U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation

NRR REVIEW STANDARD

Change Notice

Review Standard No.:	**RS-002**
Review Standard Title:	**Processing Applications for Early Site Permits**
Effective Date:	
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Responsible Organization:	**NRR/DRIP/RNRP**

Summary of Changes: This is the initial issuance of RS-002, "Processing Applications for Early Site Permits." The objective of this review standard is to ensure that staff reviews of applications for early site permits (ESPs) and the associated environmental reports are effective, efficient, and consistent; and that the reviews result in high-quality products.

Note: Change bars in this document indicate changes made from the earlier draft released for public comment and interim use in two parts: December 2002 and April 2003.

Training:	None
ADAMS Accession No.:	**ML032340334**

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NRR REVIEW STANDARD

RS-002

Processing Applications for Early Site Permits

1.0 PURPOSE

This review standard (RS)

(1) describes the process for reviewing an early site permit (ESP) application and provides guidance for completing the steps in the process (see Sections 4.1 through 4.3 below and Attachment 1),

(2) provides detailed guidance for review for ESP applications and provides references to review criteria for areas within the scope of the review (see Sections 4.4 through 4.6 below and Attachments 2 and 3),

(3) provides a sample safety evaluation to be used by the NRC staff as guidance for documenting the results of ESP application reviews (see Section 4.7 below and Attachment 4), and

(4) provides references to inspection guidance that supports the staff's determinations on ESPs (see Section 4.8 below).

The goal of an RS is to ensure that the staff's reviews of licensing actions are conducted in an effective, efficient, and consistent manner; and that the reviews result in high-quality and timely products. This RS addresses the goals in the NRC's Strategic Plan in a number of ways.

Safety. In the process of developing the ESP RS, the staff has carefully evaluated what information is needed from an applicant, and what the staff's evaluation should address to support issuance of an ESP. Therefore, this process helps ensure that the staff's review of an ESP application will be comprehensive in addressing applicable requirements.

Openness. By making the staff's review standards available to stakeholders, the ESP RS contributes to increasing openness in the regulatory process.

Effectiveness. The ESP RS makes maximum feasible use of existing NRC guidance. The issuance of the guidance in this RS will help ensure that the staff's review of future ESP applications is effective and efficient by consolidating guidance for staff review of an ESP in one document.

2.0 BACKGROUND

As discussed in the Statements of Consideration for Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52 (54 FR 15372), the purpose of the ESP regulations in Part 52 is, in part, to make it possible to resolve safety and environmental issues related to siting before an applicant needs to make large commitments of resources. Having obtained an ESP, an applicant for a combined license (COL) for a nuclear power plant or plants can then reference it in the COL application. In accordance with 10 CFR 52.39, site-related issues resolved at the ESP stage will be treated as resolved at the COL stage unless a contention is admitted that a reactor does not fit within one or more of the site parameters in the ESP, a petition alleges that the site is not in compliance with the ESP, or a petition alleges that the terms and conditions of the ESP should be modified.

The ESP application is required to address site safety, environmental protection, and emergency planning. If the applicant desires to perform limited site work after issuance of the ESP, the ESP application must also include a redress plan should no nuclear power plant be constructed on the approved site. Pursuant to 10 CFR 52.17(a)(2), consideration of the need for power, as part of an applicant's environmental report (ER), is not required at the ESP stage. In addition, the Commission has determined (and documented in letters to prospective ESP applicants dated June 2, 2003) that consideration of alternative energy sources in the ER is not required at the ESP stage.

Once an ESP application is submitted, the NRC staff reviews the ESP application in the three areas of site safety, environmental protection, and emergency planning. The purpose of the review is to determine whether the application meets NRC regulations and the requirements of the Atomic Energy Act. The staff's safety evaluation report (SER) will reach conclusions regarding whether there is reasonable assurance that the site can safely host a future nuclear power plant or plants. In addition, the SER will contain a determination regarding emergency planning based on the level of detail in the emergency planning information provided by the applicant. If the information submitted by the applicant under 10 CFR 52.17(b) is relatively limited, the staff's finding on emergency planning will focus on whether there are significant impediments to the development of emergency plans. If major features of the emergency plans are submitted, the staff will make a determination regarding the adequacy of those features. If complete emergency plans are submitted, the staff will determine whether these plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. The staff will also develop an environmental impact statement (EIS) in accordance with the National Environmental Policy Act (NEPA) and 10 CFR Part 51 to determine and evaluate environmental impacts of the potential use of the proposed site to host a nuclear power plant or plants, and alternatives.[1]

[1] ESP applicants are not required to address certain subjects within the scope of NEPA, including the need for power and alternative energy sources.

This RS provides guidance on the staff's process for reviewing an ESP application and developing the SER. The RS also provides specific technical and format guidance for developing the SER (including emergency planning aspects). Finally, it provides or references staff guidance for reviewing the ER and developing the EIS.

This RS was originally issued as a draft for interim use and public comment in December 2002. In April 2003, two additional review guidance sections (on accident analysis for the site safety assessment and on quality assurance measures) were issued for interim use and public comment.

Most comments received on the document were made by the Nuclear Energy Institute and two prospective ESP applicants. These commenters focused on the need to provide guidance in RS-002 on review of applications employing the plant parameter envelope (PPE) approach. Other comments focused on the need to be clear regarding the role and NRC treatment of quality assurance measures that support an ESP application, and on clarifying guidance for review of accident analyses in site safety assessments. The remaining comments were mostly recommendations for wording changes in certain technical guidance sections of RS-002. The staff's responses to these comments on the draft RS have been incorporated, as appropriate, into the guidance in this RS. Comments were also received from the Nuclear Information and Resource Service and Ms. Sandra Lindberg; the staff determined that RS-002 did not need to be revised to address these comments.

3.0 APPLICABILITY

This RS is applicable to ESPs.

4.0 USE OF THIS REVIEW STANDARD

This section provides guidance for use of this document and other documents in processing an ESP application.

4.1 Process Description

Attachment 1 provides a process flow chart that identifies each major step involved in processing an ESP application.

(1) The staff should follow the process outlined in Attachment 1 and this section for processing ESP applications. Specific guidance for each step is provided below. The project manager (PM) for the review of each ESP application is responsible for coordinating the staff's review following the process described in this section and illustrated in Attachment 1.

(2) Steps in the ESP Review Process

(a) The Program Director, New, Research and Test Reactors Program (RNRP), will designate a PM for each ESP application submitted or expected to be submitted.

Attachment 2 lists applicable review guidance sections, most of which are appended to Attachment 2.[2] It also lists the primary and secondary NRC technical branches responsible for performing the review of each topic. The PM will be responsible for coordinating the work of the NRC technical branches identified in Attachment 2. The PM will also be responsible for coordinating with the environmental project manager (EPM), whose responsibilities are defined in step (b) below, to ensure that (1) the schedules for development of the SER and the EIS are coordinated, and (2) the two documents are consistent. The PM will accomplish the following:

- Ensure the applicant notifies the PM when the applicant submits the ESP application to the Director, Office of Nuclear Reactor Regulation (NRR), in accordance with 10 CFR 2.101(a).

- Provide guidance to the technical branches and other staff on the process and schedule for the acceptance review of an ESP application.

- Verify, in accordance with 10 CFR 2.101(a)(2), that a copy of the tendered application is made available for public inspection at the NRC Web site and at the NRC Public Document Room.

- In consultation with the NRR Work Planning Center, obtain and notify the technical branches of the technical assignment control (TAC) number(s) for the ESP review.

- Promptly notify the Office of the General Counsel (OGC) of receipt of the ESP application, and ensure that OGC is involved throughout the ESP application review.

- Ensure that proprietary information submitted in conjunction with the ESP application is handled as required by 10 CFR 2.790 and NRR Office Instruction LIC-204, "Handling Requests to Withhold Proprietary Information from Public Disclosure."

- Ensure that a notice of receipt of the application is published in the *Federal Register*.

[2] The review guidance sections have, in most cases, been developed from NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." The review guidance sections in this RS differ from similar sections in NUREG-0800 in that they specifically address ESPs, which were not a part of the regulatory process when most sections of NUREG-0800 were last updated. These guidance sections are appended to Attachment 2 of this RS. The staff found that a few, more recent sections of NUREG-0800 provide satisfactory guidance for ESP reviews without the need for significant revision. These sections are referenced in Attachment 2 to this RS, rather than being appended to Attachment 2.

(b) The License Renewal and Environmental Impacts Branch (RLEP) will designate an EPM to coordinate review of the ER submitted by the applicant and to coordinate development of the EIS. Attachment 3 lists applicable sections of NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," that are to be addressed in the EIS and the primary and secondary NRC technical branches responsible for performing the review of each topic. Attachment 3 also provides clarifications (where appropriate) to the guidance of NUREG-1555 that the staff will consider while reviewing an ESP application. The EPM will coordinate the acceptance review of the ESP application with the PM as discussed in step (c) below. The EPM will also coordinate with the PM to ensure that (1) the schedules for development of the SER and the EIS are coordinated, and (2) the two documents are consistent. Finally, the EPM will review the site redress plan (if submitted by the applicant) to ensure, in accordance with 10 CFR 52.25(a), that the final EIS includes a conclusion with respect to whether the activities allowed under 10 CFR 50.10(e)(1) will or will not result in any significant environmental impact that cannot be redressed.

(c) The PM and EPM will coordinate the determination of whether the application is complete and acceptable for docketing. The PM and EPM will provide copies of the site safety assessment (including emergency planning information) and the ER to the primary review branches designated in Attachments 2 and 3. Responsible sections within these branches (i.e., sections responsible for performing technical reviews for the subject matter in Attachments 2 and 3) will, within the time frame specified by the PM, provide a memorandum to RNRP (for the safety assessment and emergency planning information) or to RLEP (for the ER) with a conclusion as to whether the information provided for their sections of the ESP application review is reasonably complete and acceptable to support docketing. The criterion for such determination is that information is provided to allow the staff to perform the reviews of the sections of the application assigned to their respective branches in accordance with the standard review plans and other guidance contained or referenced in Attachments 2 and 3 to this RS (i.e., all requirements addressed, no blank or essentially blank sections). During its review, it is possible that the staff will develop requests for additional information (RAIs) in each review area. The acceptance review represents a determination of whether the safety case and the evaluation of the environmental impacts presented in the application are reasonably clear and well supported, such that detailed review and development of RAIs (as needed) are feasible. Therefore, the criterion for the acceptance review is not that the application is complete or sufficient in all respects such that no additional information will be needed, nor is the criterion that it is acceptable for issuance of an ESP. Rather, the application should be reasonably complete. Upon receipt of all inputs from the technical staff, the PM, with input from the EPM, will prepare a letter from the Director, NRR (or other signature authority specified by Office Instruction ADM-200), notifying the applicant that the application is accepted for docketing or is rejected; if the

application is rejected, the letter should explain why. The PM will ensure concurrence is obtained and the letter mailed to meet the timeliness requirements of 10 CFR 2.101.

(d) If the staff determines that the application is reasonably complete such that a detailed review can be initiated, the PM will verify that the applicant has provided the number of copies required by 10 CFR 2.101 to local and State officials. The PM will then docket the application.

(e) In consultation with the NRR Work Planning Center, the PM will develop a schedule for review of the ESP application and will provide the schedule to the technical branches and other NRC staff. The PM should maintain the schedule throughout the review process and should also keep the ESP applicant informed as to the staff's progress in achieving major milestones.

(f) The PM will provide training and guidance on the process for review of the safety assessment and development of the SER to technical staff and other NRC staff, as needed.

(g) The PM will make a public notification in the *Federal Register* of the docketing of the ESP application. In addition, the Secretary of the Commission will issue a Notice of Hearing as soon as practicable after the application is docketed. The Notice of Hearing may set a date for the initial hearing (at least 30 days after issuance of the notice), or the date may be set in a subsequent notice. Given the likely duration of an ESP review, it is unlikely that the hearing date will be established in time to be included in the initial notification. Section 4.2 of this RS further discusses the hearing process.

(h) In accordance with Section 2.3 of NRR Office Instruction LIC-101, "License Amendment Review Procedures," the PM will determine whether there are any appropriate precedents for the review of an ESP application. If any are found, the PM will ensure the technical branches involved in the review are aware of the precedents and that the precedents are considered in the review of the ESP application. Technical staff may also identify precedents and should discuss them with the PM as appropriate.

(i) In consultation with the NRR Work Planning Center, the PM will develop a work plan for processing the safety evaluation, using a similar approach to that specified in Section 2.4 of LIC-101. The plan will define the scope of the review, resources needed for the review, and the schedule for completion of the review. The work plan will be coordinated with technical branches involved in the review. The PM will submit work requests to the appropriate technical branches in accordance with Section 2.5 of LIC-101.

(j) Technical branches will perform technical reviews of sections of the safety assessment within their purview, using the guidance of Attachment 2 to this RS and its references. The staff will develop preliminary draft inputs for

assigned SER sections, and will concurrently develop RAIs for assigned sections if additional information is needed to support the conclusions needed for the SER inputs. Section 4.3 of LIC-101 provides additional guidance on determining whether RAIs are necessary and appropriate. Technical branches will develop RAIs where needed and will provide them to the PM (may be e-mailed to PM, followed by internal memorandum from cognizant section chief) along with the preliminary draft SER inputs. The PM will compile the RAIs, work with the branch to ensure that the RAIs are clear and have an appropriate regulatory basis, coordinate with OGC for issues within the scope of the hearing, and develop an RAI package in accordance with LIC-101. If necessary (e.g., to verify whether the RAI package contains proprietary information), the PM may provide the RAI package to the applicant informally, in accordance with NRR Office Instruction COM-203, "Informal Interfacing and Exchange of Information with Licensees and Applicants." The PM will provide the RAI package to the applicant formally by letter or letters. Once the applicant responds to the RAIs, the PM will coordinate review of the responses by the cognizant technical branches. The PM will also review the preliminary draft SER inputs for consistency, format, and content, and will provide feedback to the technical branches to assist in developing the "formal" draft SER sections as discussed in step (k) below.

(k) Assigned technical branches will develop sections of the draft SER, ensuring that requirements of 10 CFR Part 52 and other applicable regulations are met, and using the guidance of this RS (including in particular the technical guidance sections appended to Attachment 2 to this RS) and its references. Reviewers will ensure that the safety case in all assigned sections of the site safety assessment is adequately supported by clearly identified references as needed.

As discussed in Section 4.7 of this RS, each section of the SER will contain the subsections shown in Attachment 4 to this RS (introduction, regulatory evaluation, technical evaluation, and conclusions). Technical branches will use the general format specified in Attachment 4 unless agreed otherwise by the PM, in consultation with OGC, during the work planning process. Sample content for these subsections is provided in Attachment 4. Sample wording for the "Conclusions" subsection is found under "Evaluation Findings" in the technical guidance sections appended to Attachment 2 to this RS. The actual conclusions will be site- and application-specific.

The inputs to the draft SER will summarize the RAIs developed by the staff (if any) and the applicant's responses to the RAIs. If necessary, the draft SER may contain open items that remain to be addressed by the applicant. As described in Section 4.5 of LIC-101, the SER will include, or summarize and reference, docketed information substantively relied upon by the staff in making its findings. Important assumptions and limitations on the conclusions and findings in each SER section should be clearly identified. Each technical branch developing an input to the draft SER will work with the PM and with other technical branches (including secondary review branches

as designated in Attachment 2 to this RS) as needed during development to help ensure that the product submitted is consistent and complete.

(l) RNRP will provide guidance to the NRC's inspection staff on expected areas for inspection in support of the staff's review of an ESP application. In addition, the PM will request recommendations from the technical branches during development of the SER regarding areas that the NRC's inspection staff should inspect. The PM will compile inputs received and provide them to the inspection staff. When the draft SER is complete, the PM will also provide a copy of that document to the inspection staff. Additional information and references for the inspection process are provided in Section 4.6 of this RS.

(m) After the branches prepare the inputs to the draft SER, the technical staff-approved inputs will be provided (via internal memorandum from the cognizant section or branch chief) to the PM, who will compile the inputs into a single integrated SER. The PM is responsible for ensuring that the facts stated in the staff's SER are internally consistent and consistent with those set forth in the applicant's site safety assessment, and that the SER is clearly and professionally written. The PM will work with staff reviewers as needed to correct any identified deficiencies. The PM will then submit the draft SER for technical editing and will incorporate the technical edits where appropriate. If substantive changes are made to the SER, affected technical branches will be asked to reconcur. The completed SER will then be subjected to a review and concurrence process to verify its quality and internal consistency. If substantive changes are made to any input to the draft SER, the PM will notify the providing branch as soon as possible to minimize delays in concurrence caused by disagreements between the PM and technical branches. All technical branches that provided input to the draft SER will be on concurrence.

(n) The PM will obtain concurrence from OGC, whose review will ensure the draft SER is defensible and complete from a legal perspective, and that counsel has no legal objection to the document.

(o) As authorized by NRR Office Instruction ADM-200, "Delegation of Signature Authority," the Program Director, New, Research and Test Reactors Program, will approve the draft SER unless another official is designated for this responsibility during work planning for the ESP review.

(p) If necessary (e.g., to determine whether the draft SER contains proprietary information), the PM may provide the draft SER to the applicant informally, in accordance with COM-203. The PM will provide the draft SER to the applicant formally by letter. The draft SER will be issued as a draft NUREG document and made publicly available. The PM will provide a copy of the draft SER to the Advisory Committee on Reactor Safeguards (ACRS) for its review. (See Section 4.3 of this RS for additional information on the ACRS review.)

(q) If the draft SER contains open items, the applicant will respond to the open items, and the staff will then review the responses. The resolution of the open items will be described in the final SER. The final SER will be developed in a manner similar to the process just discussed for the draft SER. The staff will revise the draft SER and, after approval of the revised document, will issue it as the final SER. The final SER will be issued as a NUREG document and made publicly available.

(r) After the environmental review [discussed in more detail in step (b) of this section] is completed, the hearing (discussed in more detail in Section 4.2) is conducted, and the ACRS report (discussed in more detail in Section 4.3) is submitted to the Commission, the Commission will determine whether the ESP application meets applicable standards and requirements of the Atomic Energy Act and the Commission's regulations. The Commission will also determine whether required notifications have been made to other agencies or bodies. If these requirements have been met, the Commission will issue the ESP in accordance with 10 CFR 52.24, with conditions and limitations as the Commission deems appropriate and necessary.

4.2 Public Hearings

A hearing is required for the ESP proceeding. OGC is primarily responsible for coordinating the activities associated with the hearing process, with technical support from the staff. The process is governed by Subpart G of 10 CFR Part 2. The process begins with public notice of the hearing and an opportunity to intervene. The Commission may select one or more of its members, an Atomic Safety and Licensing Board (ASLB), or a named officer to preside over the proceeding. If the Commission does not so provide, the chairman of the Atomic Safety and Licensing Board Panel will designate an ASLB or an administrative law judge to preside over the proceeding.

Pursuant to 10 CFR 2.714, any person whose interest may be affected by a proceeding may file a written petition for leave to intervene within the time provided in the notice of hearing, or the time otherwise specified by the Commission, the presiding officer, or the ASLB. Before the first prehearing conference, such a petitioner must file a supplement to the petition that must include a list of contentions that the petitioner seeks to have litigated in the hearing. A petitioner will not be admitted as a party to the proceeding unless the petitioner submits at least one contention meeting the standards of 10 CFR 2.714. The ASLB or presiding officer rules on each petitioner's standing and the admissibility of the contentions, and any petitioner who is denied intervention may appeal to the Commission. If intervention is granted, discovery is conducted against the applicant and admitted intervenors. This phase of the hearing process occurs early during the staff's review of the application.

Once the staff has completed the SER and the EIS, the process of preparing for and conducting the hearing begins. Late-filed contentions based on the SER and EIS may be filed. In a contested proceeding (i.e., one in which intervention has been granted, or there is a controversy between the staff and the applicant concerning issuance of the

permit or its terms and conditions), discovery is then conducted against the staff, and motions for summary disposition may be filed. The parties prepare pre-filed testimony on the contentions remaining in issue. The presiding officer or ASLB then presides over the hearings. In an uncontested proceeding, the presiding officer or ASLB will consider the issues set forth in 10 CFR 2.104(b)(2) and (3), as specified in 10 CFR 52.21.

Upon conclusion of the hearings, all parties file proposed findings and reply findings. The ASLB or administrative law judge then issues its initial decision. Petitions for Commission review of the decision may be filed. The Commission then makes a decision on the ASLB/administrative law judge decision and decides whether to issue the ESP.

4.3 ACRS Review

As required by 10 CFR Part 52, the PM will provide a copy of the ESP application to the ACRS after the ESP application is accepted for docketing. The PM will also provide the completed draft SER (with open items, if applicable) to the Committee for its review. The PM will, soon after receipt of the ESP application, discuss the schedule for the Committee's review with the ACRS staff to ensure that Committee resources are available when needed for the review. The PM will also discuss with the ACRS the staff's plans for presentations to the Committee on the ESP application and the results of the staff's review of the application. The Committee will report to the Commission on those portions of the application that concern safety. The staff will include the ACRS report in the final SER, along with the staff's responses to the Committee's comments and recommendations.

4.4 Review Criteria

Attachments 2 and 3 identify areas to be reviewed for the SER and the EIS, respectively, and the primary and secondary NRC review branches for each area. The attachments are organized by NRC technical branch for ease of use. Primary review branch reviewers will:

(1) Review the areas of the site safety assessment or environmental report identified in the matrices in Attachments 2 and 3, respectively, that fall within the purview of their branches. The column labeled "Primary Review Branch" identifies the branch responsible for review and development of an SER section or for the review of the environmental impacts for a given area, while that labeled "Secondary Review Branch" identifies review areas in which the designated branch contributes to an SER or EIS section to be developed by another branch.

(2) Refer to the guidance documents listed in the Section and Comment/Additional Guidance columns of Attachments 2 and 3 for guidance on what to consider when conducting the review. For NUREG-0800 sections applicable to the ESP review and referenced in Attachment 2, references to "the plant" will be deemed to refer to "a nuclear power plant or plants of

specified type that might be constructed on the proposed site (or falling within a plant parameter envelope [PPE])."[3]

(3) Coordinate with reviewers of other branches, as necessary, to ensure that important aspects of a review area are adequately covered during the review.

(4) Document the results of their reviews (including all necessary inputs from other review branches) for the areas within the purview of their branch.

(5) Ensure that the reviews are conducted consistent with the review guidance and criteria contained in the guidance documents identified in Attachments 2 and 3 and that any deviations are approved by the appropriate branch chief and communicated with the PM or EPM, as applicable. It should be noted that the sample evaluation findings in each NUREG-0800 section and in each technical guidance section appended to Attachment 2 to this RS use language appropriate for the case in which the applicant has met the acceptance criteria in the section. Should the staff make the determination for a given section that one or more of the acceptance criteria have not been met, the actual findings for that section will need to describe how each criterion has been met or not met.

4.5 Use of Existing Information From Nearby Facilities for ESP Applications

An ESP applicant may use existing information about the site or facility in support of its application (letter to R. Simard of the Nuclear Energy Institute dated December 18, 2002). The NRC recognizes the advantages of licensing sites and plants in a mature industry environment, rather than in an emerging industry environment as was the case for the majority of the existing plant licenses. For example, an application for an ESP for a location at or near a site for which the NRC has previously granted a construction permit or operating license offers potential advantages over an application for a location for which no prior regulatory findings have been made. The NRC expects that applicants for ESPs will rely on previously filed siting information to the extent feasible, as is permitted under existing NRC regulations. An ESP applicant referencing such information needs to demonstrate that it is applicable to and appropriate for an ESP for its proposed site.

This issue was the subject of a Nuclear Energy Institute (NEI) petition for rulemaking (PRM), specifically PRM 52-1. The Commission, recognizing that there are practical limitations to using previously filed information and that there were insufficient legal bases for the petitioner's proposals, denied the petition. However, to ensure that future ESP applicants and the public understand the staff's review process, the Commission directed the NRC staff to articulate the specific criteria it will use to make its determination as to whether new siting information is necessary.

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[3] Attachment 2 provides guidance on review of site safety assessments that include a PPE, and Attachment 3 provides guidance on review of environmental reports that include a PPE.

For site safety and emergency planning, previously filed information should be evaluated in the individual technical evaluation sections of the SER. Each reference to previously filed information should be clear and specific. The evaluation should document why the information is relevant for the specific use. The staff's evaluation findings should support the staff's conclusions as to whether the applicable regulations have been met. Considerations on potential use of existing information for each aspect of an ESP application review follow.

(1) Docketing and Acceptance Review

In order for an ESP application to be reasonably complete and acceptable for the purposes of docketing and initiating the staff's statutory reviews, it is expected that the applicant would address:

- Why the data or information is relevant to the application and how it satisfies an ESP requirement or demonstrates conformance with guidance

- How such information is incorporated by reference (e.g., provide specific citations to the relevant documents or portions of documents including docket number, date, author, etc.)

(2) Technical Evaluation of Previously Filed Information

General Criteria

For all three aspects of the ESP technical review (i.e., site safety, emergency planning, and environmental protection), the staff should consider the following criteria when reviewing existing, previously filed information:

- Whether the use of the proposed site is similar in nature to the use that the previously filed information supported.

- Whether the proposed use of the site would warrant reconsideration of the previously filed information.

- Whether the specific characteristics of the proposed site (e.g., geography, geophysical, etc.), are similar in nature to those of the site described in the previously filed information. Specifically, the thickness and other engineering properties of soil layers may vary within a short distance. Applicability of the existing information would need to be confirmed by testing and/or investigation of the characteristics of the proposed site.

- Whether the siting measurements made and data used to support approval of the previous licensing action adequately address the parameters needed for the ESP.

- Whether there have been changes to applicable regulatory requirements, for which the applicant would need to indicate how the previously filed information would comply.

- Whether there have been changes to applicable regulatory guidance, for which the applicant would need to indicate how the previously filed information is valid for the new use.

- Whether there is new, applicable, and significant information associated with the site.

Additional guidance for site safety review

For the site safety review, in addition to the general criteria above, quality assurance measures that were applicable to the original collection and analyses of the existing site data should be described to the extent such measures are needed to support the ESP application as discussed in Section 17.1.1 in Attachment 2 to this review standard. Further, it is expected that any additional site characteristic measurements and analyses used to demonstrate the technical relevancy and validity of this existing site data would be performed using quality assurance measures consistent with Section 17.1.1 in Attachment 2 to this review standard. Quality assurance measures applied to existing site data referenced by an ESP application should be reviewed using the review guidance contained in Section 17.1.1.

Additional guidance for emergency planning review

For the emergency planning review, in addition to the general criteria above, the NRC staff will consult with the Federal Emergency Management Agency (FEMA) regarding the acceptability of existing state and local (i.e., offsite) emergency plans and preparedness information if the ESP applicant references such information. Emergency planning information for an existing, operating reactor site (i.e., from a prior licensing action) may be included in an ESP application; either directly, or through incorporation by reference. Such information will be reviewed to verify it (1) is applicable to the proposed site, (2) is up-to-date when the application is submitted, and (3) reflects use of the proposed site for possible construction of a new reactor (or reactors).

The extent to which emergency planning information for an operating reactor site will be reviewed will be dependent upon the specific ESP application. In general, the existing elements of an established emergency preparedness program and emergency planning information that are relevant to, and provided (or incorporated by reference) in the ESP application will be considered acceptable and adequate; and a detailed review will not be necessary. For example, the adequacy of an existing offsite siren system would not be subject to a detailed review.

