



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

2.1.3 POPULATION DISTRIBUTION

REVIEW RESPONSIBILITIES

Primary - ~~Siting Analysis Branch (SAB)~~Civil Engineering and Geosciences Branch (ECGB)¹

Secondary - ~~Emergency Preparedness Licensing Branch (EPLB)~~Emergency Preparedness and Radiation Protection Branch (PERB)²

I. AREAS OF REVIEW

The ~~SAB~~ECGB³ reviews the population data in the site environs as presented in the applicant's safety analysis report (SAR),⁴ to determine whether the exclusion area, low population zone and population center distance for the site comply with the requirements of 10 CFR Part 100, and (at the construction permit (CP), early site permit, or combined license (COL)⁵ stage) to determine whether the population density is such, as given in Position C.3 of Regulatory Guide 4.7, that consideration should be given by the applicant to alternate sites with lower population density.

A secondary review is performed by ~~EPLB~~PERB⁶ and the written results are used by ~~SAB~~ECGB⁷ to complete the overall evaluation of the facility.

The ~~EPLB~~ reviews the low population zone (LPZ), to determine whether there is reasonable assurance that appropriate protective measures can be taken in this area, in the event of emergency. The results of the analysis are transmitted to ~~SAB~~ for inclusion in the safety evaluation report.⁸

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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.

Review Interfaces⁹

The ECGB coordinates PERB evaluations that interface with the overall evaluation of population distribution under other Standard Review Plan (SRP) sections, as follows:

1. The ECGB obtains calculations from the PERB on the radiological consequences of a design basis accident as it affects the outer boundaries of the exclusion zone and the low population zone (LPZ) (as described in SRP Chapter 15). The ECGB then verifies that these calculations have taken under consideration those physical characteristics of the site and of the proposed plant that may influence effluent releases.
2. The PERB reviews the physical characteristics of the LPZ to determine whether there is reasonable assurance that appropriate protective measures can be taken in this area in the event of a radiological emergency. The results of the evaluation are transmitted to the ECGB for inclusion in the safety evaluation report (SER).

For those areas of review identified as part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.¹⁰

II. ACCEPTANCE CRITERIA

~~SABECGB~~¹¹ acceptance criteria are based on meeting the relevant requirements of the following regulations:

1. 10 CFR ~~Part 50, §~~¹²50.34(a)(1) relates to having each applicant provide a description and safety assessment of the site in ~~his~~¹³ the SAR, with special attention to the site evaluation factors identified in 10 CFR Part 100.
2. 10 CFR ~~Part 100, §~~100.10 as it relates to determining the acceptability of a site for a power or testing reactor. The staff will take the following item, among others, into consideration:

Population density and use characteristics of the site environs, including the exclusion area, low population zone, and population center distance.

10 CFR Part 100 also provides definitions and other requirements for determining an exclusion area, low population zone, and population center distance in Sections 100.3 and 100.11, respectively.

The requirements of 10 CFR ~~Part 50, §~~50.34(a)(1) and 10 CFR Part 100 are deemed to have been met if the population density and use characteristics of the site meet the following:

1. Either there are no residents in the exclusion area, or if so, such residents are subject to ready removal, in case of necessity.

2. The specified low population zone is acceptable if it is determined that appropriate protective measures could be taken in behalf of the enclosed populace in the event of a serious accident.
3. The nearest boundary of the closest population center (as defined in 10 CFR Part 100) is at least one and one third times the distance from the reactor to the outer boundary of the low population zone.
4. The population center distance is acceptable if there are no likely concentrations of greater than 25,000 people over the plant lifetime closer than the distance designated by the applicant as the population center distance. The boundary of the population center shall be determined upon considerations of population distribution. Political boundaries are not controlling.
5. The population data supplied by the applicant in his the SAR is acceptable if:
 - a.¹⁴ It contains population data for the latest census, projected year of plant startup and projected year of end of plant life, all in the geographical format given in Section 2.1.3 of Reference 3 Regulatory Guide 1.70.¹⁵
 - b. it describes the methodology and sources used to obtain the population data, including the projections,
 - c. it includes information on transient populations in the site vicinity, and
 - d. the population data in the site vicinity, including projections, is verified by other means such as U.S. Census publications, publications from State and local governments, and other independent projections, to be reasonable.
6. If the population density at the CP, early site permit, or COL¹⁶ stage exceeds the guidelines given in Position C.3 of Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations," (Ref.4)¹⁷ the applicant will be required to give special attention to the consideration of alternative sites with lower population densities. A site that exceeds the population density guidelines of Position C.3 of Regulatory Guide 4.7 can nevertheless be selected and approved if, on balance, it offers advantages compared with available alternative sites when all of the environmental, safety, and economic aspects of the proposed and alternative sites are considered.

