates that he has appropriately considered the following factors and their interactions:

- a. The number of reactor units, their power levels, and their expected rates of completion.
- b. The relative orientations of pertinent structures and their expected completion times.
- c. The overall sizes and occupational compositions of the construction force and of the plant work force.
- d. The locations and orientations of components with significant inventories of N-16 with respect to structural concrete.
- e. The need for additional shielding for significant source-containing components.

The staff's policy on acceptance criteria for average annual radiation exposure to plant operating personnel during predictable activities has been stated in Section 12.3, II, 1 above,

in the discussion on acceptance criteria for plant radiation zoning. Also involved in the acceptance criteria for the dose assessment is the applicant's description of design and operating features for increasing accessibility to work, inspection, and sampling areas, for reducing the intensity of radiation sources that have to be worked around, for reducing the production, distribution, and retention of activated corrosion products, for reducing the time required for work in radiation fields, and for providing additional methods for reducing occupational radiation exposure. Judgment of how realistic the dose assessment is and how appropriate the ALARA operating and design features are will be used in determination of acceptability of the average annual occupational radiation exposure estimates. However, numerical acceptance criteria for total annual man-rem resulting from plant operation have not been developed. Nevertheless, the value obtained in the assessment made in this section provides a basis for judgment of the radiation protection program and a determination if ORE will be ALARA.

### III. REVIEW PROCEDURES

The information furnished in the SAR is reviewed for completeness in accordance with the "Standard Format and Contents of Safety Analysis Reports for Nuclear Power Plants," Revision 2.

The reviewer evaluates the text and scaled layout drawings of the facility to determine the manner in which the plant is zoned for radiation dose rate and to evaluate proposed occupancy. The reviewer checks the estimated occupancy factors, the calculational procedures, the dose rate values, and the in-plant airborne radioactivity concentrations. The reviewer compares the rationale and assumptions used in the dose assessment with those provided for other accepted plants and with operating experience and referenced methods. The reviewer determines whether the applicant's evaluation is thorough and realistic. The reviewer forms a judgment on whether the annual occupational radiation exposure man-rem estimate is ALARA. Under circumstances where the reviewer decided the value was not ALARA, he could request design or procedures improvements. Based on the review, RAB may also request additional information or request the applicant to modify or improve the analysis for the purpose of meeting the acceptance criteria given in Section II.

### IV. EVALUATION FINDINGS

The staff's review should verify that adequate and sufficient information is contained in the SAR and amendments to arrive at conclusions of the following type, which are to be included in the staff's Safety Evaluation report. The report will include a summary of the applicant's coverage, the staff's basis for review and acceptance criteria, and the findings of the review. The following is a brief representation of the evaluation findings:

#### "12.4 Dose Assessment

"This section of the applicant's SAR has been reviewed to evaluate the in-plant and onsite radiation dose assessment that is an essential ingredient to determining whether the radiation protection program for \_\_\_\_\_ nuclear plant will assure that ORE will be ALARA. The review covered the occupancy of plant radiation areas, the

applicant's criteria for design dose rates in those areas, the estimated annual man-rem doses for major work functions, and the estimated annual dose at the boundary of the restricted area and to construction workers due to in-plant and onsite sources.

"The basis for acceptance of the dose assessment includes the demonstration that consideration has been given to occupancy factors and use of various radiation zones; to radiation experience from operating plants, including doses accumulated in major work functions such as normal maintenance, in-service inspection, radwaste handling, and refueling; to the dose rate that is found, both in normally occupied areas during operation, and in areas where these functions are carried out; and to the overall annual plant man-rem value that results from the analysis of these factors.

"It is concluded that the dose assessment for \_\_\_\_\_ nuclear plant has appropriately considered all the factors leading to a plant annual man-rem figure that demonstrates that ORE will be ALARA."

#### V. REFERENCES

1. ICRP Publication 22, "Implications of Commission Recommendations that Doses be Kept As Low As Readily Achievable," International Commission on Radiation Protection (1973).
2. Sixth Annual Report of the Operation of the U.S. Atomic Energy Commission's Centralized Ionizing Radiation Exposure Records and Reports System," USAEC (1974).
3. T. D. Murphy, "A Compilation of Occupational Radiation Exposure from Light Water Cooled Nuclear Power Plants, 1969-1973," WASH-1311, USAEC (1974).
4. Additional testimony of Dr. Morton J. Goldman on behalf of the Consolidated Utility Group (Part I), "Occupational Exposure," Docket Number RM-50-2, November 9, 1973.
5. NCRP Report 39, "Basic Radiation Protection Criteria," National Committee on Radiation Protection (1971).
6. 10 CFR Part 20, "Standards for Protection Against Radiation."
7. R. Wilson, "Man-rem Economics and Risk in the Nuclear Power Industry," NUCLEAR NEWS, February 1972.
8. Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposures as Low As Practicable (Nuclear Reactors)."
9. T. D. Murphy and C. H. Henson, "Occupational Radioactive Exposure at Light Water Cooled Power Reactors, 1969-1974." NUREG-75/032, USNRC (1975).

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