The adequacy of such referenced elements of an existing emergency preparedness program for an operating reactor site that would include one or more proposed additional reactors would have to be adequately justified in the ESP application. The ESP application would need to clearly indicate the impact of applying an existing

emergency preparedness program element to the expanded use of the site, including addressing any necessary changes to the program in support of the new reactor(s). For example, letters of agreement, reflecting contacts and arrangements made with local and state governmental agencies with emergency planning responsibilities, might need to be revised to reflect the anticipated presence of an additional reactor (or reactors) at the site. Such revised letters of agreement should reflect any impact the additional reactor(s) would have on government agency emergency planning responsibilities, and should include acknowledgment by the agencies of the proposed expanded responsibilities.

Another acceptable method of addressing this issue would be through the use of separate correspondence. Such correspondence might be appropriate, for example, in a case for which an existing letter of agreement is written in a way that is broad enough to cover an expanded site use, and does not need to be revised. The correspondence would identify this fact.

Additional guidance for environmental protection review

Two tools are available to allow an ESP applicant to take advantage of previously-filed information that supports the environmental report. In 10 CFR 51.29(a), the NRC would use the scoping process to "identify and eliminate from detailed study those issues which are peripheral or are not significant or which have been covered by prior environmental review" and to identify other environmental assessments and impact statements that are "related to but are not part of the scope of the statement under consideration."

In addition, tiering allows Federal agencies to rely on previous environmental assessments (EAs) and EISs to aid in the presentation of issues, eliminate repetition, or reduce the size of an EIS. Tiering is encouraged by the Council on Environmental Quality (see 40 CFR 1520.20), and the NRC's regulations permit the use of tiering and incorporation by reference (see 10 CFR Part 51, Appendix A.1.(b)).

4.6 Additional Review Guidance

Additional guidance on certain subjects is provided in this subsection.

(1) Plant Parameter Envelope (PPE)

A PPE is a set of values of plant design parameters that an ESP applicant expects will bound the design characteristics of a reactor or reactors that might be constructed at a given site, and it serves as a surrogate for actual reactor design information. Use of this approach allows an ESP applicant to defer the decision on what design to build to the COL stage. An applicant may use a PPE as a surrogate for facility design information to support demonstration of compliance with 10 CFR 52.17 (letter to R. Simard of the Nuclear Energy Institute dated February 5, 2003). The staff expects that margins applied to account for uncertainties in PPE values will be identified in each application. Each staff reviewer should determine whether the PPE values are sufficient to support the review, and that the PPE values are not unreasonable for consideration in the staff

findings to comply with 10 CFR Part 52, Subpart A. Review guidance sections appended to Attachment 2 of this RS provide additional guidance on review of a PPE used in specific site safety assessment subject areas. In addition, Attachment 3 to this RS provides guidance on use of a PPE in the ER to support the staff's environmental review. Concerns regarding an applicant's use of PPE values in a reviewer's area should be discussed promptly with the PM or EPM as appropriate.

Given that PPE values do not reflect a specific design and will not be reviewed by the NRC staff for correctness, the granting of an ESP by the NRC does not indicate NRC approval of the site for any specific plant or type of plant. In addition to the emergency preparedness and environmental impact findings, site approval will be contingent on the staff's ability to make a finding, taking into consideration the site criteria contained in Subpart B of 10 CFR Part 100, that a reactor or reactors having design characteristics that fall within the PPE can be constructed and operated without undue risk to the health and safety of the public. This finding may result in conditions or limitations on the ESP in specific areas, as set forth in 10 CFR 52.24.

The combination of site characteristics and PPE values will comprise the ESP bases that will be the focus for comparison should a COL application be submitted for the site. COL applicants who reference an ESP bear the risk that the design ultimately selected for the approved site might fall outside of the terms and conditions of the ESP.

(2) ESP Duration

The staff has documented (letter to R. Simard of the Nuclear Energy Institute dated February 5, 2003) certain positions regarding the duration of an ESP. Each ESP applicant is expected to seek a specified permit duration in accordance with 10 CFR 52.27. The staff will then review the application from the perspective of the proposed permit duration. Factors considered with respect to the requested duration include the uncertainties of the application information and data provided (e.g., parameters such as population distributions and man-made hazards) and the uncertainties of the methodologies used to make future projections. The staff's review with respect to time-dependent site characteristics should be based on values representative of the end-of-life (i.e., ESP expiration) conditions at the site.

Each staff reviewer should consider whether the information in the ESP application supports the acceptability of the requested ESP duration for that reviewer's subject area. Shortcomings in the submitted information should be addressed through the RAI process. For example, if any of the application information regarding site characteristics (e.g., meteorology, geology) can only be demonstrated to be reliable for an interval less than the requested time period, the cognizant reviewer should develop RAIs to seek additional information to support determinations that those characteristics will be acceptable for the requested ESP duration.

SER inputs should reflect determinations regarding whether there is reasonable assurance that information submitted supports the duration requested. Pursuant to 10 CFR 52.24, the Commission will issue an ESP in the form, and containing the conditions and limitations, that the Commission deems appropriate and necessary.

Should the NRC staff determine, after the receipt of RAI responses, that the information submitted does not support the requested time period, the staff will notify the ESP applicant of that fact to provide the applicant with an opportunity to supplement its application. The applicant can either provide additional information to support the full duration requested, or it can amend its application to revise the duration requested.

(3) Site Preparation Work and Limited Construction Activities

The regulations in 10 CFR 52.25 allow the ESP holder the option of performing site preparation work and limited construction activities allowed by 10 CFR 50.10(e)(1) without seeking the separate authorization required by that section. The applicant should identify the activities that it seeks to perform in the ESP application. In addition, the applicant must provide, in accordance with 10 CFR 52.17(c), a site redress plan in the event those activities are performed and the ESP expires before it is referenced in an application for a construction permit or COL. The application must provide reasonable assurance that redress carried out under the plan will achieve an environmentally stable and aesthetically acceptable site. If the staff concludes in the EIS that the plan meets these criteria, the plan can be incorporated into the ESP, and the applicant may carry out the activities allowed by 10 CFR 50.10(e)(1) without obtaining the separate authorization required by that section.

Should an ESP applicant submit a site redress plan, RLEP will review the applicant's site redress plan in accordance with guidance in NUREG-1555 as indicated in Attachment 3 to this RS and will document, in the EIS, its conclusions regarding the adequacy of the plan for redressing the impacts of the activities allowed by 10 CFR 50.10(e)(1).

4.7 Documentation of Review (SER)

Attachment 4 contains a sample SER template for use in reviewing a safety assessment for an ESP application and developing the resulting SER. Reviewers will do the following:

(1) Adapt or revise the text in the sample SER to capture site-specific information, and add text as needed, using Attachment 2 to this RS and its references for guidance.

(2) Develop the regulatory evaluation section in the SE for assigned areas of review as appropriate for the licensing basis of the site under review, using the guidance of Attachment 4 to this RS and Section 4.5 of LIC-101.

(3) Summarize their technical review and findings in the technical evaluation sections of the SE for assigned review areas as discussed in Section 4.5 of LIC-101.

(4) Review the conclusions sections of the sample SER, as well as the evaluation findings subsections in guidance sections appended to Attachment 2 of this RS (or NUREG-0800 sections if shown in Attachment 2 as applicable), for guidance on documenting conclusions reached as a result of the review.

(5) Recognize that section headings for the SER are intended to closely adhere to the organization of this RS, which is consistent with the headings in NUREG-0800. Because many parts of NUREG-0800 are inapplicable for the ESP stage, there will be gaps in the heading numbers in the SER for an ESP application. RNRP will indicate in the SER why these sections are inapplicable.

(6) Provide evaluations (including a regulatory evaluation, technical evaluation, and conclusion section) related to areas not covered by the Attachment 2 if necessary. Intent to provide such additional evaluations should be discussed early in the review process with RNRP. (This guidance is intended to cover cases for which, on a site-specific basis, it is determined that additional sections are necessary to appropriately cover the applicant's request and to ensure that the site-specific SE adequately describes the staff's review effort related to the site-specific application.)

(7) Identify areas (e.g., confirmatory items) for which inspection by the NRC's inspection staff is recommended.

(8) Identify proposed conditions or limitations on an ESP should one eventually be issued to a given applicant.

4.8 Inspection Guidance

The Inspection Manual Chapter (IMC) 2500 series describes the inspection process for the construction of nuclear power reactors through the startup and operations phase. IMC 2501 describes the ESP phase of reactor licensing under the 10 CFR Part 52 regulatory process. It provides guidance for inspectors to use in conducting inspections during the pre-application and post-application phase in support of the hearing required by the Atomic Energy Act. Subsequent manual chapters provide specific guidance to inspectors on what to inspect during the various phases of construction of nuclear power plants.

5.0 PRIMARY CONTACT

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6.0 RESPONSIBLE ORGANIZATION

NRR/DRIP/RNRP

7.0 EFFECTIVE DATE

8.0 REFERENCES

(1) 54 FR 15372, 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants”

(2) NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants”

(3) NUREG-1555, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants”

(4) NRR Office Instruction LIC-101, “License Amendment Review Procedures”

(5) NRR Office Instruction COM-203, “Informal Interfacing and Exchange of Information with Licensees and Applicants”

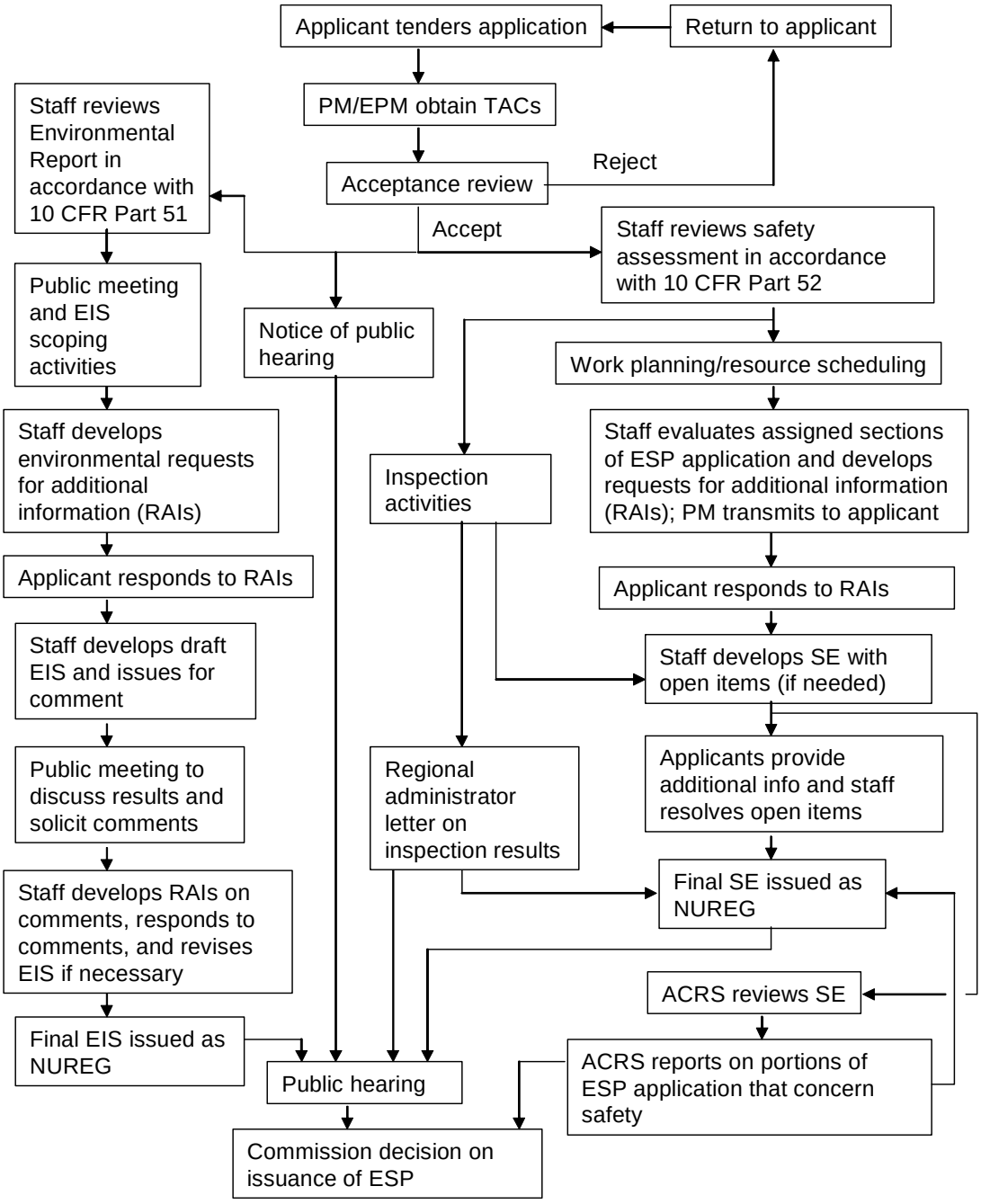
(6) NRR Office Instruction LIC-204, “Handling Requests to Withhold Proprietary Information from Public Disclosure”

(7) NRR Office Instruction ADM-200, “Delegation of Signature Authority”

(8) NRC Inspection Manual Chapter 2501, “Nuclear Reactor Inspection Program, Early Site Permit”

ATTACHMENT 1

ESP Review Process



ATTACHMENT 2

Early Site Permit
Scope and Associated Review Guidance for Site Safety Assessment

Area of Review	Primary Review Branch	Secondary Review Branch	Guidance Section	NUREG-0800 Section	Sample Safety Evaluation Section	Comment/Additional Guidance
Primary Review Branch: SPSB						
Site Location and Description	SPSB	IEPB	2.1.1	N/A	2.1.1	.
Exclusion Area Authority and Control	SPSB	IEPB	2.1.2	N/A	2.1.2	See NRC letter dated August 27, 2003 (ML032120350) for additional information on this subject
Population Distribution	SPSB	IEPB	2.1.3	N/A	2.1.3	
Identification of Potential Hazards in Site Vicinity	SPSB	None	2.2.1 2.2.2	N/A	2.2.1	
Evaluation of Potential Accidents	SPSB	None	2.2.3	N/A	2.2.3	
Regional Climatology	SPSB	None	2.3.1	N/A	2.3.1	
Local Meteorology	SPSB	None	2.3.2	N/A	2.3.2	
Onsite Meteorological Measurement Programs	SPSB	None	2.3.3	N/A	2.3.3	
Short-term Dispersion Estimates for Accidental Atmospheric Releases	SPSB	None	2.3.4	N/A	2.3.4	
Long-Term Diffusion Estimates	SPSB	IEPB	2.3.5	N/A	2.3.5	
Aircraft Hazards	SPSB	None	3.5.1.6	N/A	3.5.1.6	Guidance focuses on accidental aircraft hazards rather than the likelihood or consequences of an intentional aircraft attack

Area of Review	Primary Review Branch	Secondary Review Branch	Guidance Section	NUREG-0800 Section	Sample Safety Evaluation Section	Comment/Additional Guidance
Radiological Consequences of Design Basis Accidents	SPSB	None	15.0	N/A	15.0	See NRC letters dated February 5, 2003 (ML030210341) and June 20, 2003 (ML031150617) for additional information on this subject
Primary Review Branch: EMEB						
Hydrologic Description	EMEB	None	2.4.1	N/A	2.4.1	
Floods	EMEB	None	2.4.2	N/A	2.4.2	
Probable Maximum Flood (PMF) on Streams and Rivers	EMEB	None	2.4.3	N/A	2.4.3	
Potential Dam Failures	EMEB	None	2.4.4	N/A	2.4.4	
Probable Maximum Surge and Seiche Flooding	EMEB	None	2.4.5	N/A	2.4.5	
Probable Maximum Tsunami Flooding	EMEB	None	2.4.6	N/A	2.4.6	
Ice Effects	EMEB	None	2.4.7	N/A	2.4.7	
Channel Diversions	EMEB	None	2.4.9	N/A	2.4.9	
Low Water Considerations	EMEB	None	2.4.11	N/A	2.4.11	
Groundwater	EMEB	None	2.4.12	N/A	2.4.12	
Accidental Releases of Liquid Effluents in Ground and Surface Waters	EMEB	IEPB	2.4.13	N/A	2.4.13	

Area of Review	Primary Review Branch	Secondary Review Branch	Guidance Section	NUREG-0800 Section	Sample Safety Evaluation Section	Comment/Additional Guidance
Basic Geologic and Seismic Information	EMEB	None	Note 1	2.5.1	2.5.1	Additional applicable guidance: Regulatory Guides 1.132,1.138, and 1.198. References to Civil Engineering and Geosciences Branch (ECGB) should be changed to Mechanical and Civil Engineering Branch (EMEB).
Vibratory Ground Motion	EMEB	None	Note 1	2.5.2	2.5.2	Additional applicable guidance: Regulatory Guides 1.132, 1.138, and 1.198. References to Civil Engineering and Geosciences Branch (ECGB) should be changed to Mechanical and Civil Engineering Branch (EMEB).
Surface Faulting	EMEB	None	Note 1	2.5.3	2.5.3	Additional applicable guidance: Regulatory Guides 1.132, 1.138, and 1.198. References to Civil Engineering and Geosciences Branch (ECGB) should be changed to Mechanical and Civil Engineering Branch (EMEB).
Stability of Subsurface Materials and Foundations	EMEB	None	2.5.4	N/A	2.5.4	
Stability of Slopes	EMEB	None	2.5.5	N/A	2.5.5	
Primary Review Branch: IEPB						
Emergency Planning	IEPB	SPSB	13.3	N/A	13.3	
Quality Assurance Measures	IEPB	EMEB SPSB	17.1.1	N/A	17.1.1	
Primary Review Branch: NSIR						
Physical Security	NSIR	None	Note 2	N/A	13.6	

NOTE 1: No guidance sections are provided in this RS for SER Sections 2.5.1, 2.5.2, and 2.5.3. Reviewers should use the identified sections of NUREG-0800 as guidance for reviews of the associated subject areas.

NOTE 2: In lieu of a guidance section on physical security in this RS, the NRC staff has provided guidance to the first three prospective ESP applicants by three substantially identical letters (ML030980003, ML030980029, and ML030980083). Staff reviewers should use these letters for review guidance for the ESP applications to which they apply. However, the NRC's security orders referenced in the letters are, by their nature, subject to modification depending on changes in the terrorist threat. The security orders do not form part of the licensing basis of the early site permit and should not be imposed as conditions of prospective permits. Therefore, the security review of ESP applications should be based on the requirements of 10 CFR Parts 100 and 73 or other applicable existing regulations. The staff will develop generic review guidance for this subject in the future.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.1.1 SITE LOCATION AND DESCRIPTION

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - Emergency Preparedness and Plant Support Branch (IEPB)

I. AREAS OF REVIEW

For this section of the safety assessment for an early site permit (ESP) application, site location is reviewed (1) as identified by latitude and longitude and by the UTM[1] coordinate system; (2) with respect to political subdivisions; and (3) with respect to prominent natural and man-made features of the area to ascertain the accuracy of the applicant's site safety assessment description and for use in independent reviews of the exclusion area authority and control (Section 2.1.2 of this review standard), the surrounding population (Section 2.1.3 of this review standard) and nearby man-made hazards (Section 2.2.3 of this review standard).

The site area which would contain the reactor or reactors of specified type (or falling within a plant parameter envelope [PPE]) and associated principal plant structures is reviewed to determine the distance from the proposed site of the reactor or reactors to boundary lines of the exclusion area, including the direction and distance from the reactor(s) to the nearest exclusion area boundary line. A scaled plot plan of the exclusion area, which permits distance measurements to the exclusion area boundary in each of the 22-1/2 degree segments centered on the 16 cardinal compass points, is reviewed. The location of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site within the exclusion area is reviewed to identify potential release points and their distances to exclusion area boundary lines. The location and distance of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site from highways, railways, and waterways which traverse or lie adjacent to the exclusion area are reviewed. The reviews should verify that the location and distances are adequately described to permit analyses (Section 2.2.3 of this review standard) of the possible effects of accidents on these transportation routes on a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. The applicant may choose to provide orientation of structures if such information is available. The locations and descriptions of nearby industrial, military, and transportation facilities and routes should be noted and identified for review under Section 2.2.3.

The IEPB, as part of its primary review responsibility for Section 13.3 of this review standard, will determine whether the site location and description present any physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans.

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[1] Universal Transverse Mercator coordinate system as found on USGS topographical maps.

II. ACCEPTANCE CRITERIA

The acceptance criteria for site location and description are based on meeting the relevant requirements of 10 CFR 52.17 and 10 CFR Part 100, Subpart B. The relevant requirements of these regulations are:

1. 10 CFR Part 100, Subpart B as it relates to site acceptance being based on the consideration of factors relating to the proposed reactor design and the site characteristics.

2. 10 CFR 52.17 as it relates to the applicant submitting information needed for evaluating factors involving the use characteristics of the site environs.

The information submitted by the applicant is adequate and meets the 10 CFR 52.17 requirements if it satisfies the following criteria:

The site location, including the exclusion area and the proposed location of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, are described in sufficient detail to allow a determination (in Sections 2.1.2, 2.1.3, and 15.0 of this review standard) that 10 CFR Part 100 Subpart B is met.

Highways, railroads, and waterways which traverse the exclusion area are sufficiently distant from planned or likely locations of structures of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site so that routine use of these routes is not likely to interfere with normal plant operation (Ref. 1).

Information included in this safety assessment section should allow two types of safety analyses to be conducted. The first addresses the radiological consequences in the unlikely event that a serious release of radioactive material should occur. The second addresses the effect that accidents on, or routine use of, routes on or near the site will have on the operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

III. REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this safety assessment 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 nuclear power plants or sites, and whether items of special safety significance are involved.

The information in this section of the safety assessment forms the basis for evaluations performed in various other sections. The purpose of this review is to establish the validity of the basic data, to check the UTM coordinates to ensure that they include the zone number, and that the Northing and Easting are presented to within 100 meters. The latitude and longitude should be checked to ensure that they are expressed to the nearest second.

Cross-check the exclusion area distances with distances used in the accident analyses in safety assessment Section 15.0. Scale the map provided to check distances specified in the safety assessment and to determine the distance-direction relationships to exclusion area boundaries, roads, railways, waterways, and other significant features of the area.

If, in the reviewer's judgment, maps of larger scale are desirable, they may be obtained from the U.S. Geological Survey (USGS). The USGS map index should be consulted for the specific names of the 7-1/2 minute quadrangles that bracket the site area. If available, these maps provide topographic information in addition to details of prominent natural and man-made features in the site area. This information may be supplemented by updated information as available, e.g., aerial photographs or information obtained on the site visit. Check to determine that the plant location with respect to nearby roads, railways, and waterways is clearly shown. Check to see that there are no obvious ways in which transportation routes which traverse the exclusion area can interfere with normal plant operations.

Site Visit

A visit to the site under review permits a better understanding of the physical characteristics of the site and its relationship to the surrounding area. It permits the reviewer to gather information, independent of that supplied in the safety assessment, which is useful in confirming safety assessment data.

Site visits should be made after initial review of the site data in the safety assessment has been completed and the reviewer has become generally familiar with the site and surrounding areas. Since one of the purposes of the site visit is to discuss the preliminary review findings with the applicant, the reviewer should plan to be in the site area one or two days in advance of the scheduled meeting with the applicant. This will permit gathering information from visits to local offices of Federal, State, and county governments, industries, military facilities, etc. Specific visits to these offices should be made on the basis of the particular site characteristics and is left to the judgment of the individual reviewer. The reviewer should note that some of the local offices may have been contacted by the environmental reviewer. Generally, information sought by the respective reviewers is similar in scope but will differ in emphasis. To avoid duplication of visits to local officials, the reviewer should contact the Project Manager and, where feasible, arrange for a joint visit to those local offices in which there is a common interest. Sources investigated should include such State and local agencies as those concerned with population and land use and land use controls (zoning boards). County engineers are sources of information on public roads and traffic volumes. Local Councils of Government may have information on population growth, proposed new industries or transportation routes. Information sought should encompass, whenever possible, data in support of the review procedures for safety assessment Sections 2.1.3, 2.2.1, 2.2.2, and 2.2.3.

If information gathered indicates the need for clarification of data contained in the safety assessment, this should be discussed with the applicant in the subsequent meeting on preliminary review findings.

IV. EVALUATION FINDINGS

The reviewer verifies that the information submitted by the applicant is in accordance with 10 CFR 52.17 requirements so that compliance with 10 CFR Part 100, Subpart B can be evaluated.

Summary descriptions of the site location, the site itself, and transportation routes on or near the site will be prepared for the staff safety evaluation report. Any deficiencies of site parameters with respect to a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site will be noted.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52 (Ref. 2). 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.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria."

2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - Emergency Preparedness and Plant Support Branch (IEPB)

I. AREAS OF REVIEW

For this section of the site safety assessment for an early site permit (ESP) application, the applicant's legal authority to determine all activities within the designated exclusion area is reviewed. The regulations at 10 CFR 100.3 require that a reactor licensee have authority to determine all activities within the designated exclusion area, including the exclusion or removal of personnel and property.

In any case where the applicant does not own all the land, including mineral rights, within the designated exclusion area, assistance may be required of the Office of the General Counsel (OGC) in determining whether or not the designated exclusion area meets the requirements of 10 CFR Part 100 (Ref. 1). Also, in some cases public roads which lie within the proposed exclusion area may have to be abandoned or relocated to permit construction of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. Assistance from OGC may be required to ensure that no legal impediments to such abandonment or relocation are likely to ensue. Part 100 permits the exclusion area to be traversed by a highway, railroad, or waterway provided arrangements are made to control these areas in event of an emergency.

Activities that may be permitted within the designated exclusion area, and that will not be related to routine operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site are reviewed. Review should include the type of activity, its specific location within the exclusion area, the number and kinds of persons engaged in the activity, and the frequency and length of time the activities are to be permitted. The SPSB (with input from the IEPB) will determine whether individuals associated with unrelated activities within the exclusion area can be evacuated prior to receiving doses in excess of the reference values of 10 CFR 50.34(a)(1).

II. ACCEPTANCE CRITERIA

Acceptance criteria are based on meeting the relevant requirements of 10 CFR Part 100 with respect to the applicant's legal authority with the designated exclusion area. 10 CFR Part 100 (Ref. 1) in Section 100.3 states:

> *Exclusion area* means that area surrounding the reactor, in which the reactor licensee has the authority to determine all activities including exclusion or removal

> of personnel and property from the area. This area may be traversed by a highway, railroad or waterway, provided these are not so close to the facility as to interfere with normal operations of the facility and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway, in case of emergency, to protect the public health and safety.... Activities unrelated to operation of the reactor may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result.

To meet the requirements of 10 CFR Part 100 the applicant must demonstrate, prior to issuance of an ESP, that it has the authority within the exclusion area as required by Section 100.3, or must provide reasonable assurance that it will have such authority prior to start of construction. Absolute ownership of all lands within the exclusion area, including mineral rights, is considered to carry with it the required authority to determine all activities on this land and is acceptable.