Technical Rationale¹⁸

The technical rationale for application of these acceptance criteria is discussed in the following paragraphs:¹⁹

1. Compliance with 10 CFR 50.34(a)(1) requires, in part, that the applicant provide a site description and safety assessment in the SAR, with special attention given to site evaluation factors identified in 10 CFR Part 100.

The requirements of 10 CFR 50.34(a)(1) apply to this SRP section because the site description and safety assessment in the applicant's SAR must contain information on the exclusion area, low population zone, and population center distance invoked by 10 CFR 50.34(a)(1) (i.e., by requiring that special attention be given to site evaluation factors identified in 10 CFR Part 100). This information is an integral aspect of determining the suitability of the site in terms of population distribution. Regulatory Guide 4.7, Position C.3, and Regulatory Guide 1.70, Section 2.1.3, provide guidance acceptable to the staff for meeting these requirements.

Meeting the requirements of 10 CFR 50.34(a)(1) provides assurance that, in the event of an accident, public safety will be protected as follows: (a) the populace in the exclusion area will be subject to ready removal; (b) appropriate protective measures can be taken on behalf of the populace enclosed in the LPZ; and (c) the population distribution in the LPZ and the population center are within acceptable limits.²⁰

2. Compliance with 10 CFR 100.10 requires, in part, that the acceptability of the site for power or test reactors be determined on a basis that gives particular consideration to population density and the use characteristics of the site environs, including the exclusion area, low population zone, and population center distance.

The requirements of 10 CFR 100.10 apply to this SRP section because the reviewer determines whether the exclusion area, low population zone, and population center distance for the site are such that members of the public living in these areas/zones can either be protected or safely evacuated in the unlikely event of a serious radiological accident. SRP Section 2.1.3; Regulatory Guide 4.7, Position C.3; and Regulatory Guide 1.70, Section 2.1.3, provide guidance acceptable to the staff for meeting these requirements.

Meeting the requirements of 10 CFR 100.10 provides assurance that members of the public living in the proximity to an operating reactor will not be subjected to excessive radiological doses in the unlikely event of a radiological emergency.²¹

III. REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer on each case. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented, the similarity of the material to that recently reviewed on other plants, and whether items of special safety significance are involved. Determine that the population data contained in the SAR is in the detail and in the format described in ~~Reference 3~~ Regulatory Guide 1.70,²² Section 2.1.3.

Compare the SAR present population data ~~against~~ with²³ whatever independent population data are available (e.g., Census Bureau CED²⁴ tapes, special census which may have been conducted, local and State agencies, Councils of Government, etc.). Note any significant differences which require clarification.

Compare the SAR population projections against with whatever independent population projections are available (e.g., local and State agencies and Councils of Government, Census Bureau projections, Bureau of Economic Analysis, etc.). Note any significant underestimates in the SAR which require clarification.

At the construction permit^{CP}, early site permit, or COL²⁵ stage, use the population and its distribution, including weighted transients, projected to the year of plant startup and projected over the lifetime of the plant, to determine the population density in persons per square mile as a function of distance from the plant out to 48.3 kilometers (30 miles).²⁶ Compare results to with the SAR plot of population density vs distance (Reference 3Regulatory Guide 1.70,²⁷ Section 2.1.3.6). If the population density, including weighted transient population, projected at the time of initial operation exceeds 500 persons per 2.59 square kilometers (1 square mile)²⁸ averaged over any radial distance out to 48.3 kilometers (30 miles)²⁹ (cumulative population at a distance divided by the area at that distance), or the projected population density over the lifetime of the facility exceeds 1,000 persons per 2.59 square kilometers (mile)³⁰ averaged over any radial distance out to 48.3 kilometers (30 miles),³¹ a memorandum should be prepared advising appropriate staff personnel that an evaluation of alternative sites having lower population densities will be required.

Determine that the SAR includes a map of the low population zone and a table of population distribution which includes transients (Reference 3Regulatory Guide 1.70,³² Section 2.1.3.4). Determine the method used by the applicant to establish the boundary of the nearest population center (Reference 3Regulatory Guide 1.70,³³ Section 2.1.3.5). Evaluate communities which are closer to the plant than the design population center to determine the likelihood that any of them can be projected to 25,000 people within the plant lifetime. Compare the distance to the boundary of the population center to with the distance to the outer boundary of the low population zone and establish that the population center distance is at least one and one third times the low population zone distance as required by 10 CFR Part 100.