Where the required authority is contingent upon future procurement of ownership (e.g., by eminent domain proceedings), or by lease, easement, contract, or other means, the exclusion area may be acceptable if OGC can determine that the information provided by the applicant provides reasonable assurance that the required authority will be obtained prior to start of construction. In cases where ownership and control is to be acquired or completed during a construction period, a special review by OGC will be required. Also, in cases of proposed public road abandonment or relocation, OGC should determine that there is sufficient authority or that sufficient arrangements have been made to accomplish the proposed relocation or abandonment. At the combined license (COL) stage of review, the applicant should have completed arrangements to determine all activities within the exclusion area. The applicant will not be permitted to load fuel until exclusion area authority and control, including all transfers of title, easements, lease arrangements, public road abandonments or relocations, as applicable, are completed.

To meet the exclusion area control requirement of 10 CFR 100.21(a) and 100.3, it is not necessary that an ESP applicant demonstrate total control of the property prior to issuance of an ESP. However, the applicant should provide the staff sufficient information to determine that there is reasonable assurance that, prior to commencing activities allowed by 10 CFR 52.25, the applicant will have the authority to control all activities within the exclusion area, including the exclusion or removal of people and property from the area. In addition, where the applicant submits a redress plan, there should be reasonable assurance that the applicant will have the right to carry out that redress plan. In determining what constitutes reasonable assurance, the staff will look to precedent set in previous NRC decisions involving the issuance of construction permits and limited work authorizations.[1] In the event that an ESP applicant does not have the control required by 10 CFR 100.21(a) and 100.3, but provides reasonable assurance that it will

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[1] *See, e.g., Washington Public Power Supply System* (WPPSS Nuclear Project Nos. 3 and 5), LBP-77-25, 5 NRC 964 (April 8, 1977); *Duke Power Company* (Cherokee Nuclear Station, Units 1, 2, and 3), LBP-76-18, 3 NRC 627 (May 21, 1976); and *Duquesne Light Company, et al.* (Perry Nuclear Power Plant, Units 1 and 2), LBP-74-76, 8 AEC 701 (October 20, 1974).

acquire such control, a condition could be placed in the ESP requiring the applicant to notify the staff that the applicant has indeed acquired such control and the basis for that conclusion.

Activities unrelated to operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site within the exclusion area are acceptable provided:

(a) Such activities, including accidents associated with such activities, represent no significant hazard to a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, or are to be accommodated as part of the plant design basis at the COL stage. (See Section 2.2.3 of this review standard.)

(b) The applicant is aware of such activities and has made appropriate arrangements to evacuate persons engaged in such activities, in the event of an accident, and

(c) There is reasonable assurance that persons engaged in such activities can be evacuated without receiving radiation doses in excess of the reference values of 10 CFR 50.34(a)(1).

Where the designated exclusion area extends into bodies of water such as a lake, reservoir, or river which is routinely accessible to the public, the reviewer should determine that the applicant has made appropriate arrangements with the local, state, Federal, or other public agency having authority over the particular body of water. The reviewer should determine that the arrangements made provide for the exclusion and ready removal in an emergency, by either the applicant or the public agency in authority, of any persons on those portions of the body of water which lie within the designated exclusion area.

References 2, 3, and 4 contain pertinent Atomic Safety and Licensing Board (ASLB) and Atomic Safety and Licensing Appeal Board (ASLAB) decisions which deal with exclusion area determinations in contested cases.

III. REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this review standard 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 nuclear power plants, and whether items of special safety significance are involved.

The reviewer should determine the basis on which the applicant claims authority within the exclusion area. If absolute ownership of all lands, including mineral rights, within the area is demonstrated, the acceptance criteria are satisfied. If any other method is claimed as providing the required authority, a memorandum should be prepared for OGC containing all of the appropriate information in the safety assessment, including copies of applicable safety assessment pages and figures, and requesting a written response as to whether or not the applicant's claimed authority meets the requirements of 10 CFR 100.3. In any case where there are technical reasons which the reviewer believes make the applicant's proposed method unacceptable, these reasons should be described and discussed in the memorandum. If the exclusion area extends into a body of water such as a lake, reservoir, or river, the area of the body of water encompassed should be reviewed against the guidelines of Part 100 regarding

control of access and activities unrelated to operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. The extent of the exclusion area over a waterway should be reviewed on a case-by-case basis.

The memorandum should also include information in the safety assessment which describes the applicant's plans, procedures, and schedule for obtaining any abandonment or relocation of public roads which may be necessary. At the COL stage, review will emphasize those areas where the applicant did not possess absolute authority at the ESP review.

If the designated exclusion area is traversed by a highway, railway, waterway, or other transportation route accessible to the public, the reviewer should determine that the applicant's emergency plan includes adequate provisions for control of traffic on these routes in the event of an emergency. At the ESP stage, a finding that such provisions are feasible is adequate.

IV. EVALUATION FINDINGS

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

> As set forth above, the applicant has appropriately described the exclusion area, the authority under which all activities within the exclusion area can be controlled, and the methods by which access and occupancy of the exclusion area can be controlled during normal operation and in the event of an emergency situation. In addition, the applicant has the required authority to control activities within the designated exclusion area, including the exclusion and removal of persons and property, and has established acceptable methods for control of the designated exclusion area. Therefore, the staff concludes that the applicant's exclusion area is acceptable and meets the requirements of 10 CFR Part 100.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52 (Ref. 6). 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.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria."

2. The Cleveland Electric Illuminating Company, et. al. (Perry Nuclear Power Plant, Units 1 and 2), "Supplemental Partial Initial Decision, Site Suitability and Environmental Matters," LBP-74-76, 8 AEC 701 (October 20, 1974).

3. Southern California Edison Company, et. al. (San Onofre Nuclear Generating Station, Units 2 and 3), "Decision," ALAB-248, 8 AEC 951 (December 24, 1974).

4. Southern California Edison Company, et al. (San Onofre Nuclear Generating Station, Units 2 and 3), "Decision," ALAB-268 1-NRC 383 (April 25, 1975).

5. 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities.”

6. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.1.3 POPULATION DISTRIBUTION

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - Emergency Preparedness and Plant Support Branch (IEPB)

I. AREAS OF REVIEW

The SPSB reviews the population data in the site environs as presented in the applicant's site safety assessment, 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 (Ref. 1) to determine whether the population density is such [as given in Position C.4 of Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations" (Ref. 2)] that consideration should be given by the applicant to alternate sites with lower population density.

A secondary review is performed by the IEPB and the written results are used by SPSB to complete the overall evaluation of the facility. The IEPB determines, as a primary review responsibility for Section 13.3 of this review standard, whether the population distribution presents any physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans.

II. ACCEPTANCE CRITERIA

SPSB acceptance criteria are based on meeting the relevant requirements of the following regulations:

1. 10 CFR 52.17 as it relates to having each applicant provide a description and safety assessment of the site , with special attention to the site evaluation factors identified in 10 CFR Part 100.

2. 10 CFR 52.17 as it relates to emergency planning requirements.

3. 10 CFR Part 100, Subpart B 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.

The regulations at 10 CFR 100.3 also provide definitions and other requirements for determining an exclusion area, low population zone, and population center distance.

The applicable requirements of 10 CFR 52.17, 10 CFR Part 50, 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 population center distance (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 lifetime of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site (plus the term of the early site permit [ESP]) 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 the safety assessment are acceptable if (a) they contain population data for the latest census, projected year(s) of startup of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site (such date or dates reflecting the term of the ESP) and projected year(s) of end of plant life, all in the geographical format given in Section 2.1.3 of Reference 3; (b) they describe the methodology and sources used to obtain the population data, including the projections; (c) they include information on transient populations in the site vicinity; and (d) the population data in the site vicinity, including projections, are verified to be reasonable by other means such as U.S. Census publications, publications from State and local governments, and other independent projections.

6. If the population density at the ESP stage exceeds the guidelines given in Position C.4 of Regulatory Guide 4.7, special attention to the consideration of alternative sites with lower population densities is necessary. A site that exceeds the population density guidelines of Position C.4 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.

III. REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this section of this review standard 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 nuclear power plants, and whether items of special safety significance are involved. Determine that the population data contained in the safety assessment are in the detail and in the format described in Reference 3, Section 2.1.3.

Compare the population data presented in the safety assessment against whatever independent population data are available (e.g., Census Bureau internet data/CD-ROMs/DVDs from the decennial Census of Population and Housing, special census which may have been conducted, local and State agencies, councils of government, etc.). Note any significant differences which need clarification.

Compare the safety assessment population projections against 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 safety assessment which need clarification.

At the ESP stage, use the population and its distribution, including weighted transients, projected to the year(s) of startup of the nuclear power plant or plants that might be constructed on the proposed site (such date or dates reflecting the term of the ESP) and projected over the lifetime(s) of the plant or plants, to determine the population density in persons per square mile as a function of distance from the plant site out to 20 miles. Compare results to the safety assessment plot of population density vs distance (Reference 3, Section 2.1.3.6). If the population density, including weighted transient population, projected at the time of initial operation exceeds 500 persons per square mile averaged over any radial distance out to 20 miles (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 square mile averaged over any radial distance out to 20 miles, a memorandum should be prepared advising appropriate staff personnel that an evaluation of alternative sites having lower population densities will be needed.

Determine that the safety assessment includes a map of the low population zone and a table of population distribution which includes transients (Reference 3, Section 2.1.3.4). Determine the method used by the applicant to establish the boundary of the nearest population center (Reference 3, Section 2.1.3.5). Evaluate communities which are closer to the site than the design population center to determine the likelihood that any of them can be projected to 25,000 people within the lifetime of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site (plus the term of the ESP). Compare the population center distance to 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, "2000 Census of Population - Characteristics of the Population," or other Census Bureau publications and data sets.

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

Determine that the closest population center distance 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 site and the nearest population grouping which has, or is projected to have during the lifetime of the nuclear power plant or plants that might be constructed on the proposed site (plus the term of the ESP), a population of about 25,000. Use whatever data are 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 site to determine the potential growth in population density toward the site. The population center boundary should be established at that point nearest the plant site 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 (Refs. 4 and 5). Where a very large city is involved, a greater distance than the one and one-third factor may be necessary, and appropriate additional compensating engineered safeguards may be necessary. These will be evaluated on a case-by-case basis, and where appropriate, a memorandum should be prepared by SPSB providing any recommendations.

IV. EVALUATION FINDINGS

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

> As set forth above, the applicant has provided an acceptable description and safety assessment of the site which contains present and projected population densities which, at the early site permit (ESP) stage, are within the guidelines of Position C.4 of Regulatory Guide 4.7, and the applicant 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 (including transients) surrounding the site. Therefore, the staff concludes that the population data provided are acceptable and meet the requirements of 10 CFR 52.17 and 10 CFR Part 100.

The SPSB and IEPB shall determine (and document in Section 15.0 of the SER) that the radiological consequences of bounding design basis accidents at the outer boundary of the low population zone meet the requirements of 10 CFR 52.17 and 52.18. (Section 15.0 of this review standard provides guidance for this determination.)

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52 (Ref. 6). 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 and NUREGs.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria."

2. Regulatory Guide 4.7, "General Site Suitability for Nuclear Power Stations," Revision 2 (1998)

3. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3 (1978).

4. NUREG-0308, Safety Evaluation Report, Arkansas Nuclear One, Unit 2. November 1977 and supplements.

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

6. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.2.1 - 2.2.2 IDENTIFICATION OF POTENTIAL HAZARDS IN SITE VICINITY

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary -None

I. AREAS OF REVIEW

For an early site permit (ESP) application, the site and its vicinity are reviewed for relative location and separation distance with respect to industrial, military, and transportation facilities and routes. Such facilities and routes include air, ground, and water traffic, pipelines, and fixed manufacturing, processing, and storage facilities. They also include any existing nearby nuclear power plants. The review focuses on potential external hazards or hazardous materials that are present or which may reasonably be expected to be present during the projected lifetime of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site . The purpose of this review is to establish the information concerning the presence and magnitude of potential external hazards so that the reviews and evaluations described in Sections 2.2.3 and 3.5.1.6 of this review standard can be performed.

II. ACCEPTANCE CRITERIA

The regulations in 10 CFR 52.24 require that an ESP application meet the applicable standards and requirements of the Atomic Energy Act and the Commission regulations. With respect to site hazards, 10 CFR 100.20 requires that site acceptance be based on, among other considerations, the use characteristics of the site environs. In accordance with 10 CFR 52.17, the application is required to contain information needed for evaluating these factors. Non-seismic siting criteria are provided in 10 CFR 100.21. Guidelines for specific information requirements are described in Chapter 2, Sections 2.2.1 and 2.2.2 of Regulatory Guide (RG) 1.70.

The information submitted by the applicant is adequate and meets the 10 CFR 52.17, 10 CFR 100.20, and 10 CFR 100.21 requirements and RG 1.70 guidelines if it satisfies the following criteria:

1. Data in the site safety assessment adequately describe the locations and distances of industrial, military, and transportation facilities in the vicinity of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, and are in agreement with data obtained from other sources, when available.

2. Descriptions of the nature and extent of activities conducted at the site and nearby facilities, including the products and materials likely to be processed, stored, used, or transported, are adequate to permit identification of possible hazards in subsection III of this section.

3. Sufficient statistical data with respect to hazardous materials are provided to establish a basis for evaluating the potential hazard to a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

III. REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this review standard section will be made by the reviewer on each case. The judgment of 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 for other sites, and whether items of special safety significance are involved. The following procedures are followed:

1. The reviewer should be especially alert, in the ESP review, for any potentially hazardous activities in close proximity to the site, since the variety of activities having damage potential at ranges under about 1 kilometer can be very extensive. All identified facilities and activities within 8 kilometers (5 miles) of the plant site should be reviewed. Facilities and activities at greater distances should be considered if they otherwise have the potential for affecting safety-related features of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. For sites with existing plants, most hazards will already have been identified. Emphasis should be placed on any new information. For such sites, any existing analyses pertaining to potential accidents involving hazardous materials or activities on or in the vicinity of the site will be reviewed to ensure that results are appropriate in light of any new data or experience which is available at the time of review.[1] Facilities that are likely to either produce or consume hazardous materials should be investigated as possible sources of traffic of hazardous materials past the site.

2. Information should be obtained from sources other than the safety assessment wherever available, and should be used to check the accuracy and completeness of the information submitted in the safety assessment. This independent information may be obtained from sources such as U.S. Geological Survey (USGS) maps and aerial photos, published documents, contacts with State and Federal agencies, and from other ESP or nuclear plant applications (especially if they are located in the same general area or on the same waterway). Information should also be obtained during the site visit and subsequent discussions with local officials. (See Section 2.1.1 of this review standard for further guidance with regard to site visits.) To the extent that definitive information is available, future potential hazards over a time period that includes the proposed life of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site (plus the term of the ESP) should be reviewed.

3. The specific information relating to types of potentially hazardous material, including distance, quantity, and frequency of shipment, is reviewed to eliminate as many of the potential accident situations as possible by inspection, based on past review experience. For sites with existing plants, nearby industrial, military, and transportation facilities and transportation routes will be reviewed for any changes or additions which may affect the safe operation of a nuclear power plant or plants of specified type (or falling within a

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[1] Potential impacts of nearby existing nuclear facilities on a reactor or reactors that might be constructed on the proposed site should also be addressed.

PPE) that might be constructed on the proposed site. If these changes alter the data or assumptions used in previous hazards evaluations or demonstrate the need for new ones, appropriate evaluations will be performed.

Although detailed plant design information may not be available for the ESP review, the following specific references may provide useful guidance in the review of potential releases of hazardous materials. For pipeline hazards, Reference 6 may be used as an example of an acceptable risk assessment. For cryogenic fuels, Reference 8 may be used, and for tank barge risks, Reference 7. For aviation, guidance from Section 3.5.1.6 of this review standard may be used. References 9 and 10 also provide useful information. Safe separation distances for explosives are identified in References 1 and 2, and for toxic chemicals, Reference 3 should be consulted.

The distance from nearby railroad lines is checked to determine if a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site is within the range of a "rocketing" tank car which, from Reference 4, is taken to be 350 meters with the range for smaller pieces extending to 500 meters.

If a nuclear power plant or plants to be sited involves bulk storage of hazardous materials, e.g. liquid or compressed hydrogen or oxygen, the associated hazards will have to be addressed once this design information is identified (at the combined license stage if not available at the ESP stage). References 13 and 14 may be used for guidance to assess hazards associated with the storage and use of these materials.

The reviewer should determine whether bulk storage of propane exists on site. Propane may be used for incineration of low-level radioactive waste (dry combustible waste or contaminated oil). Reference 14 contains appropriate review guidance to assess the risk associated with the storage and use of propane.

4. Potential accidents which cannot be eliminated from consideration as design basis events because the consequences of the accidents, if they should occur, could be serious enough to affect safety-related features of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, are identified. Potential accidents so identified will have to be addressed at the combined license stage if sufficient design detail information is not available at the ESP stage.

IV. EVALUATION FINDINGS

The reviewer verifies that the information submitted by the applicant is in accordance with 10 CFR 52.17 requirements and within RG 1.70 guidelines such that compliance with 10 CFR Part 100 can be evaluated. The information is sufficiently complete and adequate if it can support conclusions of the following type, to be used in the staff's ESP safety evaluation report:

As set forth above, the applicant has provided information in the safety assessment on potential site hazards in accordance with the requirements of 10 CFR 52.17 and with the guidance of Regulatory Guide 1.70, such that compliance with 10 CFR 100.20 and 100.21 can be evaluated. The nature and extent of activities involving potentially hazardous materials which are conducted at nearby industrial, military, and transportation facilities have been evaluated to

identify any potential hazards from such activities which might pose undue risk to the type of facility proposed for the site [or falling within the applicant's PPE]. Therefore, based on evaluation of information contained in the safety assessment, as well as information independently obtained by the staff, the staff concludes that all potentially hazardous activities on and in the vicinity of the site have been identified. The hazards associated with these activities have been reviewed and are discussed in Sections _____ and _____ of this SER.

If the activities are identified as being potentially hazardous, the evaluations are performed using applicable review guidance. For example, in most cases aircraft hazards may be evaluated at the ESP stage using Sections 2.2.3 and 3.5.1.6 of this review standard. In the event the identified hazards (including aircraft hazards) cannot be addressed at the ESP stage due to the unavailability of plant design information, they will be evaluated at the combined license stage.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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 and NUREG.

VI. REFERENCES

1. Department of the Army Technical Manual TM5-1300, "Structures to Resist the Effects of Accidental Explosions," June 1969.

2. Regulatory Guide 1.91, "Evaluation of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plant Sites."

3. Regulatory Guide 1.78, Rev. 1, "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release.", December, 2001.

4. National Transportation Safety Board Railroad Accident Report, "Southern Railway Company, Train 154, Derailment with Fire and Explosion, Laurel, Mississippi, January 25, 1969," October 6, 1969.

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

6. NUREG-0014 Safety Evaluation Report, Hartsville Nuclear Plants A1, A2, B1, and B2, April 1976, Docket STN 50-518.

7. Safety Evaluation of the Beaver Valley Power Station, Unit No. 2, November 9, 1976 and supplements. Docket 50-412.

8. Safety Evaluation Report, Hope Creek Generating Station, Units 1 and 2, Supplement No. 5, March 1976, Docket 50-354 and 50-355.

9. NUREG/CR-2859, “Evaluation of Aircraft Crash Hazard Analyses for Nuclear Power Plants,” June 1982.

10. DOE-STD-3014-96, “Accident Analysis for Aircraft Crash into Hazardous Facilities,” October 1996.

11. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

12. 10 CFR Part 100, “Reactor Site Criteria."

13. NRC Staff Safety Evaluation Report (July 1987) contained in Electric Power Research Institute (EPRI) Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installation - 1987 Revision."

14. Safety Evaluation Relating to the Operation of a Mobile Volume Reduction System, August 13, 1986, Commonwealth Edison Company, Dresden Station, Unit Nos. 2 and 3, Docket Nos. 50-237 and 50-249.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.2.3 EVALUATION OF POTENTIAL ACCIDENTS

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

For an early site permit (ESP) application, the applicant's identification of potential accident situations on site and in the vicinity of the site is reviewed to determine its completeness as well as the bases upon which these potential accidents may need to be considered in the design of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. (See Sections 2.2.1 and 2.2.2 of this review standard.)

With respect to potential accidents on or in the vicinity of the site which could affect control room habitability (e.g., toxic gases, asphyxiants), those accidents which are to be accommodated on a design basis, as determined within the review conducted using Section 2.2.3 of this review standard, will need to be addressed within the design of the nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site and reviewed at the combined license (COL) stage (if the information is not available at the ESP stage) using NUREG-0800 Section 6.4.

The applicant's probability analyses of potential accidents involving hazardous materials or activities on site and in the vicinity of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, if such analyses have been performed, are reviewed to determine that appropriate data and analytical models have been utilized.

The analyses of the consequences of accidents involving nearby industrial, military, and transportation facilities are reviewed to determine if any of them need to be identified as design basis events.

II. ACCEPTANCE CRITERIA

The SPSB acceptance criteria are based on meeting the relevant requirements of 10 CFR 52.17, 10 CFR 100.20, and 10 CFR 100.21 as they relate to the factors to be considered in the evaluation of sites. These requirements stipulate that individual and societal risk of potential plant accidents must be low.

Specific criteria necessary to meet the relevant requirements of 10 CFR 100.20 and 100.21 are described in the following paragraphs.

Offsite and onsite hazards which have the potential for causing onsite accidents leading to the release of significant quantities of radioactive fission products, and thus pose an undue risk of

public exposure, should have a sufficiently low probability of occurrence and be within the scope of the low probability of occurrence criterion of 10 CFR 100.20. Specific guidance with respect to offsite hazards is provided in Chapter 2, Section 2.2.3, of Regulatory Guide (RG) 1.70 (Ref. 3). As indicated therein, the identification of design basis events resulting from the presence of hazardous materials or activities on site and in the vicinity of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site is acceptable if the design basis events include each postulated type of accident (as discussed in Subsection III below) for which the expected rate of occurrence of potential exposures in excess of the 10 CFR 100.21 guidelines is estimated to exceed the NRC staff objective of approximately 10^{-7} per year. Because of the difficulty of assigning accurate numerical values to the expected rate of unprecedented potential hazards generally considered in this section of this review standard, judgment must be used as to the acceptability of the overall risk presented.

The probability of occurrence of initiating events having the potential for causing consequences in excess of 10 CFR Part 100 exposure guidelines should be estimated using assumptions that are as representative of the specific site as is practicable. In the absence of a specific plant design, past review experience of existing plants and judgment should be factored into the determination of the need for identifying a site hazard as a design basis event. In addition, because of the low probabilities of the events under consideration, data are often not available to permit accurate calculation of probabilities. Accordingly, the expected rate of occurrence of an initiating event of approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

III. REVIEW PROCEDURES

In some cases it may be necessary to consult with or obtain specific data from other branches, such as the Materials and Chemical Engineering Branch (EMCB), the Mechanical and Civil Engineering Branch (EMEB), or the Plant Systems Branch (SPLB), regarding analyses of site hazards and/or their possible effects on structures or components of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

The applicant's probability calculations are reviewed, and an independent probability analysis is performed by the staff if the potential hazard is considered significant enough to affect the licenseability of the site or is important to the identification of design basis events.

All stochastic variables that affect the occurrence or severity of the postulated event are identified and judged to be either independent or conditioned by other variables.

Probabilistic models should be tested, where possible, against all available information. If the model or any portion of it, by simple extension, can be used to predict an observable accident rate, this test should be performed.

The design parameters (e.g., overpressure) and physical phenomena (e.g., gas concentration) selected by the applicant for each design basis event are reviewed to ascertain that the values are comparable to the values used in previous analyses and found to be acceptable by the staff.

If accidents involving release of smoke, flammable or nonflammable gases, or toxic chemical bearing clouds are considered to be design basis events, then, for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site,

an evaluation of the effects of these accidents on control room habitability will need to be made in accordance with NUREG-0800 Section 6.4 and on the operation of diesels and other safety-related equipment in accordance with NUREG-0800 Chapter 9. If the design details necessary for this evaluation are not available at the ESP stage, the evaluation will need to be done at the COL stage.

Similarly, special attention should be given to the review of a site where several sources of a particular type of manmade hazard are identified, but none of which, individually, has a probability exceeding the acceptance criteria stated herein. The objective of this should be to estimate the aggregate probability of an outcome. (A hypothetical example is a situation where the probability of a significant shock wave is about 10^{-7} per reactor year from accidents at a nearby industrial facility, and approximately equal probabilities from railway accidents, highway accidents, and shipping accidents. Individually each may be judged acceptably low; the aggregate probability may be judged sufficiently great that it would be identified as a design basis event.)

IV. EVALUATION FINDINGS

If the reviewer, after a review of the onsite and offsite hazards identified in Section 2.2.1/2.2.2 of this review standard and evaluated in the above section of this review standard, concludes that there are no identifiable design basis events, then the staff concludes that the site is acceptable for siting a nuclear power plant or plants of specified type (or falling within the PPE submitted by the applicant). If one or more design basis events are identified with respect to the site, then the site may be found to be acceptable if the design of a nuclear power plant or plants of specified type (or falling within the applicant's PPE) that might be constructed on the proposed site is shown to adequately accommodate their effects, such that the probability of exceeding the 10 CFR Part 100 dose guidelines is within the acceptance criteria of Section 2.2.3 of this review standard. A conclusion of the following type may be prepared for the staff's Safety Evaluation Report.

> As set forth above, the applicant has identified potential accidents related to the presence of hazardous materials or activities on site and in the site vicinity which could affect a nuclear power plant of type specified by the applicant, and from these the applicant has selected those which, in accordance with the relevant requirements of 10 CFR Part 100, should be considered as design basis events at the combined license (COL) stage. Therefore, the staff concludes that the site location is acceptable with regard to potential accidents that could affect a nuclear power plant of type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed on the site and meets the relevant requirements of 10 CFR Part 52.

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the NRC staff's plan for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposes an acceptable alternate 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.

VI. REFERENCES

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

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. Affidavit of Jacques B. J. Read before the Atomic Safety and Licensing Board in the matter of Skagit Nuclear Power Project, Units 1 and 2, July 15, 1976. Docket Nos. STN 50-522, 523.

5. Atomic Safety and Licensing Board, Supplemental Initial Decision in the Matter of Hope Creek Generating Station, Units 1 and 2, March 28, 1977. Docket Nos. 50-354, 355.

6. Section 2, Supplement 2 to the Floating Nuclear Plant Safety Evaluation Report, Docket No. STN 50-437, September 1976.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.1 REGIONAL CLIMATOLOGY

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application concerns averages and extremes of climatic conditions and regional meteorological phenomena which affect the safe design and siting of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. The review covers the following specific areas:

1. A description of the general climate of the region with respect to types of air masses, synoptic features (high- and low-pressure systems and frontal systems), general airflow patterns (wind direction and speed), temperature and humidity, precipitation (rain, snow, and sleet), and relationships between synoptic-scale atmospheric processes and local (site) meteorological conditions.

2. Seasonal and annual frequencies of severe weather phenomena, including tornadoes, waterspouts, thunderstorms, lightning, hail (including probable maximum size), and high air pollution potential.

3. Meteorological conditions used as design and operating bases, including:

    a. The maximum snow and ice load (water equivalent) that the roofs of safety-related structures must be capable of withstanding during plant operation.

    b. Ultimate heat sink meteorological conditions resulting in the maximum evaporation and drift loss of water and minimum water cooling.

    c. Tornado parameters, including translational speed, rotational speed, and the maximum pressure differential with the associated time interval.

    d. 100-year return period "straight-line winds," including vertical profiles and gust factors.

    e. Probable maximum frequency of occurrence and time duration of freezing rain (ice storms) and, where applicable, dust (sand) storms.

f. Other meteorological and air quality conditions used for design and operating basis considerations.

II. ACCEPTANCE CRITERIA

The information regarding the regional meteorological conditions and phenomena which would affect the safe design and siting of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed at the proposed site is acceptable if it meets the requirements of the following regulations:

1. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena" (Ref. 1), with respect to information on severe regional weather phenomena that have historically been reported for the region and that are reflected in the design bases for structures, systems, and components important to safety,

2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases" (Ref. 2), with respect to information on tornadoes that could generate missiles, and

3. 10 CFR Part 100, §100.20(c) and §100.21(d) (Ref. 3), with respect to the consideration that has been given to the regional meteorological characteristics of the site.

The information should be presented in accordance with accepted practice.

Regulatory positions and specific criteria necessary to meet the Commission's regulations identified above are as follows:

1. The description of the general climate of the region should be based on standard climatic summaries compiled by NOAA (Refs. 4, 5). Consideration of the relationships between regional synoptic-scale atmospheric processes and local (site) meteorological conditions should be based on appropriate meteorological data (Refs. 5, 6).

2. Data on severe weather phenomena should be based on standard meteorological records from nearby representative National Weather Service (NWS), military, or other stations recognized as standard installations which have long periods on record. The applicability of these data to represent site conditions during the expected period of reactor operation should be substantiated (Refs. 5, 6, 7).

3. Design basis tornado parameters may be based on Regulatory Guide 1.76 (Ref. 8) or the staff's interim position on design basis tornado characteristics (Ref. 9). ESP applicants may use any design-basis tornado wind speeds that are appropriately justified, but must conduct a technical evaluation of site-specific data.

4. Design basis straight-line wind velocity should be based on appropriate standards, with suitable corrections for local conditions (Refs. 10, 11).

5. The ultimate heat sink meteorological data, as stated in Regulatory Guide 1.27 (Ref. 12), should be based on long-period regional records which represent site conditions.

Suitable information may be found in climatological summaries (e.g. Refs. 10 or 11 or similar publications) for evaluation of wind, temperature, humidity, and other meteorological data used for ultimate heat sink design.

6. Freezing rain estimates should be based on representative NWS station data.

7. High air pollution potential information should be based on U.S. Environmental Protection Agency (EPA) studies (Refs. 13, 14).

8. All other meteorological and air quality data used for safety-related plant design and operating bases should be documented and substantiated.

III. REVIEW PROCEDURES

1. General Climate

The general climatic description of the region in which the site is located is reviewed for completeness and authenticity. Climatic parameters such as air masses, general airflow, pressure patterns, frontal systems, and temperature and humidity conditions reported by the applicant are checked against standard references (Refs. 4 and 5) for appropriateness.

The applicant's description of the role of synoptic-scale atmospheric processes on local (site) meteorological conditions is checked against the descriptions provided in References 5 and 6.

2. Regional Meteorological Averages and Extremes

Estimates of meteorological averages and extremes can only be obtained from stations that have long periods of record. It is not likely that meteorological stations used to describe the regional climatology will be near the proposed site, with the possible exception of stations at existing nuclear power plants near which an ESP site might be located. Therefore, one of the primary concerns of this review is a determination of the representativeness of the available data for the site. The adequacy of the stations and their data is also evaluated.

Meteorological averages and extremes are checked against standard publications to determine if the design-basis meteorological data presented are reasonable. Climatological data summaries suitable for review of the applicant's values are published by organizations such as the American Society of Civil Engineers (e.g., Ref. 10); the American Society of Heating, Refrigerating, and Air-Conditioning Engineers; and the American National Standards Institute. Climatological data suitable for use in this review are available from the National Climatic Data Center. For example, the Engineering Weather Data CDROM (Ref. 11) contains data summaries prepared by the U.S. Air Force Combat Climatology Center.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that the staff's evaluation supports concluding statements of the following type to be included in the staff's safety evaluation report:

> As set forth above, the applicant has presented and substantiated information relative to the regional meteorological conditions of importance to the safe design and siting of a nuclear power plant of type specified by the applicant that might be constructed on the proposed site. The staff has reviewed the available information provided. Based on [summarize bases for conclusion], the staff concludes that the identification and consideration of the regional and site meteorological characteristics meet the requirements of 10 CFR 100.20(c) and 10 CFR 100.21(d).
>
> The applicant has presented and substantiated information regarding severe regional weather phenomena. The staff has reviewed the information provided and, based on [summarize bases for conclusion], concludes that the identification and consideration of the severe weather phenomena at the site and the surrounding area meet the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," with respect to establishing the design bases for structures, systems, and components important to safety.
>
> The applicant has conformed with the position set forth in the staff's interim position on design basis tornado characteristics [or with Regulatory Guide 1.76] or has conducted a technical evaluation of site-specific tornado data sufficient to justify that values that deviate from the interim position [or from Regulatory Guide 1.76] are appropriate for the site. Therefore, the staff concludes that the identification and consideration of tornadoes are acceptable and meet the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases," with respect to determining the design basis tornado for the generation of missiles.

These statements should be preceded by a resume of the general climate and the meteorological design parameters used for the plant.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

3. 10 CFR Part 100, “Reactor Site Criteria.”

4. U.S. Department of Commerce, "Climate Atlas of the United States, "National Climatic Data Center, NOAA. CD-ROM.

5. U.S. Department of Commerce, "Local Climatological Data - Annual Summary with Comparative Data," National Climatic Data Center, NOAA, published annually for all first-order NWS stations.

6. U.S. Department of Commerce, "State Climatological Summary," National Climatic Data Center, NOAA, published annually by State.

7. U.S. Department of Commerce, "Storm Data," National Climatic Data Center, NOAA, published monthly.

8. Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants."

9. Interim staff position on tornadoes, letter dated March 25, 1988, from NRC to the Advanced Light Water Reactor (ALWR) Utility Steering Committee, Subject: ALWR Design Basis Tornado.

10. ASCE Standard No. 7-98, " Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers, 2000.

11. U.S. Department of Commerce, "Engineering Weather Data," National Climatic Data Center, NOAA. CD-ROM.

12. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

13. G. C. Holzworth, "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States," AP-101, Office of Air Programs, USEPA, January 1972.

14. J. Korshover, "Climatology of Stagnating Anticyclones East of the Rocky Mountains, 1936-1970," Publication No. 99-AP-34, Public Health Service, October 1971.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.2 LOCAL METEOROLOGY

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application concerns the local (site) meteorological parameters. It also addresses the potential influence of construction and operation of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) on local meteorological conditions that might in turn adversely impact such plant(s) or their associated facilities. Finally, it covers a topographical description of the site and its environs. The review covers the following specific areas.

1. A description of the local (site) meteorology in terms of airflow, temperature, atmospheric water vapor, precipitation, fog, atmospheric stability, and air quality.

2. An assessment of the influence on the local meteorological parameters listed in (1) of construction and operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site and its facilities, including the effects of plant structures, terrain modification, and heat and moisture sources due to plant operation.

3. A topographical description of the site and its environs, as modified by the structures of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, including the site boundary, exclusion zone, and low population zone.

II. ACCEPTANCE CRITERIA

Local meteorological and topographic descriptions of the site area both before construction and during operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site should be presented so that meteorological impacts on plant design and operation, as well as the impact on local meteorological conditions of the nuclear power plant or plants and its/their facilities, can be predicted. The information should be fully documented and substantiated as to its representativeness of conditions at and near the site. The information is acceptable if it meets the requirements of the following regulations:

1. 10 CFR Part 50, Appendix A, General Design Criterion 2 (GDC 2), "Design Bases for Protection Against Natural Phenomena," (Ref. 1) with respect to information on the most

severe local weather phenomena that have historically been reported for the site and the surrounding area and that are reflected in the design bases for structures, systems, and components important to safety.

2. 10 CFR Part 100 (Ref. 2), §100.20(c) and §100.21(d) with respect to the consideration that has been given to the local meteorological and air quality characteristics of the site and other physical characteristics of the site that can influence the local meteorology.

Specific criteria necessary to meet the requirements of GDC 2 and 10 CFR Part 100 are as follows:

1. Local meteorological data based on onsite measurements and data from nearby National Weather Service stations or other standard installations should be presented in the format specified in Regulatory Guide 1.70, Section 2.3.2 (Ref. 3). Regulatory Guide 1.23[1] (Ref. 4) provides guidance related to onsite meteorological measurements.

2. A complete topographical description of the site and environs out to a distance of 50 miles from the site should be provided. Regulatory Guide 1.70 (Ref. 3), Section 2.3.2.2, provides guidance on the topographical description.

3. A discussion and evaluation of the influence of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site and its/their facilities on local meteorological and air quality conditions should be provided. A discussion of potential changes in the normal and extreme values as presented in the safety assessment resulting from plant construction and operation should be made. The acceptability of the information is determined through comparison with standard assessments (Refs. 5 and 6).

III. REVIEW PROCEDURES

Section 2.3 of the safety assessment is reviewed for content based on the specifications outlined in Regulatory Guide 1.70 (Ref. 3).

1. The summaries listed in Section 2.3.2.1 of Regulatory Guide 1.70 (Ref. 3) are reviewed for completeness and adequacy of basic data. The wind and atmospheric stability data should be based on onsite data (Ref. 4), because airflow and vertical temperature structure, which can vary substantially from one location to another, are necessary for assessment of atmospheric diffusion conditions at the site. The other summaries should be based on data from nearby representative stations with long periods of record because the locally measured values are not likely to provide reliable estimates of the intensity or frequency of extremes. Extreme values are compared to design basis values presented in the safety assessment and are used by other branches to determine whether the meteorological conditions are limiting conditions for design and emergency procedures. When offsite data are used, a determination is made of how

[1]References in Regulatory Guide 1.23 to Appendix D to 10 CFR Part 50 should be read as references to 10 CFR Part 51. For ESP applications, references in Regulatory Guide 1.23 to 10 CFR 100.10 should be read as references to 10 CFR 100.20.

well the data represent site conditions and whether more representative data are available. National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center summaries (Refs. 7 and 8) and other standard climatological summaries related to structural design (Refs. 9 and 10) are used by the reviewer to evaluate the representativeness of stations and periods of record. The reviewer should be familiar with all primary meteorological data collection locations.

2. The reviewer ensures that all topographic maps and topographic cross sections presented by the applicant are legible and well labeled so that the information needed during the review can be readily extracted. Reference points and the direction of true north should be checked carefully. Points of interest such as structures of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, site boundary, and exclusion zone should be marked on the maps and diagrams.

   The reviewer compares the applicant's assessment of the effect of topography on local meteorological conditions to standard assessments such as those presented in "Meteorology and Atomic Energy - 1968" (Ref. 5) and "Atmospheric Science and Power Production" (Ref. 6) and decides whether the standard regulatory atmospheric diffusion models (discussed in Sections 2.3.4 and 2.3.5 of this review standard) are appropriate for the proposed site.

3. The reviewer evaluates the contents of Section 2.3.2 of the safety assessment as follows:

   a. Determine the terrain modifications that are likely to occur as a result of construction of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, such as removal of trees, leveling of ground, and installation of lakes and ponds.

   b. Determine the location, size, and materials used for structures of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, including buildings, switchyard gear, parking lots, and roads.

   c. Determine and quantify the heat and moisture sources that would be expected to result from operations of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

   d. Relate the input information in items a, b, and c, above, to modification of local meteorology so that the impact of the modifications on plant design and operation can be determined.

   e. Determine air quality conditions used for design and operating basis considerations.

   f. Compare the reviewer's assessment with that of the applicant.

4. The reviewer provides the findings on the acceptability of the meteorological parameters identified at the ESP stage that will be used by the Mechanical and Civil Engineering Branch (and other branches as necessary) for review of the adequacy of the design of structures, systems and components (SSCs) important to safety during the combined license (COL) review. Acceptability at the ESP stage is based on a review of the justification for the values of meteorological site characteristics provided by the ESP applicant. The site characteristics also include any meteorological site characteristics related to potential facility operation considerations (such as heat dissipation) that may have an impact on safety issues such as fogging and icing. To the extent that the ESP applicant provides appropriate bounding information about the SSCs and facility operation in its ESP application, impacts of local meteorology on SSCs important to safety and on facility operation should be fully resolved at the ESP stage, subject to confirmation at the COL stage that the actual SSCs and facility operation are within the bounding parameters and values specified at the ESP stage.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that the staff evaluation supports concluding statements of the following type, to be included in the staff's safety evaluation report:

> As set forth above, the staff has reviewed available information relative to local meteorological and air quality conditions that are of importance to the safe design and siting of a nuclear power plant of a type specified by the applicant [or a plant falling within the PPE submitted by the applicant] and its facilities that might be constructed on the proposed site. On this basis, the staff concludes that the identification and consideration of the meteorological and topographical characteristics of the site and the surrounding area meet the requirements of 10 CFR 100.20(c) and 100.21(d) and are sufficient for determination of the acceptability of the site. The staff has determined that the applicant has provided and substantiated information on local meteorological and air quality conditions and characteristics, including severe weather phenomena.
>
> Based on [summarize bases for conclusion], the staff also concludes that the applicant's identification and consideration of the severe local weather phenomena at the site and in the surrounding area are acceptable and meet the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," with respect to establishing the design bases for structures, systems, and components important to safety.

These statements will be preceded by a summary of local meteorological and air quality parameters appropriate for the site.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

2. 10 CFR Part 100, Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or after January 10, 1997."

3. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

4. Regulatory Guide 1.23, "Onsite Meteorological Programs."

5. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

6. Darryl Randerson (ed.), "Atmospheric Science and Power Production," DOE/TIC-27601, U.S. Department of Energy (1984).

7. U.S. Department of Commerce, "State Climatological Summary," National Climatic Data Center, NOAA, published annually by state.

8. U.S. Department of Commerce, "Local Climatological Data - Annual Summary with Comparative Data," National Climatic Data Center, NOAA, published annually for all first-order NWS stations.

9. ASCE Standard No. 7-98, "Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers," 2000.

10. U.S. Department of Commerce, "Engineering Weather Data," National Climatic Data Center, NOAA. CD-ROM.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.3 ONSITE METEOROLOGICAL MEASUREMENTS PROGRAMS

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application concerns the onsite meteorological measurements programs, including instrumentation and measured data. The review covers the following specific areas:

1. Meteorological instrumentation, including siting of sensors, sensor performance specifications, methods and equipment for recording sensor output, the quality assurance program for sensors and recorders, and data acquisition and reduction procedures.

2. Meteorological data, including consideration of the period of record and amenability of the data for use in characterizing atmospheric dispersion conditions.

3. Additional meteorological measurement requirements for emergency preparedness planning pursuant to 10 CFR 50.47 (Ref. 1) and Appendix E to 10 CFR Part 50 (Ref. 2) are reviewed by SPSB as a secondary review responsibility for Section 13.3 of this review standard.

II. ACCEPTANCE CRITERIA

The acceptance criteria for the onsite meteorological measurement program are based on the relevant requirements of the following regulations:

1. 10 CFR 100.20(c) 100.21(c), and 100.21(d) (Ref. 3) as related to meteorological data collected for use in characterizing meteorological conditions of the site and surrounding area.

2. 10 CFR Part 50, Appendix I (Ref. 4), as related to meteorological data used in determining the compliance with the numerical guides for doses to meet the criterion of "as low as is reasonably achievable."

Specific criteria necessary to meet Part 100 and Appendix I are as follows:

1. The onsite meteorological measurements programs should produce data that describe the meteorological characteristics of the site and its vicinity for the purpose of making

atmospheric dispersion estimates for both postulated accidental and expected routine airborne releases of effluents and for comparison with offsite sources to determine the appropriateness of climatological data used for design considerations. The criteria for an acceptable onsite meteorological measurements program are documented in the Regulatory Position, Section C, of Regulatory Guide 1.23[1] (Ref. 5).

2. For the ESP application, at least one annual cycle of onsite meteorological data should be provided at docketing. (Ref. 6)

Meteorological data should be presented in the form of joint frequency distributions of wind speed and wind direction by atmospheric stability class in the format described in Regulatory Guide 1.23. If a site has a high occurrence of low wind speeds, a finer category breakdown should be used for the lower speeds so data are not clustered in a few categories. A listing of each hour of the hourly-averaged data should be provided on electronic media in the format described in Appendix A to this section of this review standard.

Evidence of how well these data represent long-term conditions at the site should be presented.

III. REVIEW PROCEDURES

1. Meteorological Instrumentation

The basic meteorological parameters measured by instrumentation are reviewed and should include wind direction and wind speed at two levels, ambient air temperature difference between two levels, temperature, and atmospheric moisture (at sites where water vapor is emitted, as from cooling towers or spray ponds).

a. Instrument Siting

Instrument types, heights, and locations are compared generally to the position stated in Regulatory Guide 1.23, Positions C.1 and C.2. Detailed review procedures follow. Information sources such as References 7 and 8 may be used during the review.

(1) Local Exposure of Instruments

The local exposure of the wind and temperature sensors is reviewed to ensure that the measurements will represent the general site area. A determination is made whether the tower which supports the sensors will influence the wind or temperature measurements. Professional experience and studies have shown that wind sensors should be mounted on booms such that the sensors are at least two tower widths away from an open-latticed tower. For temperature sensors, mounting booms need not be as long as those for wind sensors but should be

[1] References in Regulatory Guide 1.23 to Appendix D to 10 CFR Part 50 should be read as references to 10 CFR Part 51. For ESP applications, references in Regulatory Guide 1.23 to 10 CFR 100.10 should be read as references to 10 CFR 100.20.

unaffected by thermal radiation from the tower itself. No temperature sensors may be mounted directly on stacks or closed towers. Mounting booms for all sensors should be oriented normal to the prevailing wind at the site.

A determination is made whether the terrain at or near the base of the tower will affect the wind or temperature measurements. Heat reflection characteristics of the surface underlying the meteorological tower (grass, soil, gravel, paving, etc.) are considered to ensure that localized influences on measurements are minimal. The position, size, and materials of nearby structures and vegetation are also examined for potential localized influence on the measurements.

(2) General Exposure of Instruments

Since the objective of the instrumentation is to provide measurements which represent the overall site meteorology without structure interference, the tower position(s) should have been selected with this general objective in mind. Examination of topographical maps, which have been modified to show the likely finished grade of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site, a site visit, and professional judgment on airflow patterns are used to evaluate the representativeness of the measurement location(s).

The planned structure layout of the nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site (to the extent known), including structure heights, is examined to identify potential influence on meteorological measurements. Sensors should be located at least 10 obstruction heights away from an obstruction to minimize the influence of the obstruction on measurements.

b. Meteorological Sensors

The type and performance specifications of the sensors are evaluated. Manufacturers' specifications and analysis, and operating experience for these sensors are considered in evaluation of adequacy with respect to accuracy and the potential for acceptable data recovery. References 8 through 11, as well as operational experience reports contained in research papers that describe sensors, may be used in this evaluation.

The suitability of the specific type of sensor for use in the environmental conditions at the site is evaluated. To this end, the range of wind conditions and the ability of the sensors to withstand corrosion, blowing sand, salt, air pollutants, birds, insects, lightning, icing, and humidity are considered.

If the sensors are new and unique, a meteorological instrumentation expert may need to be consulted.

c. Transmission and Recording of Meteorological Sensor Output

The methods of data transmission and recording (e.g., digital or analog, instantaneous or average, engineering units or raw voltages) and the recording equipment, including performance specifications and location of this equipment, are evaluated. Manufacturers' specifications and operating experience for the transmission and recording systems are considered in evaluation of adequacy with respect to accuracy and data recovery.

The environmental conditions in which the transmission and recording systems are kept are reviewed for adequacy in accordance with the manufacturers' specifications. The ability to obtain a direct readout in situ during routine inspection of systems is checked to ensure that the inspector will be able to relate the output directly to the sensor measurement. Some specific guidelines are contained in Regulatory Guide 1.23, Position C.3. Additional information is provided in Refs. 8 and 12.

The reviewer determines that there are provisions for proper display of measurements of wind direction, wind speed, and vertical temperature difference in the control room during operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

d. Instrumentation Surveillance

The inspection, maintenance, and calibration procedures and their frequency are evaluated. These surveillance procedures and the frequency of attention that the instrumentation systems receive are compared to operating experience at this site and other sites with similar instrumentation with the objective of determining that acceptable data recovery with acceptable accuracy will be obtained throughout the duration of the meteorological program. Regulatory Guide 1.23, Positions C.4 and C.5 describe acceptable accuracy and data recovery rates. Additional information is provided in Refs. 8, 9, and 12.

e. Data Acquisition and Reduction

Procedures, including hardware and software for data acquisition and reduction, are evaluated. Since there are many methods of acquiring data from meteorological measurement systems which are acceptable to the staff, the review procedure varies. The basic components of the program which are reviewed to ascertain the acceptability of data acquisition and reduction are:

(1) accuracy of direct measurements and their precision,

(2) accuracy in conversion of direct measurement units to meteorological units,

(3) adequacy of frequency and mode (instantaneous or average) of sampling,

(4) averaging time of system outputs for final disposition and accuracy of these data, and

(5) identification and handling of suspect data.

Regulatory Guide 1.23 guidance on accuracy refers to overall system accuracy for time-averaged values. Therefore, the overall system accuracy is evaluated in addition to the component (sensor, recorder, and reduction) accuracies. The evaluation consists primarily of using statistical procedures for compound errors, based on sensor accuracy, recorder accuracy, conversion of units accuracy, and frequency and mode of sampling (Ref. 13).

2. Meteorological Data Summaries

Annual (i.e., representing the annual cycle) joint frequency distributions of wind direction and wind speed by atmospheric stability class are evaluated for sufficient detail to permit the staff to make an independent determination of the atmospheric dispersion conditions.

The format of the data (joint frequency distributions and hourly averages) is reviewed to ensure that it will be usable by the staff. The formats in Regulatory Guide 1.23 and in Appendix A to this section of this review standard are used for comparison. If a site has a high occurrence of low wind speeds, a finer category breakdown should be used for the lower speeds so data are not clustered in a few categories.

"Calm" wind conditions (which should be defined as wind speeds less than the starting speed of the anemometer or vane, whichever is higher) are checked for reasonableness. For the joint frequency distribution summary, they should be in the distributions as a separate wind speed class, without directional assignment, for each atmospheric stability class.

Data quality may be checked using the NUREG-0917 (Ref. 14) or similar methodology and/or a computer spreadsheet.

Annual joint frequency distributions for each expected mode of release (i.e., ground level and elevated) are checked for appropriateness of heights of measurements of wind direction, wind speed, and atmospheric stability. Winds at the 10-meter level and the temperature difference (ΔT) between the 10-meter level and the vent height (but no less than 30 m above the lower sensor) are used for vent and penetration releases. Winds from near release height and ΔT between release height and the 10-meter level are used for stack releases.

The climatic representativeness of the joint frequency distribution is checked by comparison with nearby stations which have collected reliable meteorological data over a long period of time (10-20 years). The distributions are compared with sites in similar geographical and topographical locations to ensure that the data are reasonable.

References 8 through 15 are information sources that may be used during the review.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided in accordance with the requirements of this section of this review standard and that the evaluation supports the following type of concluding statement, to be included in the staff's safety evaluation report:

> As set forth above, the applicant has provided and substantiated information on the meteorological measurements program. The staff has reviewed the available information relative to the onsite meteorological measurements program and the data collected by the program.
>
> Based on [summarize bases for conclusion], the staff concludes that the system provides adequate data to represent onsite meteorological conditions as required by 10 CFR 100.20. The onsite data also provide an acceptable basis for making estimates of atmospheric dispersion for design basis accident and routine releases from a nuclear power plant of type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed on the proposed site to meet the requirements of 10 CFR Part 100 and Appendix I to 10 CFR Part 50.

These statements should be preceded by a brief summary description of the onsite meteorological measurements program covering the following items:

1. height and location of meteorological sensors by type,

2. period of data record,

3. data recovery, and

4. meteorological parameters used for atmospheric diffusion estimates.

V. IMPLEMENTATION

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

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR 50.47, "Emergency Plans."

2. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

3 10 CFR Part 100, Subpart B, “Evaluation Factors for Stationary Power Reactor Site Applications on or after January 10, 1997.”

4. 10 CFR Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Condition."

5. Regulatory Guide 1.23, "Onsite Meteorological Programs."

6. Regulatory Guide 4.2, "Preparation of Environmental Reports for Nuclear Power Plants."

7. R. C. Hilfiker, "Exposure of Instruments," Chapter in Air Pollution Meteorology Manual, Training Course 411 conducted by USEPA Air Pollution Training Institute, Research Triangle Park, North Carolina, August 1973.

8. U.S. Environmental Protection Agency, “Meteorological Monitoring Guidance for Regulatory Modeling Applications,” EPA-454/R-99-005, February 2000.

9. U.S. Environmental Protection Agency, “Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements,” EPA/600/R-94/038d, March 1995.

10. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

11. Darryl Randerson (ed.), “Atmospheric Science and Power Production,” DOE/TIC-27601, U.S. Department of Energy (1984).

12. American Nuclear Society, “Determining Meteorological Information at Nuclear Facilities,” ANSI/ANS-3.11-2000, February 2000.

13. C. E. P. Brooks and N. Caruthers, "Handbook of Statistical Methods in Meteorology," M.O. 538, Her Majesty's Stationary Office, London (1953).

14. NUREG-0917, “NRC Staff Computer Programs for Use with Meteorological Data,” July 1982.

15. D. A. Mazzarella, "An Inventory of Specifications for Wind Measuring Instruments," Bull. Amer. Meteor. Soc. 53, 860 (1972).

APPENDIX A

RS-002 Section 2.3.3

RECOMMENDED FORMAT FOR HOURLY METEOROLOGICAL DATA TO BE PLACED ON ELECTRONIC MEDIA

When hourly meteorological data are submitted to the NRC, the data may be submitted on mutually-agreed-upon media. The data should be in files that are of a size that are convenient for use and storage. Annual data files are acceptable.

At the beginning of each file, use the first five (5) records to give a file description. Include plant name, location (latitude, longitude), dates of data, information explaining data contained in the "other" fields if they are used, heights of measurements, and any additional information pertinent to identification of the file. Make sure all five records are included, even if some are blank. Format for the first five records will be 160A1. Meteorological data format is (A4, I4, I3, I4, 25F5.1, F5.2, 3F5.1).

All data should be given to the tenth of a unit, except solar radiation, which should be given to a hundredth of a unit. This does not necessarily indicate the accuracy of the data (e.g., wind direction is usually given to the nearest degree). All nines in any field indicate a lost record (99999). All sevens in a wind direction field indicate calm (77777). If there are only two levels of data, use the upper and lower levels. If there is only one level of data, use the upper level.