Population and population density data of specific towns and cities within the low population zone can be checked against population data as contained in the Department of Commerce publication, "1970 Census of Population - Characteristics of the Population," 1990 CP-1-1, 1990 Census of Population - General Population Characteristics of the U.S.,³⁴ or other Census Bureau publications.

Determine that the current and projected population data for the LPZ includes transients (e.g., workers, occupants of schools, hospitals, etc., recreational facilities).

The EPLBPERB³⁵ determines the acceptability of the LPZ with respect to the necessary finding that there is reasonable assurance that appropriate protective measures could be taken in behalf of the people within the LPZ in the event of a radiological emergency. [10 CFR Part 100, §100.3(b)]

A memorandum stating this finding should be transmitted to SABECGB³⁶ for use in preparing the staff's safety evaluation reportSER.³⁷

Determine that the nearest boundary of the closest population center is at least one and one-third times the distance to the outer boundary of the low population zone. Evaluate the characteristics of the land area between the plant and the nearest population grouping which has, or is projected to have during plant lifetime, a population of about 25,000. Use whatever data is available on land use, land use controls such as zoning, potential for growth, or factors which are likely to limit growth between the population grouping and the plant to determine the potential growth in population density toward the site. The population center boundary should be established at that point nearest the plant where, in the reviewers judgment, the population density may grow to a value comparable to the density of the community itself. Population density is the controlling criteria, and in this regard, the corporate boundary of the community itself is not limiting. The detail to which this aspect of the site is reviewed will depend on the distance of the nearest probable population center relative to the distance to the outer boundary of the low population zone. ~~(See References 5 and 6.)~~³⁸ Where a very large city is involved, a greater distance than the one and one-third factor may be required, and appropriate additional compensating engineered safeguards may be required. These will be evaluated on a case-by-case basis, and where appropriate, a memorandum should be prepared by ~~SABECGB~~³⁹ providing any recommendations.

Results of the review under this SRP section should be forwarded to the ~~Division of Licensing, Assistant Director for Operating Reactors~~ division responsible for operating reactor licenses⁴⁰ whenever the site contains a previously licensed and operating nuclear unit.

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.⁴¹

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided, and that ~~his~~ the evaluation is sufficiently complete and adequate to support conclusions of the following type, to be included in the staff SER:

The staff concludes that the population data provided is acceptable and meets the requirements of 10 CFR ~~Part 50, §50.34(a)(1)~~, and 10 CFR Part 100. This conclusion is based on the applicant having provided an acceptable description and safety assessment of the site which contains present and projected population densities which, at the CP, ~~early site permit, or COL~~⁴² stage, are within the guidelines of Position C.3 of Regulatory Guide 4.7 and has properly specified the low population zone and population center distance. In addition, the staff has reviewed and confirmed by comparison with independently obtained population data, the applicant's estimates of the present and projected populations surrounding the site, including transients.

The ~~Emergency Preparedness Licensing Branch~~ Emergency Preparedness and Radiation Protection Branch⁴³ shall determine that:

The applicant also has calculated the radiological consequences of design basis accidents at the outer boundary of the low population zone (SRP ~~Section~~ Chapter⁴⁴ 15) and has provided reasonable assurance that appropriate protective measures can be taken within the low population zone to protect the population in the event of a radiological emergency.

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.⁴⁵

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC 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 52.⁴⁶ 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.

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.⁴⁷

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

VI. REFERENCES

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
2. 10 CFR Part 100, "Reactor Site Criteria."
3. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."
4. Regulatory Guide 4.7, "General Site Suitability for Nuclear Power Stations."
5. ~~NUREG-0308 Safety Evaluation Report, Arkansas Nuclear One, Unit 2. November 1977 and supplements.~~

6. ~~NUREG-75/054 Safety Evaluation Report, Pilgrim Nuclear Generating Station, Unit 2,
June 1975 and supplements.~~⁴⁸