METEOROLOGICAL DATA ON ELECTRONIC MEDIA

LOCATION:

DATE OF DATA RECORD:

A4	Identifier (can be anything)
I4	Year
I3	Julian Day
I4	Hour (on 24-hour clock)

		ACCURACY
F5.1	Upper Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____
F5.1	Wind Speed (meter/sec)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Intermediate Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____
F5.1	Wind Speed (meters/sec)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Lower Measurements: Level = _____ meters	_____
F5.1	Wind Direction (degrees)	_____

METEOROLOGICAL DATA ON ELECTRONIC MEDIA (Continued)

F5.1	Wind Speed (meters/sec)	_____
F5.1	Sigma Theta (degrees)	_____
F5.1	Ambient Temperature (°C)	_____
F5.1	Moisture: _____	_____
F5.1	Other: _____	_____
F5.1	Temp. Diff. (Upper-Lower) (°C/100 meters)	_____
F5.1	Temp. Diff. (Upper-Intermediate) (°C/100 meters)	_____
F5.1	Temp. Diff. (Intermediate-Lower) (°C/100 meters)	_____
F5.1	Precipitation (mm)	_____
F5.1	Solar Radiation (cal/cm^2/min)	_____
F5.1	Visibility (km)	_____
F5.1	Other: _____	_____
F5.1	Other: _____	_____

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.4 SHORT-TERM DISPERSION ESTIMATES FOR ACCIDENTAL ATMOSPHERIC RELEASES

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application concerns atmospheric dispersion estimates for postulated accidental releases of radioactive effluents to the atmosphere. Section 2.3.4 of this review standard applies to dispersion estimates for radiological releases to the exclusion area boundary and low population zone. Because little detailed design information is likely to be available for a nuclear power plant or plants that might be constructed on the proposed site at the ESP stage, dispersion of airborne radioactive materials to the control room will be evaluated at the combined license (COL) stage. The review covers the following specific areas:

1. Atmospheric transport and diffusion models to calculate relative concentrations for postulated accidental radioactive releases.

2. Meteorological data summaries used as input to diffusion models.

3. Specification of diffusion parameters.

4. Probability distributions of relative concentrations.

5. Determination of relative concentrations used for assessment of consequences of postulated radioactive atmospheric releases from design basis and other accidents.

Potential non-radiological accidents on or in the vicinity of the site that could affect control room habitability (such as toxic chemical releases) are addressed in Section 2.2 of this review standard.

II. ACCEPTANCE CRITERIA

The applicant should provide conservative estimates of atmospheric transport and diffusion conditions at appropriate distances from the source for postulated accidental releases of radioactive materials to the atmosphere.

These estimates are necessary to demonstrate compliance with 10 CFR 100.21 (Ref. 1) with respect to the meteorological considerations used in the evaluation to determine an acceptable

exclusion area and low population zone. Regulatory Guides 1.23[1] and 1.145 (Refs. 2 and 3) provide information, recommendations and guidance, and in general describe methods acceptable to the staff for meeting the requirements of 10 CFR Part 100. For light-water reactors, applicants using the "alternate source term" (AST) may use Regulatory Position 5.3 of Regulatory Guide 1.183 (Ref. 4) as guidance as appropriate. The NRC does not have a similar reference for reactors not cooled and moderated by light water.

The applicant's diffusion estimates should demonstrate that the requirements of 10 CFR Part 52 and 10 CFR Part 100 are met. Specifically, the following information is needed:

1. A description of the atmospheric dispersion models used to calculate relative concentrations (χ/Q values) in air resulting from accidental releases of radioactive material to the atmosphere. The models should be documented in detail and substantiated within the limits of the model so that the staff can evaluate their appropriateness to site characteristics, plant characteristics (to the extent known), and release characteristics.

2. Meteorological data used for the evaluation (as input to the dispersion models) which represent annual cycles of hourly values of wind direction, wind speed, and atmospheric stability for each mode of accidental release.

3. The variation of atmospheric diffusion parameters used to characterize lateral and vertical plume spread (σ_y and σ_z) as a function of distance, topography, and atmospheric conditions, as related to measured meteorological parameters. The methodology for establishing these relationships should be appropriate for estimating the consequences of accidents within the range of distances which are of interest with respect to site characteristics and established regulatory criteria.

4. Cumulative probability distributions of relative concentrations (χ/Q values) describing the probabilities of these χ/Q values being exceeded. These cumulative probability distributions should be presented for appropriate distances (e.g., the exclusion area boundary distance and the outer boundary of the low population zone) and time periods as specified in Section 2.3.4.2 of Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" (Ref. 5). The methods of generating these distributions should be adequately described.

5. Relative concentrations used for assessment of consequences of atmospheric radioactive releases from design basis and other accidents.

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[1] References in Regulatory Guide 1.23 to Appendix D to 10 CFR Part 50 should be read as references to 10 CFR Part 51. For ESP applications, references in Regulatory Guide 1.23 to 10 CFR 100.10 should be read as references to 10 CFR 100.20.

III. REVIEW PROCEDURES

1. Atmospheric Dispersion Models

The applicant's dispersion models are compared to the general Gaussian models which are contained in Regulatory Guide 1.145 for design basis accidental releases. The models are reviewed for suitability to release characteristics, plant configuration (to the extent known), and site topography. The accidents and release characteristics to be considered are obtained from the reviews of safety assessment Chapter 15. When the models described in Regulatory Guide 1.145 are not applicable (e.g., buoyant gases), other models and techniques used to make estimates are identified and evaluated. Each release should be characterized as either an elevated point source or a ground-level point source. Generally the release point is considered to be elevated if it is at least two-and-one-half times as high as nearby solid structures. Turbulent mixing of the effluent into the wake of plant structures is usually allowed for ground-level releases (if sufficient information is available on the plant design to make this feasible).

Most accidental releases can be considered as continuous releases (i.e., on the order of several minutes or more). However, some releases, such as those resulting from steam line breaks, may be considered instantaneous (puffs). The general Gaussian diffusion model for continuous releases is used to evaluate releases on the order of several minutes or more. For puff releases, instantaneous point-source Gaussian diffusion equations are used with a correction for initial source volume. (Ref. 6)

Other modifications to the atmospheric dispersion model which should be considered include restrictions to horizontal or vertical plume spread (e.g., by narrow deep valleys, channeling of airflow, and by persistent low-level temperature inversions). Fumigation conditions should be considered for elevated releases transported to offsite locations. In the absence of site-specific information concerning the frequency, duration, and directional preference of fumigation conditions, a deterministic approach such as that described in Regulatory Guide 1.145 may be used.

2. Meteorological Data

The meteorological data used in atmospheric dispersion analyses are reviewed for compatibility with the models used. General criteria for onsite data are stated in Regulatory Guide 1.23 and in subsection III.2 of Section 2.3.3 of this review standard. Additional sources of meteorological data for consideration in the description of airflow trajectories from the site may include National Weather Service stations or other meteorological programs that are well maintained and well exposed (e.g., other nuclear facilities, university and private meteorological programs).

3. Atmospheric Diffusion Parameters

Measurement of vertical temperature gradient (Ref. 2) should be used to define atmospheric stability, particularly during stable conditions accompanied by low wind speeds (i.e., less than 1.5 m/s). Other classification schemes (Refs. 7 and 8) may be used to estimate atmospheric stability class or to determine plume spread parameters directly for unstable and neutral conditions, or for wind speeds greater than 1.5 m/s.

Methods for the classification of atmospheric stability, or for direct determination of plume spread parameters, should be adequately described and substantiated for applicability to the site.

Diffusion parameters σ_y and σ_z are reviewed with respect to the characteristics of the accidental release and distances of interest. The curves of σ_y and σ_z as functions of downwind distance and atmospheric stability as presented in References 3, 9, and 10 are acceptable for most sites with the addition of a curve for an extremely stable (Type G) class. For elevated releases (Ref. 11) or for unusual sources, meteorological conditions, or topography (e.g., narrow, deep valleys, channeling of airflow), modification of the σ_y and σ_z curves may be appropriate (Ref. 12). Modified curves that reflect the results of atmospheric tracer tests primarily during stable, light wind conditions may be used with the atmospheric dispersion model described in Regulatory Guide 1.145. Modified curves based on specific studies under conditions similar to those at the proposed site may also be considered for sites in or near unique terrain features such as deserts (Ref. 6) and large bodies of water (Ref. 13). Such specific studies should meet the criteria for the use of site-specific experimental data as outlined in Regulatory Position 7 in Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," (Ref. 14).

For situations where a puff diffusion equation is used, $\sigma_x = \sigma_y$ is usually an acceptable assumption.

4. Cumulative Frequency Distributions of χ/Q Values

The cumulative probability distributions of χ/Q values are reviewed for inclusion of pertinent modes and time periods of release, and adequacy of input data in accordance with the guidelines set forth in Section 2.3.4.2 of the Standard Format (Ref. 5). The methods used to generate these distributions are reviewed for adequacy and conservatism.

An ESP application that references a certified design will need to verify that appropriate site-related meteorological parameters for the proposed site have been used to derive site-specific χ/Q values and that these values are consistent with (or bounded by) those identified in the site parameter envelope for the certified design.

5. Relative Concentrations Used for Accidents

The χ/Q values used for assessment of consequences of atmospheric radioactive releases for design basis accidents and other accidents are reviewed for appropriateness of atmospheric dispersion model assumptions and input data and adequate documentation of this information.

The staff makes an independent evaluation of atmospheric dispersion for pertinent distances, usually the exclusion area boundary and the low population zone outer boundary, using the appropriate meteorological data and dispersion model. Two probabilistic approaches are available for evaluating short-term atmospheric transport and diffusion characteristics.

a. A direction-dependent probabilistic approach using the χ/Q values which are exceeded 0.5% of the time in each of 16 directions from the plant site. This methodology is described in Regulatory Guide 1.145.

b. A direction-independent probabilistic approach using the χ/Q value which is exceeded 5% of the time. This methodology is described in Reference 15.

These values are assumed to represent conditions for a 2-hour period. χ/Q values for time periods greater than two hours are estimated for the low population zone (LPZ) distance by assuming either a logarithmic relationship between the "2-hour" value and the annual average value or a "sliding window" approach using hourly meteorological data. As applied herein, the term "sliding window" refers to the calculation of running mean χ/Q values for time periods varying from 1 to 720 hours in duration, using an averaging method similar to that used for control room χ/Q values as calculated by the ARCON96 computer code referenced in Regulatory Guide 1.194. The methodology is described in Sections 3.6, 3.7, and 3.8 of NUREG/CR-6331, Rev.1, "Atmospheric Relative Concentrations in Building Wakes" (Ref. 16). Any similar methodology that is applied to LPZ calculations should be made on a direction-dependent basis, analogous to that presented in Regulatory Guide 1.145.

These values of χ/Q based on appropriate models for appropriate time intervals and distances are used in the analyses presented in Chapter 15 for dose assessment of design basis accidents.

IV. EVALUATION FINDINGS

The reviewer verifies that adequately conservative atmospheric dispersion models and appropriate meteorological data have been used to calculate relative concentrations for appropriate distances and directions from postulated release points for accidental airborne releases of radioactive materials.

The reviewer's evaluation should support the following type of concluding statement, to be used in the staff's safety evaluation report (conclusions regarding the control room are not necessary for the ESP review):

As set forth above, the applicant has made conservative assessments of post-accident atmospheric dispersion conditions from the applicant's meteorological data and appropriate diffusion models. These atmospheric dispersion estimates are appropriate for the assessment of consequences from radioactive releases for design basis accidents in accordance with 10 CFR 100.21(c).

[For an ESP application referencing a certified standard design:] The applicant has used appropriate site-related meteorological parameters for the proposed site to derive site-specific χ/Q values, and these values are consistent with [or bounded by] those identified in the site parameter envelope for the certified design.

Based on these considerations, the staff concludes that atmospheric dispersion estimates are acceptable and meet the relevant requirements of 10 CFR Part 100.

Atmospheric dispersion estimates for the control room from radioactive releases will be addressed in the review of the combined license (COL) application.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR 100.21, "Non-Seismic Siting Criteria."

2. Regulatory Guide 1.23, "Onsite Meteorological Programs."

3. Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants."

4. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

6. G. R. Yanskey, E. H. Markee, and A. P. Richter, "Climatography of the National Reactor Testing Station," IDO-12048, Idaho Operations Office, USAEC (1966).

7. Hanna, S. R., G. A. Briggs, J. Deardorff, B. A. Egan, F. A. Gifford, and F. Pasquill, "AMS Workshop on Stability Classification Schemes and Sigma Curves-Summary of Recommendations," Bulletin of the American Meteorological Society, Vol. 58, No. 12 (December 1977).

8. Hoffman, F. 0., "Proceedings of a Workshop on the Evaluation of Models Used for the Environmental Assessment of Radionuclide Releases," CONF-770901, Oak Ridge National Laboratory (April 1978).

9. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

10. Darryl Randerson (ed.), “Atmospheric Science and Power Production,” DOE/TIC-27601, U.S. Department of Energy (1984).

11. Singer, I. A. and M. E. Smith, "Atmospheric Diffusion at Brookhaven National Laboratory," Int. J. Air and Water Pollution, 10, 125-135 (1966).

12. Weber, A. H. "Atmospheric Dispersion Parameters in Gaussian Plume Modeling," EPA-600/4-76-030a, U.S. Environmental Protection Agency (July 1976).

13. R. P. Hosker, Jr., "A Comparison of Estimation Procedures for Over-Water Plume Dispersion," paper presented at the Symposium on Atmospheric Diffusion and Air Pollution in Santa Barbara, Calif., American Meteorological Society (September 9-13, 1974).

14. Regulatory Guide 1.194, “Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants.”

15. J. F. Sagendorf, "A Program for Evaluating Atmospheric Dispersion From A Nuclear Power Station," Technical Memorandum ERL ARL-42, National Oceanic and Atmospheric Administration (1974).

16. NUREG/CR-6331, “Atmospheric Relative Concentrations in Building Wake,” Revision 1 (May 1997).

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.3.5 LONG-TERM DIFFUSION ESTIMATES

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - Emergency Preparedness and Plant Support Branch (IEPB)

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application concerns atmospheric diffusion estimates for routine releases of effluents to the atmosphere. The review covers the following specific areas:

1. Atmospheric dispersion models to calculate concentrations in air and amount of material deposited as a result of routine releases of radioactive material to the atmosphere.

2. Meteorological data used as input to diffusion models.

3. Specification of diffusion parameters.

4. Relative concentration (χ/Q) and relative deposition (D/Q) values used for assessment of consequences of routine airborne radioactive releases.

5. Points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations (if available at the ESP stage). Bounding values for these parameters may be provided at the ESP stage. In such a case, the applicant will need to confirm at the combined license (COL) stage that the parameters provided at the ESP stage bound the actual values provided at the COL stage, and that the calculational methodology used for the confirmation is consistent with that employed at the ESP stage.

To assist in demonstrating compliance with 10 CFR 100.21(c)(1) (Ref.1), annual average χ/Q and D/Q values at standard distances in the 16 radial sectors from the site boundary to a distance of 50 miles from the proposed site of the nuclear power plant or plants are provided to the IEPB for calculation of doses. Calculations for specific receptor locations such as the limiting residence, cow, garden, etc., will be evaluated at the combined license (COL) stage. However, to the extent bounding evaluations are provided in ESP applications, a secondary review is performed by IEPB and the results are used by SPSB in the overall evaluation of the long-term diffusion estimates. The IEPB reviews the points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and locations of potential receptors for dose computations. (If the applicant provides bounding values for these parameters as discussed above, these values are reviewed.) The results of their analyses are

transmitted to SPSB for use in its review of diffusion estimates. In such a case, the applicant will need to confirm at the combined license (COL) stage that the values provided at the ESP stage bound the actual values provided at the COL stage, and that the calculational methodology used for the confirmation is consistent with that employed at the ESP stage. For ESP applications that do not provide a full evaluation of atmospheric transport and diffusion of routine releases, those portions not addressed at the ESP stage will be evaluated at the COL stage.

II. ACCEPTANCE CRITERIA

Characterization of atmospheric transport and diffusion conditions is necessary for estimating the radiological consequences of routine releases of radioactive materials to the atmosphere to demonstrate compliance with the numerical guides for doses contained in 10 CFR Part 50, Appendix I (Ref. 2).

The following regulatory guides provide acceptable criteria for complying with this review standard section:

1. Regulatory Guide 1.109 (Ref. 3) presents identification criteria to be used for specific receptors of interest (applicable at the ESP stage to the extent the applicant provides receptors of interest).

2. Regulatory Guide 1.111 (Ref. 4) describes acceptable methods for characterizing atmospheric transport and diffusion conditions for evaluating the consequences of routine releases. Use of the model described in NUREG/CR-2919 (Ref. 5) is acceptable.

3. Regulatory Guide 1.112 (Ref. 6) presents identification criteria to be used for release points and release characteristics (applicable at the ESP stage to the extent the applicant provides release points and release characteristics).

Specifically, the following information should be provided by the applicant in the safety assessment:

1. A description of the atmospheric dispersion models used to calculate concentrations in air and the amount of material deposited as a result of routine releases of radioactive material to the atmosphere. The models should be sufficiently documented and substantiated to allow a review of their appropriateness for site characteristics, plant characteristics (to the extent known), and release characteristics.

2. A discussion of the relationship between atmospheric diffusion parameters, such as vertical plume spread (σ_z), and measured meteorological parameters. Use of these parameters should be substantiated as to their appropriateness for use in estimating the consequences of routine releases from the site boundary to a radius of 50 miles from the plant site.

3. Meteorological data used as input to the dispersion models. Data used for this evaluation should represent hourly average values of wind speed, wind direction, and atmospheric stability which are appropriate for each mode of release. The data should

reflect atmospheric transport and diffusion conditions in the vicinity of the site throughout the course of a year. (See Section 2.3.3 of this review standard for data acceptability criteria, and see Regulatory Guide 1.23[1] (Ref. 7) for data formats.)

4. Relative concentration (χ/Q) and relative deposition (D/Q) values used for assessment of consequences of routine radioactive gas releases as described in Section 2.3.5.2 of Regulatory Guide 1.70 (Ref. 8).

5. Points of routine release of radioactive material to the atmosphere, the characteristics of each release mode, and the location of potential receptors for dose computations (if available at the ESP stage). Bounding values for these parameters may be provided at the ESP stage. In such a case, the applicant will need to confirm at the combined license (COL) stage that the parameters provided at the ESP stage bound the actual values provided at the COL stage, and that the calculational methodology used for the confirmation is consistent with that employed at the ESP stage.

A licensee can use the numerical guides for doses specified in 10 CFR Part 50, Appendix I, to meet the requirement in 10 CFR 50.34a(a) that the nuclear facility be operated to keep levels of radioactive effluents to unrestricted areas “as low as is reasonably achievable” (ALARA).

10 CFR 20.1301 establishes radiation dose limits to individual members of the public from radioactive effluents in unrestricted areas. In addition, 10 CFR 20.1101 states that licensees shall, in addition to complying with the limits set forth in 10 CFR Part 20, use procedures and engineering controls to achieve doses to members of the public that are ALARA. 10 CFR Part 50, Appendix I, provides numerical guidance for doses to meet the ALARA criterion.

III. REVIEW PROCEDURES

1. Atmospheric Dispersion Models

The applicant's models are compared to the general modeling criteria presented in Regulatory Guide 1.111. The models should be suitable for the topography of the site and vicinity, plant configuration (to the extent known), and release characteristics. Additional information for determining model suitability may be found in standard references such as "Meteorology and Atomic Energy - 1968" (Ref. 9) and “Atmospheric Science and Power Production” (Ref. 10).

The staff performs an independent evaluation of long-term dispersion characteristics. To the extent release points, release characteristics, and locations of interest are identified in the ESP application, they are confirmed by IEPB. Using the criteria presented in Regulatory Guide 1.111, each release is classified as completely elevated or completely ground level. Turbulent mixing of the effluent into the wake of plant

[1] References in Regulatory Guide 1.23 to Appendix D to 10 CFR Part 50 should be read as references to 10 CFR Part 51. For ESP applications, references in Regulatory Guide 1.23 to 10 CFR 100.10 should be read as references to 10 CFR 100.20.

structures is considered where appropriate and feasible given information available about plant design in accordance with Regulatory Guide 1.111.

To the extent relevant and sufficient evaluations are provided in ESP applications on plant design at the ESP stage, any releases characterized as partially elevated or intermittent should be evaluated. Conclusions of these evaluations will be subject to confirmation by the applicant at the COL stage that the parameters provided at the ESP stage remain valid (i.e., they bound the values provided at the COL stage). The staff review at the COL stage will verify that the calculational methodology used for this confirmation is consistent with that employed at the ESP stage. For ESP applications that do not provide a full evaluation of atmospheric transport and diffusion of routine releases, those aspects not addressed at the ESP stage will be evaluated at the COL stage.

Topographic characteristics in the vicinity of the site are examined for restrictions of horizontal and/or vertical plume spread, channeling or other changes in airflow trajectories, or other unusual conditions affecting atmospheric transport and diffusion between the source and receptors of interest. Examples of conditions where modifications to standard approaches may be necessary are narrow, deep valleys; land-sea (lake) breeze regimes; and low-level subsidence inversions of temperature. "Fumigation" may be a concern for infrequent releases of short duration from elevated sources.

The standard diffusion model used by the staff is described in NUREG/CR-2919 (Ref. 11). This model is a straight-line Gaussian model with a specific calculational procedure for estimating χ/Q values for intermittent releases. Modifications to the straight-line model to consider the effects of variations in space and time in airflow are also described in NUREG/CR-2919.

For unusual topographic and meteorological conditions, a variable trajectory model may be used on a case-by-case basis.

2. Atmospheric Diffusion Parameters

The specification of the vertical diffusion parameter, σ_z, as a function of distance and atmospheric stability, is reviewed. Atmospheric stability should be defined by measurement of vertical temperature gradient, particularly during stable conditions. Other classification schemes (e.g., Refs. 12 and 13) may be used to estimate atmospheric stability class or to determine the diffusion parameter directly for unstable and neutral conditions. If used, these alternative classification schemes are reviewed for appropriateness to site characteristics, plant characteristics (to the extent known), and release characteristics. Standard curves of σ_z as a function of distance are presented in Regulatory Guide 1.111. Modified diffusion parameters may also be considered for proposed sites in or near unique terrain features such as deserts (see Ref. 14) and large bodies of water (see Ref. 15).

3. Meteorological Data

Meteorological data are reviewed for compatibility with the models used, representativeness of conditions within the area of interest, and representativeness of annual average meteorological characteristics in the vicinity of the site. General guidelines for collection and presentation of onsite meteorological data are stated in Regulatory Guide 1.23 and in Section 2.3.3 of this review standard, subsection III.2.

4. Relative Concentrations Used for Routine Releases

The relative concentration (χ/Q) and relative deposition (D/Q) values used for assessment of the consequences of routine radioactive releases are reviewed for appropriateness to site conditions, plant configuration (to the extent known), and release characteristics.

Annual average χ/Q and D/Q values are calculated for 16 radial sectors from the site boundary to a distance of 50 miles. To the extent relevant and sufficient evaluations are provided in ESP applications, values are also reviewed for specific receptor locations. IEPB confirms the locations of specific receptors (e.g., site boundary, residence, garden, cow). Adjustments of the χ/Q and D/Q values may be necessary to account for unusual site and/or meteorological conditions.

The following information is provided to the IEPB for the calculation of appropriate doses: (1) annual average χ/Q and D/Q values at standard distances in the 16 radial sectors from the site boundary to a distance of 50 miles, and (2) values for the locations of specific receptors (to the extent relevant and sufficient evaluations are provided in the ESP application).

IV. EVALUATION FINDINGS

The reviewer verifies that appropriate atmospheric dispersion models and meteorological data have been used to calculate relative concentration and relative deposition at appropriate distances and directions from postulated release points for evaluation of routine airborne releases of radioactive material. The reviewer's evaluation should support the following type of concluding statement, to be included in the staff's safety evaluation report:

> As set forth above, the applicant has provided meteorological data and an atmospheric dispersion model that are appropriate for the characteristics of the site and release points. Therefore, the staff concludes that representative atmospheric transport and diffusion conditions have been calculated for 16 radial sectors from the site boundary to a distance of 50 miles and [to the extent relevant and sufficient evaluations are provided in ESP applications] for the specific receptor locations. Therefore, the information required to address 10 CFR 100.21(c)(1) has been provided. Based on [summarize bases for conclusion], the characterization of atmospheric transport and diffusion conditions is appropriate for demonstration of compliance with the numerical guides for doses contained in 10 CFR Part 50, Appendix I.

[If not provided at the ESP stage:] Atmospheric transport and diffusion from specific release points having specific release characteristics, as well as specific locations of receptors of interest, will be evaluated at the combined license (COL) stage.

Any deviation from the acceptance criteria should be explained by a statement that the applicant has provided an alternative approach that the staff has reviewed and found to be acceptable.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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 of parts of the method discussed herein are contained in the referenced regulatory guides and NUREGs.

VI. REFERENCES

1. 10 CFR Part 100, Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or after January 10, 1997."

2. 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."

3. 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."

4. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents In Routine Releases From Light-Water-Cooled Reactors."

5. NUREG/CR-2919, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations" (September 1982).

6. Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Reactors."

7. Regulatory Guide 1.23, "Onsite Meteorological Programs."

8. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

9. D. H. Slade (ed.), "Meteorology and Atomic Energy - 1968," TID-24190, Division of Technical Information, USAEC (1968).

10. Darryl Randerson (ed.), “Atmospheric Science and Power Production,” DOE/TIC-27601, U.S. Department of Energy (1984).

11. NUREG/CR-2919, “XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,” September 1982.

12. S. R. Hanna, G. A. Briggs, J. Deardorff, B. A. Egan, F.A. Gifford, and F. Pasquill, "AMS Workshop on Stability Classification Schemes and Sigma Curves--Summary of Recommendations," Bulletin of the American Meteorological Society, Vol. 58, No. 12 (December 1977).

13. F. 0. Hoffman (General Chairman), "Proceedings of a Workshop on the Evaluation of Modes Used for the Environmental Assessment of Radionuclide Releases," CONF-770901, Oak Ridge National Laboratory (April 1978).

14. G. R. Yanskey, E. H. Markee, and A. P. Richter, "Climatography of the National Reactor Testing Station," IDO-12048, Idaho Operations Office, USAEC (1966).

15. R. P. Hosker, Jr., "A Comparison of Estimation Procedures for Over-Water Plume Dispersion." Paper Presented at the Symposium on Atmospheric Diffusion and Air Pollution in Santa Barbara, California, American Meteorological Society (September 9-13, 1974).

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.1. HYDROLOGIC DESCRIPTION

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

The areas of review under this section of this review standard for the site safety assessment that supports an early site permit (ESP) application are:

1. Identification of the interface of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site with the hydrosphere.

2. Identification of hydrologic causal mechanisms that may necessitate special plant design bases or operating limitations with regard to floods and water supply needs.

3. Identification of surface and ground water uses that may be affected by operation of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

The review of Section 2.4.1 calls for identification of the hydrologic characteristics of streams, lakes (e.g., location, size, shape, drainage area), shore regions, the regional and local groundwater environments, and existing or proposed water control structures (upstream and downstream) influencing the type of flooding mechanisms that may adversely effect safety aspects of plant siting and operation.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard address 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they relate to identifying and evaluating hydrologic features of the site. The regulations at 10 CFR 52.17(a) and 10 CFR 100.20(c) require that physical characteristics of a site (including seismology, meteorology, geology, and hydrology) be taken into account to determine its acceptability for a nuclear power reactor. In addition, 10 CFR 100.20(c) addresses the hydrologic characteristics of a proposed site that may affect the consequences of an escape of radioactive material from the facility. Factors important to hydrologic radionuclide transport, described in 10 CFR 100.20(c)(3), should be obtained from on-site measurements.

To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the surface and subsurface hydrologic characteristics of the site and region. This description should be sufficient to assess the

acceptability of the site and the potential for those characteristics to influence the design of structures, systems, or components of a nuclear power plant or plants (or falling within a PPE) that might be constructed on the proposed site.

Meeting this requirement provides reasonable assurance that the hydrologic characteristics of the site and potential hydrologic phenomena would pose no undue risk to the type of facility (or facility falling within a PPE) proposed for the site. Further, it provides reasonable assurance that such a facility would pose no undue risk of radioactive contamination to surface or subsurface water from either normal operations or as the result of a reactor accident.

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 3) as it relates to structures, systems, and components important to safety being designed to withstand the effects of hurricanes, floods, tsunamis, and seiches.

To meet the requirements of the hydrologic aspects of 10 CFR Parts 52 and 100, the following specific criteria are used:

1. The information presented in safety assessment Section 2.4.1 forms the basis for subsequent hydrologic engineering analysis with respect to the application for an ESP. Therefore, completeness and clarity are of paramount importance. Maps should be legible and adequate in coverage to substantiate applicable data. Site topographic maps should be of good quality and of sufficient scale to allow independent analysis of pre-construction drainage patterns. Data on surface water users, location with respect to the site, type of use, and quantity of surface water used are necessary. Inventories of surface water users should be consistent with regional hydrologic inventories reported by applicable state and federal agencies. The description of the hydrologic characteristics of streams, lakes, and shore regions should correspond to those of the United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers, or appropriate state and river basin agencies. Descriptions of all existing or proposed reservoirs and dams (both upstream and downstream) that could influence conditions at the site should be provided. Descriptions may be obtained from reports of the USGS, United States Bureau of Reclamation (USBR), Corps of Engineers, and others. Generally, reservoir descriptions of a quality similar to those contained in pertinent data sheets of a standard Corps of Engineers Hydrology Design Memorandum are adequate. Tabulations of drainage areas, types of structures, appurtenances, ownership, seismic and spillway design criteria, elevation-storage relationships, and short- and long-term storage allocations should be provided.

2. Appendix A, "Hydrologic Engineering Site Visits," to this section of the review standard (Ref. 4) details the purposes and procedures of the site visit. The site visit serves to acquaint the reviewer with the site and to provide an independent confirmation of the hydrologic characteristics of the site and adjacent environs.

III. REVIEW PROCEDURES

The information presented in safety assessment Section 2.4.1 is generally amenable to independent verification through cross-checks with other safety assessment sections and chapters, available publications relating to hydrologic characteristics of the site region, and by site visits. The review procedure consists of evaluating the completeness of the information

and data (Ref. 5) by sequential comparison with information available from references. Based on the description of the hydrosphere (e.g., geographic location and regional hydrologic features) potential site flood mechanisms are identified. Subsequent safety assessment sections addressing the mechanisms are cross-checked to ensure that data and information needed therein for review and substantiation are available.

An important facet of the review procedure for this and other sections of this review standard in hydrologic areas is the site visit. The site visit provides the principal technical reviewer with independent confirmation of hydrologic characteristics of the site and adjacent environs. The site visit is discussed in Appendix A to this section of the review standard.

IV. EVALUATION FINDINGS

For ESP reviews, findings will consist of a brief general description of the site with respect to the general hydrosphere as required by 10 CFR Parts 52 and 100, and of the offsite uses of surface water. The hydrologic description for each plant site is unique. The review verifies that sufficient information has been provided and will support conclusions of the following type, to be included in the staff's safety evaluation report:

> The proposed site is located about 42 kilometers (26 miles) SSE of XYZ City on the southwest bank of the DEF River at about river kilometer 245 (mile 152). Plant grade will be at about elevation 67 m (220 feet) above mean sea level (MSL).
>
> As set forth above, the applicant has provided sufficient information pertaining to the general hydrologic characteristics of the site including descriptions of water bodies, water control structures, and water users. Therefore, the staff concludes that the requirements of 10 CFR Parts 52 and 100, with respect to general hydrologic descriptions, have been met.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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 and NUREGs.

VI. REFERENCES

Because of the geographic diversity of plant sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps and charts by the USGS, NOAA, Army Map Service (AMS), and Federal Aviation Administration (FAA); water-supply papers of the USGS; River Basin Reports of the Corps of Engineers; and other publications of

state, federal, and other regulatory bodies, describing hydrologic characteristics and water utilization in the site vicinity and region, are referred to on an "as-available" basis.

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

2. 10 CFR Part 100, "Reactor Site Criteria."

3. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

4. Appendix A, RS-002 Section 2.4.1, "Hydrologic Engineering Site Visits," attached.

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

APPENDIX A
RS-002 SECTION 2.4.1
HYDROLOGIC ENGINEERING SITE VISITS

I. PURPOSES

The purposes of hydrologic engineering site visits are as follows:

1. Acquaint the reviewer with general site and regional hydrologic characteristics and topography.

2. Confirm the applicant's general appraisal of the hydrologic interfaces between the site and a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the site.

3. Review specific hydrologic engineering problem areas with the applicant, its engineers, and its consultants.

The site visit objectives will have been achieved if, in addition to viewing pertinent hydrologic features, the reviewer has had the opportunity to discuss specific questions and concerns with the applicant's hydrologic engineers and is assured that the questions and concerns are understood. In addition, generally acceptable techniques and procedures necessary to respond to staff concerns should be discussed.

II. PROCEDURES

Questions or items of staff concern are to be developed by the EMEB reviewer and discussed in detail with the Branch Chief 7-14 days before the scheduled site visit. For any unscheduled site visit (which may be necessary to resolve issues or prepare for hearings), similar questions or items of staff concern should be prepared at least 3 days prior to such site visit and also discussed in detail with the Branch Chief.

Areas of overlap or interfaces with reviewers in other areas (such as geology, foundation engineering, auxiliary and power conversion systems, mechanical engineering, effluent treatment systems, and structural engineering) should be coordinated before questions or items of staff concern are finalized.

The staff reviewer for Hydrologic Description will discuss any unusual or potentially controversial areas of concern with the Chief, EMEB, prior to transmittal of the questions or items of staff concern to the Project Manager. Transmittal will be forwarded by memo route slip through the Branch Chief.

Site visits are generally to consist of a detailed reconnaissance of site areas and environs with the applicant and technical counterparts, discussions of questions (or items of staff concern), discussions of acceptable methods of analysis, and a general summarization of the areas discussed and conclusions reached.

Normally, a small group composed of the staff reviewer and project manager (PM) should meet with an applicant representative responsible for responding to staff questions and the applicant's technical advisor. For verbal summarization during the site visit, the recommended

method is to have the applicant or his technical advisor summarize the discussions to ensure understanding.

III. TRIP REPORT

A trip report on a site visit should be prepared within 5 days of the reviewer's return. The report is to be as brief as possible and should summarize the trip and the areas of discussion and should list the participants in technical discussions.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.2 FLOODS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

This section of the site safety assessment for an early site permit (ESP) application identifies historical flooding (defined as occurrences of abnormally high water stage or overflow from a stream, floodway, lake, or coastal area) at the proposed site or in the region of the site. It summarizes and identifies the individual types of flood-producing phenomena, and combinations of flood-producing phenomena, considered in establishing the flood design bases for safety-related features for a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. It also covers the potential effects of local intense precipitation. Although topical information may appear in safety assessment Sections 2.4.3 through 2.4.7, the types of events considered and the controlling event are reviewed in this section.

The flood history and the potential for flooding are reviewed for the following sources and events. Factors affecting potential runoff (such as urbanization, forest fire, or change in agricultural use), erosion, and sediment deposition are considered in the review.

1. Stream flooding

    a. Probable maximum flood (PMF) with coincident wind-induced waves, considering dam failure potential due to inadequate capacity, inadequate flood-discharge capability, or existing physical condition.

    b. Ice jams, both independently and coincident with a winter probable maximum storm.

    c. Tributary drainage area PMF potential.

    d. Combinations of less severe river floods, coincident with surges and seiches.

2. Surges

    a. Probable maximum hurricane (PMH) at coastal sites.

    b. PMH wind translated inland and resulting wave action coincident with runoff-induced flood levels.

c. Probable maximum wind-induced (non-hurricane) storm surges and waves.

d. Combinations of less severe surges, coincident with runoff floods.

3. Seiches

a. Meteorologically induced in inland lakes (e.g., Great Lakes and harbors) and at coastal harbors and embayments.

b. Seismically induced in inland lakes.

c. Seismically induced by tsunami (seismic sea waves) on coastal embayments.

d. Combinations of less severe surges and seiches, coincident with runoff floods.

4. Tsunamis

a. Near field, or local, excitation.

b. Far field, or distant, excitation.

5. Seismically induced dam failures (or breaches) and maximum water level at site from:

a. Failure of dam (or dams) during safe shutdown earthquake (SSE) coincident with 25-year flood.

b. Failure during an earthquake equal to ½ the SSE coincident with standard project flood (SPF).[1]

c. Failure during other earthquakes, coincident with runoff, surge, or seiche floods where the coincidence is at least as likely as for 5.a and 5.b above.

6. Flooding caused by landslides

a. Flood waves.

b. Backwater effects due to stream blockage.

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[1] This combination is based on the guidance of Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants" and past NRC licensing practice. Regulatory Guide 1.59 references ANSI Standard N170-1976, which has been superseded by ANSI/ANS-2.8-1992, "American National Standard for Determining Design Basis Flooding at Power Reactor Sites." Section 9.2.1.2 of this standard calls for consideration of dam failure caused by the Operating Basis Earthquake (OBE) coincident with the peak of flood. Existing reactors were licensed using an OBE equal to ½ the SSE. Though a 1997 rulemaking eliminated use of the OBE in reactor design, the value of ½ the SSE (or other value if justified by an ESP applicant) may be used to analyze seismically induced dam failures.

7. Ice loadings from water bodies

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard address 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they relate to identifying and evaluating hydrologic features of the site. The regulations at 10 CFR 52.17(a) and 10 CFR 100.20(c) require that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability to host a nuclear reactor or reactors.

To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the surface and subsurface hydrologic characteristics of the site and region and an analysis of the PMF. This description should be sufficient to assess the acceptability of the site and to assess the potential for those characteristics to influence the design of plant structures, systems, and components important to safety. Meeting this requirement provides reasonable assurance that the hydrologic characteristics of the site and potential hydrologic phenomena would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting the limiting parameters from among the group. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 3) as it relates to structures, systems, and components important to safety being designed to withstand the effects of hurricanes, floods, tsunamis, and seiches.

To meet the requirements of the hydrologic aspects of 10 CFR Parts 52 and 100, the following specific criteria are used:

For safety assessment Section 2.4.2.1 (Flood History): The potential flood sources and flood response characteristics of the region and site identified by the staff's review (described in Review Procedures) are compared to those of the applicant. If similar, the applicant's conclusions are accepted. If, in the staff's opinion, significant discrepancies exist, the applicant will be requested to provide additional data, reestimate the effects on a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, or revise the applicable flood design bases, as appropriate.

For safety assessment Section 2.4.2.2 (Flood Design Considerations): The applicant's estimate of controlling flood levels is acceptable if it is no more than 5% less conservative than the staff's independently determined (or verified) estimate. If the applicant's safety assessment estimate is more than 5% less conservative, the applicant should fully document and justify its estimate of the controlling level. On the other hand, the applicant may accept the staff's estimate.

For safety assessment Section 2.4.2.3 (Effects of Local Intense Precipitation): The applicant's estimates of local probable maximum precipitation (PMP) and the capacity of site drainage

facilities (including drainage from the roofs of buildings and site ponding) are acceptable if the estimates are no more than 5% less conservative than the corresponding staff's assessment. Similarly, conclusions relating to the potential for any adverse effects of blockage of site drainage facilities by debris, ice, or snow should be based upon conservative assumptions of storm and vegetation conditions likely to exist during storm periods. If a potential hazard does exist (e.g., the elevation of ponding exceeds the elevation of plant access openings), the applicant should document and justify the local PMP basis. At the COL stage, the applicant should analyze and design affected facilities to ensure they are protected against PMP.

Appropriate sections of the following documents are used by the staff to determine the acceptability of the applicant's data and analyses in meeting the requirements of 10 CFR Parts 52 and 100. Regulatory Guide 1.59[2] (Ref. 4) provides guidance for estimating the design basis flooding considering the worst single phenomenon and combinations of less severe phenomena. Publications of the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers, applicable State and river basin authorities, and other similar agencies are used to verify the applicant's data relating to hydrologic characteristics and extreme events in the region. Sections 2.4.3 through 2.4.7 of this review standard discuss methods of analysis to determine the individual flood-producing phenomena.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information necessary for such a permit includes a description of the site's flood-related hydrologic characteristics. (Ref. 6) For this type of permit, the scope and level of detail for reviewing hydrologic data are outlined below.

ESP reviews are carried out under this section of this review standard to evaluate the significance of the controlling flood level with regard to the design basis for flood protection of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

For safety assessment Section 2.4.2.1 (Flood History):

The staff will review publications of the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers, applicable State and river basin agencies, and others to ensure that historical maximum events and the flood response characteristics of the region and site have been identified. Similar material, in addition to applicant-supplied information, will be reviewed to identify independently the potential sources of site flooding.

For safety assessment Section 2.4.2.2 (Flood Design Considerations):

The potential flood levels from consideration of the worst single phenomenon and combinations of less severe phenomena are identified in accordance with Sections 2.4.3 through 2.4.7 of this review standard and the controlling flood level is selected. The controlling flood level is

[2] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992 (Ref. 5), which has superseded the earlier document.

compared with the proposed protection levels to ensure that the safety-related facilities for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site will not be adversely affected. If appropriate, additional provisions for flood protection will be imposed to ensure adequate protection of safety-related facilities.

For safety assessment Section 2.4.2.3 (Effect of Local Intense Precipitation):

The staff's estimates of flooding potential are based on PMP estimates from the appropriate hydrometeorological reports and similar NOAA publications. The staff's estimates are compared with the applicant's estimates to determine conformity to Acceptance Criteria in subsection II of this section of the review standard. Runoff models, such as the unit hydrograph if applicable, or other runoff discharge estimates presented in standard texts, are used to estimate discharge on the site drainage system. Where generalized runoff models are used, coefficients used for the site and region are compared to information available at documented locations to evaluate hydrologic conditions used in determining the probable maximum flood for the site drainage system. Potential ponding on the site is also determined.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will consist of a statement indicating the completeness of the identification of site flood characteristics and flood design bases in compliance with 10 CFR Parts 52 and 100. Sample statements for an ESP review follow:

> The maximum flood known to have occurred on the A River was in 1796. The peak discharge at B City, Montana, was estimated to be 10,200 m^3/s (360,000 cubic feet per second (cfs)). The applicant estimated that a comparable flood would produce water surface elevation at the site of 35.4 m (116 ft) MSL. The maximum flood during the period since records were maintained (1883) at B City was 9,900 m^3/s (350,000 cfs) and occurred on October 3, 1929. These floods occurred prior to construction of several upstream dams. Flood flows are now regulated by C and D Reservoirs as well as by upstream hydropower plants.
>
> The applicant has estimated potential flooding from rainfall over the E River basin upstream from the site. The probable maximum flood (PMF), the upper level of flooding the staff considers to be reasonably possible, was estimated to produce a flow of 140,000 m^3/s (5,000,000 cfs) near the city of F. This estimate was made by using 165% of the Corps of Engineers project design flood (PDF) estimate of 85,800 m^3/s (3,030,000 cfs) at the same location, as modified by upstream flood control reservoirs.
>
> The 85,800-m^3/s (3,030,000-cfs) project design flood flow is estimated to be partially diverted to the leveed G and H Floodways upstream of the site, with 42,500 m^3/s (1,500,000 cfs) continuing downstream within the levee system past the plant site. The applicant concluded that the PMF could result in overtopping of levees and flooding of the river valley well upstream from the site, thereby causing generally low level flooding in the site area. The upstream levee overtopping and resulting valley flow during such an event would reduce the flow

in the main levee channel adjacent to the site to levels equal to or less than those that would exist during a project design flood.

The staff concludes that the combination of a runoff-type flood less severe than a PMF, but more severe than a PDF, and a coincident levee break in the vicinity of the site could occur before water approaches levee grade upstream. A failure or levee breach, when the levee is full to design capacity [1 m or 3 ft] below the top of the levee adjacent to the site plus the effects of any coincident wind-generated wave activity), would result in a higher water surface at the plant site than a PMF spread over the valley as a result of levee failures upstream. At the staff's request, the applicant evaluated various modes of levee failure in the vicinity of the site.

One of the conditions postulated is that of a flood, approaching the severity of a PMF, causing a massive failure of the upstream left bank levee along the G floodway, resulting in flooding around the site, coincident with a failure of the levee adjacent to the site. The applicant estimated the resulting water level at the site would reach elevation 6.9 m (22.5 ft) MSL for this case. The case of an instantaneous levee failure adjacent to the site, with no upstream levee failure, resulted in an estimated water level of 7.5 m (24.6 ft) MSL.

Based on this evaluation, the staff concludes that, in order to meet the requirements of 10 CFR Parts 52 and 100 with respect to potential hydrologic events, the applicant should design for the conditions associated with the 7.5-m (24.6-ft) MSL water level.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

Because of the geographic diversity of plant sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps, papers, and charts by the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers; and other publications of state, federal, and other regulatory bodies, describing hydrologic characteristics and water utilization in the site vicinity and region, are referred to on an "as-available" basis.

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

2. 10 CFR Part 100, "Reactor Site Criteria

3. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena.

4. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

5. ANSI/ANS-2.8-1992, “Determining Design Basis Flooding at Power Reactor Sites."

6. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.3 PROBABLE MAXIMUM FLOOD (PMF) ON STREAMS AND RIVERS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

In this section of the site safety assessment for an early site permit (ESP) application, the hydrometeorological design basis is developed to determine the extent of any flood protection necessary for those structures, systems, and components necessary to ensure the capability to shut down a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site and maintain it/them in a safe shutdown condition. The areas of review include the probable maximum precipitation (PMP) potential and precipitation losses over the applicable drainage area, the runoff response characteristics of the watershed, the accumulation of flood runoff through river channels and reservoirs, the estimate of the discharge rate trace (hydrograph) of the PMF at the plant site, the determination of PMF water level conditions at the site, and the evaluation of coincident wind-generated wave conditions that could occur with the PMF. Included is a review of the details of design bases for site drainage (which is summarized in safety assessment Section 2.4.2); a review of the runoff for site drainage and drainage areas adjacent to the plant site, including the roofs of safety-related structures, resulting from potential PMP; and a review of the potential effects from erosion and sedimentation. The analyses involve modeling of physical rainfall and runoff processes to estimate the upper level of possible flood conditions adjacent to and on site.

Regulatory Guide 1.59[1] (Ref. 1) describes two positions with respect to flood protection for which a PMF estimate is necessary to determine the controlling design basis conditions. If Position 1 is chosen, all safety-related systems, structures, and components should be capable of withstanding the effects from the controlling flood design basis. Position 2 limits the review to specific safety-related structures, systems, and components necessary for cold shutdown and maintenance thereof.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard address 10 CFR Parts 52 and 100 (Refs. 3 and 4) as they relate to identifying and evaluating hydrologic features of the site. The regulations at 10 CFR Parts 52 and 100 require that a site's physical characteristics (including

[1] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992 (Ref. 2), which has superseded the earlier document.

seismology, meteorology, geology, and hydrology) be taken into account when determining the acceptability of a site for a nuclear reactor or reactors.

To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the hydrologic characteristics of the site and region and an analysis of the PMF. This description should be sufficient to assess the acceptability of the site and the potential for those characteristics to influence the design of structures, systems, and components important to safety for a nuclear power plant or plants of specified type that might be constructed on the proposed site. Meeting this requirement provides reasonable assurance that hydrologic phenomena of severity up to and including the PMF would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 5) as it relates to structures, systems, and components important to safety being designed to withstand the effects of floods.

To meet the requirements of the hydrologic aspects of 10 CFR Parts 52 and 100, the following specific criteria are used:

The PMF as defined in Regulatory Guide 1.59 has been adopted as one of the conditions to be evaluated in establishing the applicable stream and river flooding design basis referred to in General Design Criterion 2, Appendix A, 10 CFR Part 50. PMF estimates are needed for all adjacent streams or rivers and site drainage (including the consideration of PMP on the roofs of safety-related structures). The criteria for accepting the applicant's PMF-related design basis depend on one of the following three conditions:

1. The elevation attained by the PMF (with coincident wind waves) establishes a necessary protection level to be used in the design of the facility.

2. The elevation attained by the PMF (with coincident wind waves) is not controlling; the design basis flood protection level is established by another flood phenomenon (e.g., the probable maximum hurricane).

3. The site is "dry"; that is, the site is well above the elevation attained by a PMF (with coincident wind waves).

When condition 1 is applicable, the staff will assess the flood level (described in subsection III). The assessment may be made independently from basic data, by detailed review and checking of the applicant's analyses, or by comparison with estimates made by others that have been reviewed in detail. The applicant's estimates of the PMF level and the coincident wave action are acceptable if the estimates are no more than 5% less conservative than the staff's estimates. If the applicant's estimates of discharge are more than 5% less conservative than

the staff's, the applicant should fully document and justify its estimates or accept the staff's estimates.

When condition 2 or 3 applies, the staff analyses may be less rigorous (described in subsection III). For condition 2, acceptance is based on the protection level estimated for another flood-producing phenomenon exceeding the staff estimate of PMF water levels. For condition 3, the site grade should be well above the staff assessment of PMF water levels. The evaluation of the adequacy of the margin (difference in flood and site elevations) is generally a matter of engineering judgment. The judgment is based on the confidence in the flood level estimate and the degree of conservatism in each parameter used in the estimate.

Appropriate sections of the following documents are used by the staff to determine the acceptability of the applicant's data and analyses. (Ref. 6) Regulatory Guide 1.59 provides guidance for estimating the PMF design basis. Publications of the National Oceanic and Atmospheric Administration (NOAA) and the Corps of Engineers may be used to estimate PMF discharge and water level condition at the site and coincident wind-generated wave activity.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such a permit includes a description of the site's hydrometeorological characteristics. For this type of permit, the scope and level of detail for reviewing such data are outlined below.

For conditions 1 and 2 (described in subsection II), the methods used for evaluating flooding potential are separated into two parts--PMF on adjacent streams and local PMF. (The procedure for evaluating the adequacy of site drainage facilities based on a local PMF is outlined in Section 2.4.2 of this review standard.) Corps of Engineers PMF assessments for specific locations, or generalized PMF assessments for a geographical area approved by the Chief of Engineers and contained in published or unpublished reports of that agency, may be used in lieu of staff-developed analyses. In the absence of such assessments, both large and small basin PMP estimates by NOAA; published techniques of the World Meteorological Organization; and runoff, impoundment, and river-routing models of the Corps of Engineers are used by the staff to estimate PMF discharge and water level at the site. A comprehensive review of the applicant's analyses will be performed and a simplified analysis using calculational procedures or models with demonstrably conservative coefficients and assumptions is performed. If the applicant's PMF estimates are within acceptable margins (described in subsection II), the staff positions will indicate concurrence with the applicant's PMF estimates and the safety evaluation report (SER) input will be written accordingly. If the simplified analysis indicates a potential problem with the applicant's estimates, a detailed analysis using more realistic techniques will be performed. The staff will develop a position based on the detailed analysis; resolve, if possible, differences between the applicant's and staff's estimates of PMF design basis; and prepare the SER input accordingly.

Wind-generated wave action will be independently estimated using Corps of Engineers criteria such as the "Coastal Engineering Manual."[2] (Ref. 7) When sufficient water depth is available, the significant wave height and runup are used for structural design purposes, and the one

[2] The “Coastal Engineering Manual” replaced the “Shore Protection Manual” in 2002.

percent wave height and runup are used for flood level estimates. Where depth limits wave height, the breaking or broken wave height and runup is used for both purposes.

For condition 3 (i.e., a "dry site"--one not subject to stream flooding by virtue of local topographic considerations), the following procedures apply:

1. Use Corps of Engineers PMF estimates for other sites in the region to develop "regional drainage area versus PMF discharge " (m^3 per sec/km^2 (ft^3 per sec/mi^2)) data, for extrapolation to the site.

2. Envelope the above data points to obtain an estimate of the PMF applicable to the site.

3. Increase the estimate based on a judgment as to the applicability of the basic estimates. An increase in the range of 10% to 50% is generally appropriate.

4. If warranted by relative elevation differences between the site and adjacent stream, estimate the flood level at the site using slope-area techniques or water surface profile computations.

5. Estimate wind (2-yr extreme windspeed) wave runup based on breaking or 1% wave heights. Criteria for estimating windspeed are discussed in ANSI/ANS-2.8-1992.

6. Compare resultant water level with plant grade and lowest safety-related facility that can be affected.

The above items of review are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will summarize the applicant's and staff's estimates of the peak PMF runoff rate and water level (including allowance for coincident wind-generated wave activity) at the site. If the applicant's estimates are within the criteria (described in subsection II), staff concurrence will be stated. If the staff's estimates are 5% more conservative than the applicant's estimates, if the flood conditions may adversely affect a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, and if the applicant has been unable to support his estimates, a statement on use of the staff bases will be made. If the flood conditions do not constitute a design basis, the findings will so indicate.

If Regulatory Guide 1.59, Position 2, is elected by the applicant, a statement describing lesser design bases will be included in the findings with a staff conclusion of adequacy.

A sample statement for an ESP review follows:

> As set forth above, the probable maximum flood (PMF) resulting from the probable maximum precipitation (PMP) on the ABC River drainage basin yielded an estimated maximum stillwater level at the planned location of the intake structure on the D & E Canal of about 1.5 m (5.0 ft) MSL.

The PMF resulting from a local PMP storm on the drainage basins for the small streams near the site yielded an estimated maximum stillwater level of about 18 m (60 ft) MSL, which is about 6 m (20 ft) below plant grade.

The local PMF resulting from the estimated local PMP was found not to cause flooding of safety-related facilities for a nuclear power plant of type specified by the applicant [or of a facility falling within the plant parameter envelope submitted by the applicant] that might be constructed on the proposed site, since the site drainage system would be capable of functioning adequately during such a storm. Catch basins would be provided as part of the storm drainage system and would be located throughout the plant site to drain local areas. The plant yard would be graded with gentle slopes away from high points at the plant buildings, and storm water would drain away from the buildings into the local streams at lower elevations.

Historical data for the proposed site are consistent with the probable maximum precipitation and flood levels identified in the safety assessment.

Therefore, the staff concludes that the site meets the flood requirements of 10 CFR Parts 52 and 100 and is acceptable.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

Because of the geographic diversity of plant sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps, papers, and charts by the U.S. Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers; and other publications of state, federal, and other regulatory bodies, describing hydrologic characteristics and water utilization in the site vicinity and region, are referred to on an "as-available" basis.

1. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

2. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites."

3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

4. 10 CFR Part 100, "Reactor Site Criteria."

5. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

6. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

7. “Coastal Engineering Manual,” U.S. Army Engineer Waterways Experiment Station, U.S. Government Printing Office, Washington, DC (2002).