SRP Draft Section 2.1.3
Attachment A - Proposed Changes in Order of Occurrence

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 review responsibility | Changed PRB to Civil Engineering and Geosciences Branch (ECGB). |
| 2. | Current SRB name and abbreviation | Changed SRB to Emergency Preparedness and Radiation Protection Branch (PERB). |
| 3. | Current PRB abbreviation | Changed PRB to ECGB. |
| 4. | Editorial | Defined SAR. |
| 5. | SRP-UDP format item | Defined CP; added early site permit and combined license to accommodate 10 CFR 50 Part 52. |
| 6. | Current SRB abbreviation | Changed SRB to PERB. |
| 7. | Current SRB abbreviation | Changed PRB to ECGB. |
| 8. | SRP-UDP format item | Relocated to "Review Interfaces." |
| 9. | SRP-UDP format item | Added "Review Interfaces" to AREAS OF REVIEW and organized in numbered paragraph form to describe how other branches support the review of population distribution. |
| 10. | SRP-UDP format item | Added reference to primary review responsibility of other branch reviews to reflect inclusion of "Review Interfaces" in this SRP section and for consistency with other sections. |
| 11. | Current PRB abbreviation | Changed PRB to ECGB. |
| 12. | Editorial | Simplified citation format used for the Code of Federal Regulations (global change for this section). |
| 13. | Editorial | Replaced personal pronoun "his" with "the" (global change for this section). |
| 14. | SRP-UDP format item | Reformatted into numbered paragraphs for clarity. |
| 15. | SRP-UDP format item | Replaced "Reference 3" with Regulatory Guide 1.70. |
| 16. | SRP-UDP format item | Added "early site permit or COL" to accommodate 10 CFR 50 Part 52. |
| 17. | Editorial | Deleted unnecessary reference callout for Ref. 4. |
| 18. | SRP-UDP format item | Added "Technical Rationale" to ACCEPTANCE CRITERIA and formatted into numbered paragraph form to describe the basis for referring to the Code of Federal Regulations. |
| 19. | SRP-UDP format item | Added lead-in sentence for "Technical Rationale." |
| 20. | SRP-UDP format item | Added technical rationale for 10 CFR 50.34(a)(1). |

SRP Draft Section 2.1.3
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|------|---|---|
| 21. | SRP-UDP format item | Added technical rationale for 10 CFR 100.10. |
| 22. | SRP-UDP format item | Replaced "Reference 3" with Regulatory Guide 1.70. |
| 23. | Editorial | Replaced compared "against" or "to" with compared "with" (global change for this section). |
| 24. | SRP-UDP format item | "Census Bureau CED tapes" could not be identified. See REFERENCES THAT COULD NOT BE VALIDATED in this SRP document package. |
| 25. | SRP-UDP format item | Added "early site permit or COL" to accommodate 10 CFR 50 Part 52 and replaced "construction permit" with "CP." |
| 26. | Conversion to SI units | Converted miles to kilometers. |
| 27. | SRP-UDP format item | Replaced Reference 3 with Regulatory Guide 1.70. |
| 28. | Conversion to SI units | Converted square miles to square kilometers. |
| 29. | Conversion to SI units | Converted miles to kilometers. |
| 30. | Conversion to SI units | Converted square miles to square kilometers. |
| 31. | Conversion to SI units | Converted miles to kilometers. |
| 32. | SRP-UDP format item | Replaced Reference 3 with Regulatory Guide 1.70. |
| 33. | SRP-UDP format item | Replaced Reference 3 with Regulatory Guide 1.70. |
| 34. | SRP-UDP format item* | Updated reference to current Census Bureau document. |
| 35. | Current SRB abbreviation | Changed SRB to PERB. |
| 36. | Current PRB abbreviation | Changed PRB to ECGB. |
| 37. | Editorial | Used "SER" as previously defined. |
| 38. | Editorial | Deleted unnecessary reference callouts for References 5 and 6. |
| 39. | Current PRB abbreviation | Changed PRB to ECGB. |
| 40. | Editorial | Replaced "Division of Licensing, Assistant Director for Operating Reactors" with "division responsible for operating reactors," because the former is too specific due to potential organizational changes. |
| 41. | SRP-UDP Guidance, Implementation of 10 CFR 52 | Added standard paragraph to address application of Review Procedures in design certification reviews. |
| 42. | SRP-UDP format item | Added "early site permit, or COL" to accommodate 10 CFR 50 Part 52. |
| 43. | Current SRB name | Changed SRB to Emergency Preparedness and Radiation Protection Branch. |

SRP Draft Section 2.1.3
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|------|---|--|
| 44. | Editorial | Replaced "Section" with "Chapter" to reflect the cited reference more accurately. |
| 45. | SRP-UDP format item | Added reference to design certification reviews. |
| 46. | 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. |
| 47. | SRP-UDP Guidance | Added standard paragraph to indicate applicability of this section to reviews of future applications. |
| 48. | Editorial | Deleted References 5 and 6 from subsection VI, REFERENCES. |

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SRP Draft Section 2.1.3
Attachment B - Cross Reference of Integrated Impacts

| Integrated Impact No. | Issue | SRP Subsections Affected |
|------------------------------|--|---------------------------------|
| | No Integrated Impacts were incorporated in this SRP Section. | |