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.4 POTENTIAL DAM FAILURES

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

In this section of the site safety assessment for an early site permit (ESP) application, the hydrogeologic design basis is developed to ensure consideration of any potential hazard to the safety-related facilities of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site due to the failure of upstream and downstream water control structures. The areas of review include consideration of flood waves (bores) from severe breaching of upstream dams and the potential loss of water supply due to failure of a downstream dam, domino-type failures of dams, landslides, and effects of sediment deposition and erosion.

When data are provided to show that seismic events will not cause failures of upstream dams that could produce the governing flood at a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, this section may contain additional data and other information to support a contention that the dams are equivalent to seismic Category I structures and will survive a local equivalent of the safe shutdown earthquake (SSE) ground motion coincident with a 25-year flood or will survive ½ of the SSE gound motion coincident with a standard project flood (SPF).[1] In such cases, the EMEB will evaluate the data necessary to justify such a classification. EMEB review procedures are outlined in the appropriate geosciences and structural sections of this review standard. The balance of this section applies to the hydrologic analyses of dam failures or breaches.

Where analyses are provided in support of either a conclusion that a probable maximum flood (PMF) should be the design basis flood for a stream, or that a postulated or arbitrarily assumed dam failure flood is the design basis flood for a stream, the areas of review consist of the following:

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[1] This combination is based on the guidance of Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants" and past NRC licensing practice. Regulatory Guide 1.59 references ANSI Standard N170-1976, which has been superseded by ANSI/ANS-2.8-1992, "American National Standard for Determining Design Basis Flooding at Power Reactor Sites." Section 9.2.1.2 of this standard calls for consideration of dam failure caused by the Operating Basis Earthquake (OBE) coincident with the peak of flood. Existing reactors were licensed using an OBE equal to ½ the SSE. Though a 1997 rulemaking eliminated use of the OBE in reactor design, the value of ½ the SSE (or other value if justified by an ESP applicant) may be used to analyze seismically induced dam failures.

1. Conservatism of modes of assumed dam failure and deposition of debris downstream.

2. Consideration of flood control reservoirs at full pool level.

3. Conservatism of coincident flow rates and levels, depending on whether failure is postulated with an equivalent SSE coincident with a 25-year flood or ½ of the SSE coincident with an SPF. An SPF is considered to be about forty percent of a PMF.

4. Flood wave attenuation to downstream dams or to the site, whichever would be encountered first.

5. Potential for multiple dam failures; flood wave effects and potential for failure of downstream dams.

6. Hydraulic failure as a result of overtopping for any reason.

7. Dynamic effects of possible bores on exposed facilities of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

8. Conservative flow conditions for downstream dam failures that can influence safety-related water supplies.

9. Applicability and conservatism of models used to predict the effects of dam failure floods including breach shape and rate of failure.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard are based on meeting the requirements of the following regulations:

1. 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they relate to evaluating hydrologic features of the site.

2. 10 CFR 100.23 as it relates to establishing the design basis flood due to seismic dam failure.

The regulations at 10 CFR 52.17(a) and 10 CFR Part 100.20(c) require that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability to host a nuclear reactor or reactors.

The regulations at 10 CFR Parts 52 and 100 are applicable to safety assessment Section 2.4.4 because it addresses the physical characteristics, including hydrology, considered by the Commission when determining the acceptability of a site for a power reactor. To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the hydrologic characteristics of the region and an analysis of potential dam failures. The description should be sufficient to assess the acceptability of the site and the potential for those characteristics to influence the design of structures, systems, and components important to safety. Meeting this criterion provides reasonable assurance that effects of high water levels resulting from failure of upstream dams, as well as those of low

water levels resulting from failure of a downstream dam, would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

The regulation at 10 CFR 100.23 requires consideration of geologic and seismic factors in determination of site suitability. Section 100.23(c) requires an investigation to obtain geologic and seismic data for evaluating seismically induced floods, including failure of an upstream dam during an earthquake.

The regulation at 10 CFR 100.23 is applicable to Section 2.4.4 of this review standard because it requires investigation of seismically induced floods or low water levels that guide the Commission in its consideration of the suitability of proposed sites for nuclear power plants. More detailed guidance on the investigation of seismically induced floods is provided in Regulatory Guide 1.70 (Ref. 3), including results for seismically induced dam failures and antecedent flood flows coincident with the flood peak. Meeting 10 CFR 100.23 provides reasonable assurance that, given the geologic and seismic characteristics of the proposed site, a nuclear power plant or plants of specified type (or falling within a PPE) could be constructed and operated on the proposed site without undue risk to the health and safety of the public with respect to those characteristics.

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 4) as it relates to structures, systems, and components important to safety being designed to withstand floods.

To meet the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23, as they relate to dam failures, the following specific criteria are used:

The staff will review the applicant’s analyses and independently assess the coincident river flows at the site and at the dams being analyzed. ANSI/ANS-2.8-1992 (Ref. 5) provides guidance on acceptable river flow conditions to be assumed coincident with the dam failure event. The applicant’s estimates (which may include landslide-induced failures) of the flood discharge resulting from the coincident events should be no more than 5% less conservative than the staff’s estimates to be acceptable. If the applicant’s estimates differ by more than 5%, the applicant should fully document and justify its estimates or accept the staff’s estimates.

For safety assessment Section 2.4.4.1 (Dam Failure Permutations): The location of dams and potentially "likely" or severe modes of failure should be identified. Dams or embankments for the purpose of impounding water for a nuclear power plant or plants that might be constructed on the proposed site should also be identified. The potential for multiple, seismically induced dam failures and the domino failure of a series of dams should be discussed. Approved models of the Corps of Engineers and the Tennessee Valley Authority are used to predict the downstream water levels resulting from a dam breach (Refs. 6 through 10). First-time use of other models will necessitate complete model description and documentation. Acceptance of the model (and subsequent analyses) is based on the staff review of model theory, available

verification, and application. Where other than instantaneous failure is assumed, the conservatism of the rate of failure and shape of the breach should be well documented. A determination of the peak flow rate and water level at the site for the worst possible combination of dam failures and a summary analysis (that substantiates the condition as the critical permutation) should be presented, along with a description (and the bases) of all coefficients and methods used. Also, the effects of other concurrent events on plant safety, such as blockage of the river and water-borne missiles, should be considered.

For safety assessment Sections 2.4.4.2 (Unsteady Flow Analysis of Potential Dam Failures) and 2.4.4.3 (Water Level at Plant Site): The effects of coincident and antecedent flood flows (or low flows for downstream structures) on initial pool levels should be considered. Use of the methods given in References 11 or 12 is acceptable for determination of initial pool levels. Depending upon estimated failure modes and the elevation difference between plant grade and normal river levels, it may be acceptable to use conservative simplified procedures to estimate flood levels at the site. Where calculated flood levels using simplified methods are at or above plant grade and using assumptions which cannot be demonstrated as conservative, it will be necessary to use unsteady flow methods to develop flood levels at the site. References 7, 13, and 14 are acceptable methods; however, other programs would be acceptable with proper documentation and justification. Computations, coefficients, and methods used to establish the water level at the site for the most critical dam failures should be summarized. Coincident wind-generated wave activity should be considered in a manner similar to that discussed in Section 2.4.3 of this review standard.

Appropriate sections of the guides described below are used by the staff to determine the acceptability of the applicant's data and analyses. Regulatory Guide 1.59[2] (Ref. 15) provides guidance for estimating the design basis for flooding considering the worst single phenomenon and combination of less severe phenomena.

III. REVIEW PROCEDURES

The conservatism of the applicant's estimates of flood potential and low water levels from structure failures is judged against the criteria indicated in subsection II above. An analysis is performed using simplified, conservative procedures (such as instantaneous failure, coincident SPF flows, minimal flood wave attenuation, and extrapolated site discharge-rating curves). Techniques for such analyses are identified in standard hydraulic design references and text books, such as those listed in the reference section (Refs. 16 through 31). If no potential flood problem exists, the staff safety evaluation report (SER) input is written accordingly. If the simplified analysis indicates a potential flooding problem, the analysis is repeated using a more refined technique which may include time rate of failure and hydrometeorologically compatible storm centering. Detailed failure models, such as those of the Corps of Engineers and the Tennessee Valley Authority, are utilized to identify the outflows from various failure modes. Models of the Corps of Engineers or the Tennessee Valley Authority are used to identify the outflow characteristics and resultant water level at the site (Refs. 6 through 10, and 13). The staff will develop a position based on the analyses performed; resolve, if possible, differences between the applicant's and staff's estimates; and write the SER input accordingly.

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[2] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992, which has superseded the earlier document.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will summarize the applicant and staff evaluations in compliance with 10 CFR Parts 52 and 100, and 10 CFR 100.23, of the design basis maximum and minimum water levels caused by potential dam failures. If the applicant's estimates are within acceptable margins (described in subsection II), staff concurrence in the applicant's estimates will be stated. If the applicant's estimates are not within acceptable margins, and if a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site may be adversely affected, a position on use of the staff bases will be stated. If no dam failure review was undertaken at the ESP stage (of the scope described), this fact will be indicated. Evaluation of a dam constructed after issuance of an ESP would need to be performed at the COL stage.

Sample statements for ESP reviews follow:

> As set forth above, the distance (more than 480 km [300 mi]) to upstream reservoirs of appreciable size is such that the staff assessment leads to the conclusion that their arbitrarily assumed failure, under postulated combinations of floods and earthquakes of the severity discussed in Regulatory Guide 1.59, would not constitute a threat to a nuclear power plant of specified type [or to a facility falling within the plant parameter envelope submitted by the applicant] that might be constructed on the proposed site.
>
> Dam failure-caused "worst case" floods were evaluated by the applicant based upon failures with consideration of only the location and sizes of upstream impoundments, and not on inherent capability of such structures to resist earthquakes, volcanic activity, and severe landslide-induced floods. The most severe flood of this kind was estimated based upon an assumed catastrophic failure of Dam A some 680 km (420 mi) upstream. The peak flow at the site from such a flood was estimated to be 85,000 m^3/s (3,000,000 cfs). This flow is estimated to occur about 2 days after the dam failure and reach elevation 12 m (39 ft) MSL, 3 m (10 ft) below plant grade.
>
> A volcanically induced flood was assumed to cause a domino-type failure of the three dams on the tributary B River from a volcanic eruption of Mt. D. The evaluation indicated such an event could cause the second most severe artificial flood that would reach the site. This event was estimated to produce a peak flow at the site of 80,000 m^3/s (2,800,000 cfs) and a water level of 12 m (39 ft) MSL, 3 m (10 ft) below plant grade.
>
> Therefore, the staff concludes that the plant design flood elevation, at plant grade of 15 m (50 ft) above mean sea level (MSL), is acceptable and meets the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23 with respect to potential hazards due to dam failure floods.

The findings will address the envelope of site-related hydrologic parameters. These parameters should be representative of the most severe hydrologic characteristics likely to occur as a result of dam failure.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

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. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

5. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites."

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RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

In this section of the site safety assessment for an early site permit (ESP) application, the hydrometeorological design basis is developed to determine the extent of flood protection necessary for safety-related systems for a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. The areas of review include the characteristics of the assumed probable maximum hurricane or other probable maximum wind storms and the techniques, methodologies, and parameters used in the determination of the design surge and/or seiche. Antecedent water levels, storm tracks, methods of analysis, coincident wind-generated wave action and wave runup on safety-related structures, potential for wave oscillation at the natural periodicity, and the resultant design bases for surge and seiche flooding are also reviewed.

II. ACCEPTANCE CRITERIA

The EMEB acceptance criteria for this section of this review standard are based on meeting the requirements of 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they relate to evaluating the hydrologic characteristics of the site. Specific criteria necessary to meet the relevant hydrologic requirements of 10 CFR Parts 52 and 100 are the regulations at 10 CFR 52.17(a) and 10 CFR 100.20(c), which require that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability for a nuclear reactor or reactors.

To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the surface and subsurface hydrologic characteristics of the region and an analysis of the potential for flooding due to surges or seiches. This description should be sufficient to assess the acceptability of the site and the potential for a surge or seiche to influence the design of structures, systems, and components important to safety for a nuclear power plant or plants of specified type that might be constructed on the proposed site. Meeting this requirement provides reasonable assurance that the most severe flooding likely to occur as a result of storm surges or seiches would not pose an undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment

Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 3) as it relates to structures, systems, and components important to safety being designed to withstand hurricanes and seiches.

If it has been determined that surge and seiche flooding estimates are necessary to identify flood design bases, the applicant's analysis will be considered complete and acceptable if the following areas are addressed and can be independently and comparably evaluated from the applicant's submission.

1. All reasonable combinations of probable maximum hurricane, moving squall line, or other cyclonic wind storm parameters are investigated, and the most critical combination is selected for use in estimating a water level.

2. Models used in the evaluation are verified or have been previously approved by the staff.

3. Detailed descriptions of bottom profiles are provided (or are readily obtainable) to enable an independent staff estimate of surge levels.

4. Detailed descriptions of shoreline protection and safety-related facilities are provided to enable an independent staff estimate of wind-generated waves, runup, and potential erosion and sedimentation.

5. Ambient water levels, including tides and sea level anomalies, are estimated using NOAA and Corps of Engineers publications as described below.

6. Combinations of surge levels and waves that may be critical to design of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site are considered, and adequate information is supplied to allow a determination that no adverse combinations have been omitted.

7. At the COL stage, if Regulatory Guide 1.59[1] (Ref. 4), Position 2, is elected by the applicant, the design basis for flood protection of all safety-related facilities identified in Regulatory Guide 1.29 (Ref. 6) should be shown to be adequate in terms of time necessary for implementation of any emergency procedures. The applicant should also demonstrate that all potential flood situations that could negate the time and capability to initiate flood emergency procedures are provided for in the less severe design basis selected.

This section of the safety assessment may also state with justification that surge and seiche flooding estimates are not necessary to identify the flood design basis (e.g., the site is not near a large body of water).

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[1] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992 (Ref. 5), which has superseded the earlier document.

Hydrometeorological estimates and criteria for development of probable maximum hurricanes for east and Gulf Coast sites, squall lines for the Great Lakes, and severe cyclonic wind storms for all lake sites by the Corps of Engineers, National Oceanic and Atmospheric Administration (NOAA), and the staff are used for evaluating the conservatism of the applicant's estimates of severe windstorm conditions, as discussed in Regulatory Guide 1.59. The Corps of Engineers and NOAA criteria call far variation of the basic meteorological parameters within given limits to determine the most severe combination that could result. The applicant's hydrometeorological analysis should be based on the most critical combination of these parameters. (Refs. 7 and 8)

Data from publications of NOAA, the Corps of Engineers, and other sources (such as tide tables, tide records, and historical lake level records) are used to substantiate antecedent water levels. These antecedent water levels should be as high as the "10% exceedance" monthly spring high tide, plus a sea level anomaly based on the maximum difference between recorded and predicted average water levels for durations of 2 weeks or longer for coastal locations or the 100-yr recurrence interval high water for the Great Lakes. In a similar manner, the storm track, wind fields, effective fetch lengths, direction of approach, timing, and frictional surface and bottom effects are evaluated by independent staff analysis to ensure that the most critical values have been selected. Models used to estimate surge hydrographs that have not previously been reviewed and approved by the staff are verified by reproducing historical events, with any discrepancies in the model being on the conservative (i.e., high) side.

Criteria and methods of the Corps of Engineers, as generally summarized in Reference 9, are used as a standard to evaluate the applicant's estimate of coincident wind-generated wave action and runup.

Criteria and methods of the Corps of Engineers and other standard techniques are used to evaluate the potential for oscillation of waves at natural periodicity.

At the COL stage, criteria and methods of the Corps of Engineers (Ref. 9) are used to evaluate the adequacy of protection from flooding, including the static and dynamic effects of broken, breaking, and nonbreaking waves. Regulatory Guide 1.102 (Ref. 10) provides further guidance on flood protection. Regulatory Guide 1.125 (Ref. 11) provides guidance for using physical models in assessing flood protection.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such a permit includes a description of the site's hydrometeorological characteristics. For this type of review, the procedures below should be followed.

The staff will evaluate the applicant's analysis, including all of the assumptions, techniques, and models used. If satisfied with their technical soundness and applicability to the problem, the staff's evaluation will be focused on the conservatism of parameters used by the applicant.

If not satisfied with the applicant's techniques, the staff will perform a simplified analysis of the controlling surge and seiche flooding level (coincident with wind-generated wave activity) for comparison with the PPE (or selected plant design) for allowable site water level. If the applicant's estimates of critical water level are no more than 5% less conservative than the

staff's estimates,[2] staff concurrence will be stated. If the applicant's estimates are more than 5% less conservative, the analysis is repeated using more realistic techniques. The staff will develop a position based on the analysis; resolve, if possible, differences between the applicant's and staff's estimates of surge and seiche flooding levels; and write the safety evaluation report (SER) input accordingly. The specific review procedures are described below.

In general, the conservatism of the applicant's estimates of flood potential from surges and seiches is judged against the criteria indicated in subsection II above and as discussed in Regulatory Guide 1.59. If the site is not near a large body of water, the staff findings may be prepared a priori. Methods of the Corps of Engineers and National Oceanic and Atmospheric Administration (NOAA) (HUR 7-97 and amendments, Ref. 12) are used to develop the critical probable maximum hurricane (PMH) parameters for the site. The Corps of Engineers model SURGE (or other verified models) may be used to estimate the maximum surge stillwater elevations at coastal sites. Coincident wind-generated waves and runup are estimated from publications by the Corps of Engineers (Ref. 9). Reports of NOAA and the Corps of Engineers are used to estimate probable maximum wind fields over the Great Lakes. Models such as Platzmann's (Ref. 13), or other verified models, may be used to estimate the maximum surge or seiche stillwater elevation for Great Lakes sites; coincident wind-generated waves and runup are estimated as above. Additional information related to storm surge and wave setup problems is available in References 14 through 36.

Two-dimensional models (Refs. 37 through 39) include seiching effects. Seiching potential is evaluated using one-dimensional models by comparing the natural period of oscillation (resonance) of the water body with the estimated meteorologically induced wave periods. Resonance of a water body may be calculated by the methods presented in Reference 9 or standard texts. Generally, a demonstration that the water body cannot generate or sustain waves of the period for resonance is satisfactory to discuss the possibility of damaging seiching. Similarly, seismically induced seiching is precluded if the natural period of oscillation of the water body is dissimilar from the period of seismic excitation. If resonance is possible, the maximum seiche should be considered in the selection of the critical flood design bases.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will summarize the applicant's and staff's estimates of critical water level (including wind-generated wave levels) at the site. If the estimates meet the criteria (described in subsection II above), staff concurrence will be stated. If the applicant's estimates do not meet the criteria in subsection II above, and a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site may be adversely affected, a statement on use of the staff's estimates for the design basis will be made. If the flood conditions do not constitute a design basis, the statement will so indicate.

If Regulatory Guide 1.59, Position 2, is elected by the applicant for protection, a statement describing lesser design bases will be included in the findings with the staff conclusion of adequacy.

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[2] Based on the difference between normal water levels and the flood event.

A sample statement for an ESP review follows:

> As set forth above, the design basis hurricane-induced high and low stillwater levels were established during the early site permit review at elevations 6.7 m (22.0 ft) MSL and -2.3 m (-7.5 ft) MSL, respectively. These levels are based upon the estimated water levels, exclusive of wave action, that would occur during passages of a probable maximum hurricane (PMH) to the south and north, respectively, of the proposed plant site.
>
> Therefore, the staff concludes that the applicant has adequately described the surface and subsurface hydrologic characteristics of the region and the potential for flooding due to surges or seiches. The applicant's description is sufficient to meet the requirements of 10 CFR Part 52 and 10 CFR Part 100 with respect to surge and seiche flooding.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

2. 10 CFR Part 100, "Reactor Site Criteria."

3. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

4. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

5. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites."

6. Regulatory Guide 1.29, "Seismic Design Classification."

7. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

8. H. E. Graham and D. E. Nunn, "Meteorological Considerations Pertinent to Standard Project Hurricane, Atlantic and Gulf Coasts of the United States," Report No. 33,

National Hurricane Research Project, U.S. Weather Bureau and Corps of Engineers (1959).

9. "Shore Protection Planning and Design," Technical Report No. 4, Third Edition, Corps of Engineers Coastal Engineering Research Center (1966), and "Coastal Engineering Manual," U.S. Army Engineer Waterways Experiment Station (2002)[3].

10. Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants."

11. Regulatory Guide 1.125, "Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants."

12. "Interim Report - Meteorological Characteristics of the Probable Maximum Hurricane, Atlantic and Gulf Coasts of the United States," U.S. Weather Bureau Memorandum HUR 7-97, and HUR-97A (1968).

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[3] This document replaces “Shore Protection Manual” (1974).

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23. D. L. Harris, "Characteristics of the Hurricane Storm Surge," Technical Paper No. 48, U.S. Department of Commerce (1963).

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26. C. Marinos and J. W. Woodward, "Estimation of Hurricane Surge Hydrographs,' Jour. Waterways and Harbors Division, Proc. Am. Soc. Civil Engineers, Vol. 94, No. WW2, pp. 189-216 (1968).

27. T. Saville, Jr., "Experimental Determination of Wave Set-Up," NHRP Report No. 50, Proc. of the Second Technical Conference on Hurricanes, pp. 242252 (1962).

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29. "Waves in Inland Reservoirs: Summary Report on CWI Projects CW-164 and CW-165," Technical Memorandum No. 132, U.S. Army Beach Erosion Board (1962).

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37. J. J. Leendertse, "Aspects of a Computational Model for Long-Period Water Wave Propagation," Memorandum RM-5294-PR, prepared for United States Air Force, Project Rand (1967).

38. R. O. Reid and B. R. Bodine, "Numerical Model for Storm Surges in Galveston Bay," Jour. Waterways and Harbors Division, Proc. Am. Soc. Civil Engineers, Vol 94, No. WW1, pp. 33-57 (1968).

39. Y. J. Tsai and Y. C. Chang, "Prediction and Verification of Storm Surges in Lake Ontario and Lake Erie," 17th Conference on Great Lakes Research, International Association for Great Lakes Research, August 12-14, 1974, Hamilton, Ontario.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

The geohydrological design basis of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE] that might be constructed on the proposed site is developed in this section of the site safety assessment for an early site permit (ESP) application to determine the extent of plant protection necessary for tsunami flooding and drawdown (outlined in Regulatory Guide 1.102). (Ref. 1) The areas of review include the hydrologic characteristics of the maximum locally and distantly generated tsunami and the techniques, methodologies, and parameters, including the geoseismic parameters of the generators, used in the determination of the design basis tsunami (discussed in Regulatory Guide 1.59[1]). (Ref. 2)

Hydrologic analysis techniques, including tsunami formation, propagation and shoaling models, and coincident water levels, including astronomical tide, storm surges and waves, are reviewed.

The review will encompass the geologic and seismic characteristics of potential faults that might cause a tsunami, including the earthquake magnitude, focal depth, source dimensions, fault orientation, and vertical displacement. The applicant's values for parameters used to model tsunami, which may represent the upper bounds of the parameters, will be reviewed.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard relate to the following regulations:

1. 10 CFR Parts 52 and 100 (Refs. 4 and 5) as they relate to identifying and evaluating hydrologic features of the site.

2. 10 CFR 100.23, as it relates to investigating the tsunami potential at the site.

The regulations at 10 CFR 52.17(a) and 10 CFR 100.20(c) require that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability to host a nuclear reactor or reactors. The regulations at 10 CFR Parts 52 and 100 are applicable to Section 2.4.6 of this review standard because they address the physical characteristics, including hydrology, considered by the

[1] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992 Ref. 3), which has superseded the earlier document.

Commission when determining the acceptability of the proposed site. To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of the hydrologic characteristics of the coastal region in which the proposed site is located and an analysis of severe seismically induced waves. The description should be sufficient to assess the acceptability of the site and the potential for a tsunami to influence the design of structures, systems, and components important to safety for a nuclear power plant or plants of specified type that might be constructed on the proposed site. Meeting this requirement provides reasonable assurance that the most severe flooding likely to occur as a result of tsunami would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

The regulation at 10 CFR 100.23(c) requires that geologic and seismic factors be considered when determining suitability of the site. Section 100.23(c) requires an investigation to obtain geologic and seismic data necessary for evaluating seismically induced floods and water waves. Section 100.23(c) is applicable to Section 2.4.6 of this review standard because it requires investigation of distantly and locally generated waves or tsunami that have affected or could affect a proposed site, including available evidence regarding the runup or drawdown associated with historic tsunami in the same coastal region and local features of coastal topography that might modify runup or drawdown. More detailed guidance on the investigation of seismically induced flooding is provided in Regulatory Guide 1.70. (Ref. 6)

Note: Though not required at the ESP stage, the applicant for a combined operating license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 7) as it relates to structures, systems, and components important to safety being designed to withstand the effects of tsunami.

To meet the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23, with respect to tsunami and the analysis thereof, the following specific criteria are used:

1. If it has been determined that tsunami estimates are necessary to identify flood or low water design bases, the analysis will be considered complete if the following areas are addressed and can be independently and comparably evaluated from the applicant's submission:

    a. All potential distant and local tsunami generators, including volcanoes and areas of potential landslides, are investigated and the most critical ones are selected.

    b. Conservative values of seismic characteristics (source dimensions, fault orientation, and vertical displacement) for the tsunami generators selected are used in the analysis.

    c. All models used in the analysis are verified or have been previously approved by the staff. Regulatory Guide 1.125 (Ref. 8) provides guidance in the use of physical models of wave protection structures.

d. Bathymetric data are provided (or are readily obtainable).

e. Detailed descriptions of shoreline protection and safety-related facilities are provided for wave runup and drawdown estimates. Regulatory Guide 1.102 provides guidance on flood protection for nuclear power plants.

f. Ambient water levels, including tides, sea level anomalies, and wind waves, are estimated using National Oceanic and Atmospheric Administration (NOAA) and Corps of Engineers publications as described below.

g. If Regulatory Guide 1.59, Position 2, is adopted by the applicant, the design basis for tsunami protection of all safety-related facilities identified in Regulatory Guide 1.29 (Ref. 9) should be shown at the COL stage to be adequate in terms of the time necessary for implementation of any emergency procedures.

2. The applicant's estimates of tsunami runup and drawdown levels are acceptable if the estimates are no more than 5% less conservative than the staff's estimates. If the applicant's estimates are more than 5% less conservative (based on the difference between normal water levels and the maximum runup or drawdown levels) than the staff's, the applicant should fully document and justify its estimates or accept the staff's estimates.

3. This section of the safety assessment will also be acceptable if it states the criteria used to determine that tsunami flooding estimates are not necessary to identify the flood design basis (e.g., the site is not near a large body of water).

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such a permit includes a description of the site's geohydrological characteristics. For this type of permit, the procedures below should be followed.

The references used for this review are general geophysical, seismological, and hydrodynamic publications, such as published data by NOAA, and wave propagation models, such as those developed by NOAA, the Corps of Engineers' Waterways Experiment Station (WES), and Tetra Tech.

Section 2.4.6 of the applicant's safety assessment is reviewed to identify any missing data, information, or analysis necessary for the staff's evaluation of potential tsunami flooding. This section is evaluated when the applicant has responded to all the additional information requested. If the site is not near a large body of water with potential tsunami generators, the staff findings may be prepared a priori.

The EMEB staff will review the potential tsunami sources analyzed by the applicant to ensure that all locations capable of generating a tsunami of significant magnitude at the site have been considered. The EMEB staff will evaluate the geoseismic parameters of the tsunami generators, including fault location and orientation, and amplitude and areal extent of vertical displacement, to ensure that conservative values have been chosen.

An independent staff analysis, using one of the models listed in the references, may be performed. Staff estimates of tsunami levels are compared with the applicant's. The applicant should justify, to the staff's satisfaction, tsunami levels more than 5% less conservative than the staff's.

As an alternative, the staff may perform an independent evaluation of the applicant's model and its utilization. The model's theoretical basis, its inherent conservatism and applicability to the problem, will be evaluated (this can be done on a generic basis). The conservatism of the model's use, including the conservatism of all input parameters, will be evaluated.

Coincident ambient tide and wave conditions will be evaluated to ensure that they are of at least annual severity. Data from publications of NOAA, the Corps of Engineers, and other sources are used to substantiate these conditions chosen.

Criteria and methods of the Corps of Engineers as generally summarized in Reference 10 are used as a standard to evaluate the applicant's estimate of coincident wind-generated wave action and runup.

Criteria and methods of the Corps of Engineers and other standard techniques are used to evaluate the potential for oscillation of waves at natural periodicity.

Criteria and methods of the Corps of Engineers (Ref. 10) are used to evaluate the adequacy of protection from flooding, including the static and dynamic effects of broken, breaking, and nonbreaking coincident waves.

At the COL stage, the maximum wave runup and drawdown will be compared to the design flood level and intake pumphouse design, respectively.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will consist of a statement summarizing estimates of the maximum and minimum tsunami water levels, and static and dynamic effects of wave action. A statement of acceptability of the tsunami-induced design basis in meeting the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23 will be made. If the tsunami conditions do not constitute a design basis, the findings will so indicate.

A sample statement for an ESP review follows:

> As set forth above, analyses of tsunamic effects from local and distant generators were performed by the applicant. The design tsunami results from a magnitude 8.7 earthquake in the Aleutian Trench. A finite difference numerical model was used to analyze tsunami generation and propagation to the continental shelf. Results of this computation were used in a near-shore model to calculate tsunami runup and drawdown. Including the effects of high and low tides of annual occurrence, the maximum tsunami runup and drawdown are estimated as +7.5 m (+24 ft) MLLW and -4.1 m (-13.4 ft) MLLW, respectively. Wind waves of annual severity were assumed coincident with the tsunami. Plant grade at elevation +55 feet MLLW is well above the tsunami flood level.
>
> Historical data for the site are consistent with the flood levels identified in the early site permit application.

Therefore, the staff concludes that the applicant has adequately described the potential for a tsunami to impact a nuclear power plant of the type specified by the applicant [or to impact a facility falling within the plant parameter envelope submitted by the applicant] that might be constructed at the site. It therefore meets the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. Regulatory Guide 1.102, "Flood Protection Requirements for Nuclear Power Plants."

2. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

3. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites."

4. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

5. 10 CFR Part 100, "Reactor Site Criteria."

6. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

7. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

8. Regulatory Guide 1.125, "Physical Models for Design and Operation of" Hydraulic Structures and Systems for Nuclear Power Plants."

9. Regulatory Guide 1.29, "Seismic Design Classification."

10. "Shore Protection Planning and Design," Technical Report No. 4, Third Edition, Corps of Engineers Coastal Engineering Research Center (1966), and "Coastal Engineering Manual," U.S. Army Engineer Waterways Experiment Station (2002)[2].

[2] Replaces “Shore Protection Manual” (1984).

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.7 ICE EFFECTS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

The hydrometeorologic design basis is developed in this section of the site safety assessment for an early site permit (ESP) application to ensure that safety-related facilities and water supply are not affected by ice flooding or blockage. The areas of review include:

1. The regional history and types of historical ice accumulations (i.e., ice jams, wind-driven ice ridges, floes, etc.).

2. The potential for ice-produced forces on, or blockage of, safety-related facilities.

3. The potential effects of ice-induced high or low flow levels on safety-related facilities and water supplies.

If there is evidence of potential structural effects, EMEB will ascertain whether these effects are properly considered in the site safety assessment. The staff will develop a position based on the analysis; resolve, if possible, differences between the applicant's and staff's estimates of ice effects; and write the safety evaluation report (SER) input accordingly.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard are based on meeting the requirements of 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they relate to identifying and evaluating hydrologic features of the site.

Compliance with 10 CFR 52.17(a) and 10 CFR 100.20(c) requires that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability for a nuclear power reactor. To satisfy the hydrologic requirements of 10 CFR Parts 52 and 100, the applicant's safety assessment should contain a description of any icing phenomena with the potential to result in adverse effects to the intake structure or other safety-related facilities for a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. Ice-related characteristics historically associated with the site and region should be described, and an analysis should be performed to determine the potential for flooding, low water, or ice damage to safety-related structures, systems, or components. (Ref. 3) The analysis should be sufficient to evaluate the site's acceptability and to assess the potential for those characteristics to influence the design of structures, systems, or components

important to safety for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. Meeting this requirement provides reasonable assurance that the effects of potentially severe icing conditions would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 4) as it relates to structures, systems, and components important to safety being designed to withstand the effects of natural phenomena.

Appropriate sections of the following documents are used by the staff to ensure that the Commission regulations identified above are met: Regulatory Guide 1.59[1] (Ref. 5) provides guidance for developing the hydrometeorologic design basis.

To meet the requirements of 10 CFR Parts 52 and 100 as they relate to ice effects the following specific criteria are used:

1. Publications of the National Oceanic and Atmospheric Administration (NOAA), the United States Geologic Survey (USGS), the Corps of Engineers, and other sources are used to identify the history and potential for ice formation in the region. Historical maximum depths of icing should be noted, as well as mass and velocity of any large floating ice bodies. The phrase "historical low water ice affected" or similar phrases in stream flow records (USGS and State publications) will alert the reviewer to the potential for ice effects. The following items should be considered and evaluated, if found necessary.

    a. The regional ice and ice jam formation history should be described to enable an independent determination of the need for including ice effects in the design basis.

    b. If icing has not been severe, based on regional icing history, design considerations should be presented (e.g., return of a portion of low-grade heat to the intake) to ensure that icing or ice blockage of intake screens and pumps would not adversely affect safety-related facilities and water supplies. (This item is to be addressed at the COL stage.)

    c. If the potential for icing is severe, based on regional icing history, it should be shown that water supplies capable of meeting safety-related needs are available from under the ice formations postulated and that safety-related equipment could

[1] In using Regulatory Guide 1.59, references to ANSI N170-1976 should be read as references to ANSI/ANS-2.8-1992 (Ref. 6), which has superseded the earlier document.

be protected from icing as in item b. above. If this cannot be shown, it should be demonstrated that alternate sources of water are available, that they could be protected from freezing, and that the alternate source would be capable of meeting safety-related requirements in such situations.

d. If floating ice is prevalent, based on regional icing history, potential impact forces on safety-related intakes should be considered . The dynamic loading caused by floating ice should be included in the structural design basis. (This item is to be addressed at the COL stage.)

e. If ice blockage of the river or estuary is possible, it should be demonstrated that the resulting water level in the vicinity of the site has been considered. If this water level would adversely affect the intake structure, or other safety-related facilities of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, it should be demonstrated that an alternate safety-related water supply would not also be adversely affected.

2. The applicant's estimates of potential ice flooding or low flows are acceptable if the estimates are no more than 5% less conservative than the staff's estimates. If the applicant's estimates are more than 5% less conservative than the staff's,[2] the applicant should fully document and justify its estimates or accept the staff's estimates.

III. REVIEW PROCEDURES

Applicable literature describing historical occurrences of icing in the region is reviewed to determine if icing protection should be considered in the design of safety-related facilities. (Ref. 7) If considered necessary, the most likely types of icing conditions (floating ice, river blockage by ice buildup, frazil, etc.) are listed, and the potential impact of each type on the design of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site is identified. Criteria of the Corps of Engineers and others (Refs. 8 through 16) provide a means of assessing icing impact and methods of mitigating adverse effects. For each type of icing condition, preliminary independent estimates of the "worst case" will be made by either conservative statistical or deterministic techniques.

If the applicant's estimates of ice effects are comparable to the staff's preliminary analysis, the staff will concur with the applicant's estimates. If the preliminary analysis indicates the applicant's estimates of ice effects are not comparable to the staff's estimates, the staff's analysis will be repeated using more realistic techniques.

The above reviews are performed only when applicable to the site or site regions. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will summarize the applicant's and staff's estimates of the potential for ice flooding, ice blockage of water intakes, and the minimum low water levels (from upstream ice blockage). If the applicant's estimates are within acceptable margins (described

[2] Based on the difference between normal water levels and the flood event or low water.

in Acceptance Criteria), staff concurrence with the applicant's estimate will be stated. If the applicant's estimates are not within acceptable margins, if the staff predicts potential blockage of the intake, or if the effects of potentially severe icing conditions would pose an undue risk to the type of facility proposed for the site (or to a facility falling within the applicant's PPE), a statement of the staff bases will be made. If the icing conditions do not constitute a design basis, the findings will so indicate.

A sample ESP statement follows:

> As set forth above, ice flooding, which is common on the A River at the makeup intake structure, could only affect the river intake structure of a nuclear power plant of type specified by the applicant [or of a facility falling within the plant parameter envelope (PPE) submitted by the applicant]; this would not result in any adverse effects to the plant's safety-related facilities. Ice flooding may possibly raise the water surface near the A River intake to a maximum elevation of about 170 m (555 ft) MSL. Also, ice and ice flooding on the A River tributaries outside the cooling lake will not affect the facilities of a nuclear plant of the type specified by the applicant that might be built at the site [or a facility falling within the PPE submitted by the applicant]. The major tributary nearest the site is the B Creek with the closest point located about 1.6 km (1 mi) to the southeast of the site. Because of the distance from the proposed site and the wide floodplain of the river, the effects of severe icing conditions would not pose an undue risk to the type of facility proposed for the site [or to a facility falling within the PPE submitted by the applicant] due to ice in the river and consequent flooding.
>
> Therefore, the staff concludes that, with respect to ice flooding, the applicant has adequately described the potential adverse impacts of icing on the safety-related facilities of a nuclear power plant of type specified by the applicant [or on a facility falling within the PPE submitted by the applicant] that might be constructed on the proposed site. In addition, the applicant has adequately described the ice-related characteristics historically associated with the site and region. The safety assessment demonstrates that the site is acceptable and meets the requirements of 10 CFR Part 52 and 10 CFR Part 100.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
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. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
5. Regulatory Guide 1.59, "Flood Design Basis for Nuclear Power Plants."
6. ANSI /ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites."
7. Regulatory Guide 1.29, "Seismic Design Classification."
8. "River Ice Jams - A Literature Review," Engineer Technical Letter No. 1110-2-58, Corps of Engineers (1969).
9. EM 1110-2-1612 "Engineering and Design - Ice Engineering," Corps of Engineers, October 2002.
10. Roscoe E. Perham, "Forces Generated in Ice Boom Structures," SR 200, CRREL, Hanover, New Hampshire, January 1974.
11. George D. Ashton, "Air Bubbler Systems to Suppress Ice," SR 210, CRREL, Hanover, New Hampshire, September 1974.
12. Darryl J. Calkins and George D. Ashton, "Arching of Fragmented Ice Covers," SR 222, CRREL, Hanover, New Hampshire, April 1975.
13. W. H. Brierley, et al., "Lock Wall Deicing with Water Jets: Field Tests at Ship Locks in Montreal, Canada, and Sault Sainte Marie, Michigan," SR 239, CRREL, Hanover, New Hampshire, December 1975.
14. Bernard Michel, "Ice Pressure on Engineering Structures," CRREL, Hanover, New Hampshire, June 1970.
15. F. D. Haynes, et al., "Ice Force Measurements on the Pembina River, Alberta, Canada," SR 269, CRREL, Hanover, New Hampshire, October 1975.
16. K. L. Carey, et al., "Ice Engineering for Civil Works, Baseline Study," CRREL, Hanover, New Hampshire, August 1973.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.9 CHANNEL DIVERSIONS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

In this section of the applicant's site safety assessment for an early site permit (ESP) application, the geohydrologic design basis is developed to ensure that a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site and essential water supplies will not be adversely affected by natural stream channel diversion or that, in such an event, alternate water supplies would be available to safety-related equipment.

The review includes:

1. Historical channel diversions, including cutoffs and subsidence.

2. Regional topographic evidence which suggests that future channel diversion may or may not occur (used in conjunction with evidence of historical diversions).

3. Alternate water sources and operating procedures (coordinate review with that of safety assessment Section 2.4.11.6).

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard relate to the following regulations:

1. General Design Criterion 44 (GDC 44) (Ref. 1) requires an ultimate heat sink capable of accepting the heat load of a nuclear power plant or plants that might be constructed on the proposed site under normal operating and accident conditions.

2. 10 CFR Parts 52 and 100 (Refs. 2 and 3) require that hydrological characteristics be considered in the evaluation of the site.

The regulations at 10 CFR 52.17(a) and 10 CFR 100.20(c) require that physical characteristics of the site, including seismology, meteorology, geology, and hydrology, be taken into account to determine the acceptability of a site for a nuclear reactor.

Channel diversion or realignment, which poses the potential for flooding or adversely affecting the supply of cooling water for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, is one of the many natural phenomena

specified in GDC 2 that must be considered in designing the plant to accommodate the characteristics of a proposed site. Meeting these requirements provides reasonable assurance that the effects of flooding or loss of cooling water caused by channel diversion resulting from severe natural phenomena would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a combined license (COL) will need to demonstrate compliance with General Design Criterion 2 (Ref. 4) as it relates to structures, systems, and components important to safety being designed to withstand floods.

To meet the requirements of GDC 44 and 10 CFR Parts 52 and 100 as they relate to channel diversion, the following specific criteria are used:

1. A description of the applicability (potential adverse effects) of stream channel diversions is necessary.

2. Historical diversions and realignments should be discussed.

3. The topography and geology of the basin and its applicability to natural stream channel diversions should be addressed.

4. If applicable, the safety consequences of diversion and the potential for high or low water levels caused by upstream or downstream diversion adversely to affect safety-related facilities, water supply, or ultimate heat sink should be addressed. (Ref. 5) Regulatory Guide 1.27 (Ref. 6) provides guidance on acceptable criteria for ultimate heat sinks.

III. REVIEW PROCEDURES

Site-specific publications and maps are reviewed to identify historical channel diversions and to evaluate (by independent conservative calculations and professional judgment) the potential for future diversions. Where an alternate safety-related cooling water supply is provided, the criteria for safety assessment Section 2.4.11.6 apply and are checked for consistency.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews and when applicable, findings will consist of a brief general description of historical channel diversions. If the staff concurs with the applicant that channel diversion is unlikely or that a plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site would be protected from potential flood effects and that alternate essential water supplies meet the criteria of Regulatory Guide 1.27, the findings will so

indicate. If the staff evaluation does not support the applicant's contention of channel stability or the effects of channel diversions, flood protection and/or an alternate source of water may be necessary.

A sample ESP statement follows:

> As set forth above, diversions of the A River are well documented in historical and topographic data. Oxbow lakes, low-lying swamps, and bars and chutes provide eloquent evidence of historical diversion. Other organizations are planning further bank protection measures, in addition to the existing levee system, in the vicinity of the planned or likely location of the plant intake structure. However, the diversion of the main channel by degradation/aggradation within the confines of the levee system, or by breaching the west levee during major floods, cannot be discounted. Nonetheless, the ultimate heat sink (as discussed in safety assessment Section 2.4.11) would not be directly dependent on the river intake. Therefore, the staff concludes that the ultimate heat sink of a nuclear power plant of the type specified by the applicant [or of a facility falling within the plant parameter envelope (PPE) submitted by the applicant] that might be constructed on the proposed site would not be endangered by potential channel diversions and thus meets this aspect of GDC 44.
>
> In addition, a nuclear power plant of type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed on the proposed site would be well away from the path of any potential diversion of the A River and well above the level of any resultant flood. Therefore, the staff concludes that the proposed site meets the requirements of 10 CFR Parts 52 and 100 with respect to floods caused by channel diversions.
>
> Based upon the above evaluation, the staff concludes that channel diversions present no safety-related hazard to a nuclear power plant of type specified by the applicant [or to a facility falling within the PPE submitted by the applicant] that might be constructed on the proposed site and that the requirements of 10 CFR Parts 52 and 100 relative to channel diversions have been met.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52 . 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.

VI. REFERENCES

No specific publications can be cited for general use. However, site-specific publications and maps can be obtained from the United States Geologic Survey, Soil Conservation Service, National Oceanic and Atmospheric Administration, Corps of Engineers, and State and other agencies and organizations, to identify historical and potential future channel diversions.

1. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."

2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

3. 10 CFR Part 100, "Reactor Site Criteria."

4. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

6. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.11 LOW WATER CONSIDERATIONS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

The purpose of this section of the applicant's site safety assessment for an early site permit (ESP) application is to identify natural events that may reduce or limit the available cooling water supply, and to ensure that an adequate water supply will exist to operate or shut down a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site under normal operations, anticipated operational occurrences, and emergency conditions.

Depending on the site, the areas of review include:

1. The worst drought considered reasonably possible in the region.

2. Low water (setdown) resulting from surges, seiches, or tsunami.

3. Low water resulting from icing in relation to the events described in Section 2.4.7 of this review standard.

4. The effect of existing and proposed water control structures (dams, diversions, dam failures, etc.).

5. The intake structure and pump design basis in relation to the events described in safety assessment Subsections 2.4.11.1, 2.4.11.2, 2.4.11.3, and 2.4.11.4. (This item is to be addressed at the combined license [COL] stage.)

6. The use limitations imposed or under discussion by Federal, State, or local agencies authorizing the use of the water.

7. Comparison of minimum flow characteristics of the site with the range of water supply needed by a plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, including maximum essential design cooling water design flow and maximum design flow for normal plant needs at power and at shutdown.

8. The effects of potential blockage of intakes by sediment, littoral drift, and ice.

9. The capability of the ultimate heat sink to provide adequate cooling water under normal operations, anticipated operational occurrences, and emergency conditions.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard relate to the following regulations:

1. General Design Criterion 44 (GDC 44) (Ref. 1) requires an ultimate heat sink capable of accepting the plant's heat load under normal and accident conditions.

2. 10 CFR Parts 52 and 100 (Refs. 2 and 3) require that hydrologic characteristics be considered in the evaluation of the site.

3. 10 CFR 100.23 requires, in part, that consideration of river blockages or diversion or other failures which may block the flow of cooling water, tsunami runup and drawdown, and dam failures be included in the evaluation of the adequacy of the emergency cooling water supply.

Compliance with 10 CFR Parts 52 and 100 requires, in part, that hydrologic characteristics be considered in the evaluation of a nuclear power plant site. The regulations at 10 CFR Parts 52 and 100 apply to this section of this review standard because the reviewer verifies that the applicant's safety assessment contains a description of surface and subsurface hydrological characteristics of the site and region. The ultimate heat sink for the cooling water system consists of water sources affected by, among other things, site hydrological characteristics that may reduce or limit the available supply of cooling water for safety-related structures, systems, and components. (Ref. 4)

Meeting the requirements of 10 CFR Parts 52 and 100 provides assurance that severe hydrologic phenomena, including low water conditions, would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Compliance with 10 CFR 100.23 requires, in part, that consideration of river blockages or diversion or of other failures that may block the flow of cooling water, tsunami runup and drawdown, and dam failures be included in the evaluation of the emergency cooling water supply for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

The regulation at 10 CFR 100.23 applies to this section of this review standard because the ultimate heat sink for the cooling water system consists of water sources that are subject to natural events that may reduce or limit the available supply of cooling water (i.e., the heat sink). Natural events such as river blockages or diversion or other failures that may block the flow of cooling water, tsunami runup and drawdown, and dam failures should be conservatively estimated to assess the potential for these characteristics to influence the design of structures, systems, and components important to safety for a nuclear power plant of type specified by the applicant (or falling within a PPE) that might be constructed on the proposed site. The available

water supply should be sufficient to meet the needs of the plant or plants to be located at the site; those needs may be falling within a PPE (e.g., the stored water volume of the cooling water ponds), if an applicant uses that approach. Specifically those needs include the maximum design essential cooling water flow, as well as maximum design flow for normal plant needs at power and at shutdown.

Note: Though not required at the ESP stage, the applicant for a COL will need to demonstrate compliance with General Design Criterion 2 (Ref. 5) as it relates to structures, systems, and components important to safety being designed to withstand the effects of natural phenomena.

To meet the requirements of the hydrologic aspects of the above regulations, the following specific criteria are used. Acceptance is based principally on the adequacy of the ultimate heat sink to supply cooling water for normal operation, anticipated operational occurrences, safe shutdown, cooldown (first 30 days), and long-term cooling (periods in excess of 30 days) during adverse natural conditions.

Safety assessment Section 2.4.11.1 (Low Flow in Rivers and Streams): For essential water supplies, the low-flow/low-level design for the primary water supply source must be based on the probable minimum low flow and level resulting from the most severe drought that can reasonably be considered for the region. The low flow and level site parameters for operation should be such that shutdowns caused by inadequate water supply will not cause frequent use of emergency systems.

Safety assessment Section 2.4.11.2 (Low Water Resulting from Surges, Seiches, or Tsunami): For coastal sites, the appropriate probable maximum hurricane (PMH) wind fields should be postulated at the ESP stage to give maximum winds blowing offshore, thus creating a probable minimum surge level. Low water levels on inland ponds, lakes, and rivers due to surges should be estimated from probable maximum winds oriented away from the plant site. The same general analysis methods discussed in Sections 2.4.3, 2.4.5 and 2.4.6 of this review standard are applicable to low-water estimates due to the various phenomena discussed. If the site is susceptible to such phenomena, minimum water levels resulting from setdown (sometimes called runout or rundown) from hurricane surges, seiches, and tsunami should be verified at the COL stage to be higher than the intake design basis for essential water supplies.

Safety assessment Section 2.4.11.3 (Historical Low Water): If historical flows and levels are used to estimate design values by inference from frequency distribution plots, the data used should be presented so that an independent determination can be made. The data and methods of the National Oceanic and Atmospheric Administration, United States Geologic Survey, Soil Conservation Service, Bureau of Reclamation, and the Corps of Engineers are acceptable. (Refs. 6 through 14)

Safety assessment Section 2.4.11.4 (Future Controls): This section is acceptable if water use and discharge limitations (both physical and legal), already in effect or under discussion by responsible Federal, regional, state, or local authorities, that may affect water supply for a nuclear power plant of type specified by the applicant that might be constructed on the proposed site, have been considered and are substantiated by reference to reports of the appropriate agencies. The most adverse possible effects of these controls should be shown and taken into account in the design basis to ensure that essential water supplies are not likely to be affected adversely in the future.

Safety assessment Section 2.4.11.5 (Plant Requirements): At the COL stage, acceptance of a plant design is based on the following information:

1. Minimum essential cooling water flow rates and levels should be presented (or cross-referenced) and shown to be less than the probable minimum low flows and levels from the applicable sources of supply.

2. Maximum water needs for normal operations should be presented and (if applicable) shown to be less than the water available under all likely conditions from the sources of supply.

Safety assessment Section 2.4.11.6 (Heat Sink Dependability Requirements): At the COL stage, the required data and information are those necessary to determine that the facility meets the criteria of GDC 44 as described in Regulatory Guide 1.27. The analyses will be considered complete and acceptable if the following are adequately addressed:

1. The initial water inventory should be sufficient for shutdown and cooldown of the plant.

2. Water losses (such as seepage, drift, and evaporation) should be conservatively estimated, as suggested in Regulatory Guide 1.27.

3. The design basis hydrometeorology (temperature, dewpoint, etc.) should be as conservative as the criteria of the guide (see Section 2.3 of this review standard).

4. The limit on the heat sink return water temperature should be less than the maximum allowable cooling water inlet design temperature.

5. The heat sink intakes are located such that no potential exists for blockage by littoral drift and/or sediment that would decrease water supply below minimum levels.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such a permit includes a description of the site's hydrological and meteorological characteristics. For this type of permit, the procedures below should be followed.

For multiple-purpose (normal operations, normal shutdown, and emergency shutdown) water supplies , the primary portion of the supply is first reviewed to determine that the water supply will be maintained at minimum volume requirements at all times. The secondary portion of the supply is then reviewed to determine whether an adequate emergency water supply can be expected to be available during operating conditions such as the regional drought of record (flows should be adjusted for historical and potential future effects). If not, at the COL stage the applicant will provide a technical specification requiring plant shutdown at the point where an adequate shutdown water supply is still assured.

Institutional restraints on water use, such as limitations in water use and discharge permits, are reviewed to ensure that a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site would have an adequate supply and not exceed limitations imposed upon operation. If a conflict is foreseen, the applicant is requested to either obtain a variance or make a design change to accommodate the limitation.

The potential for blockage of the intakes by littoral drift and sediment is reviewed to determine if mitigative measures are necessary to protect safety-related facilities. Independent estimates of "worst-case" buildups, determined by a review of applicable literature describing historic sediment accumulations in the site region, will be made using statistical or deterministic techniques.

For plants that would use rivers, asymptotic extrapolations of low-flow frequency curves, which have been corrected for historical and potential future effects, will be reviewed. For ocean or estuary plants, probable maximum hurricane and tsunami-induced low water levels will be reviewed. For Great Lakes plants, minimum historical levels coincident with probable maximum surge or seiche-induced low water levels will be reviewed.

The ability of the ultimate heat sink to provide a 30-day supply of cooling water for minimum needs of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, as specified in Regulatory Guide 1.27, will be independently evaluated. For those cases where makeup water cannot be assured, estimates of water loss due to drift, evaporation, blowdown, and seepage are made. Techniques described in References 15 and 16 are used to evaluate the adequacy of the initial water inventory under meteorological conditions of the severity discussed in Regulatory Guide 1.27.

If the ultimate heat sink system is not capable of continued long-term water supply under the criteria in Regulatory Guide 1.27, or the above considerations, the system will be reviewed in two parts: short-term capability and long-term capability. For short-term capability, the time period for which a highly dependable water supply would be available is compared with the time necessary to obtain water from an alternative supply, and the natural or accident environmental conditions which could prevail.

For long-term water supply capability, different sources and means of obtaining water may be necessary because of the limited capability of a "short-term" supply. In those cases where different sources are necessary to ensure long-term plant heat removal capability, the alternative sources and the means of supplying water from the sources to the plant or plants of specified type (or falling within a PPE) should be identified.

The following guidance applies to the COL stage.

Minimum water levels and flows for a nuclear power plant or plants as specified by the applicant that are identified in safety assessment subsection 2.4.11.5 are compared to the estimated minimum water levels and flows given in section 2.4.11.1. If normal operation is not assured at the minimum water supply conditions, and loss of normal operation capability can adversely affect safety-related components, estimates of warning time are reviewed to assure that shutdown or conversion to alternate water sources can be accomplished prior to the trip. For such cases, emergency operating procedures are required, and are reviewed to assure that they are consistent with the postulated conditions. The analysis of the dependability of the ultimate heat sink is reviewed. Determination of the dependability of the ultimate heat sink is accomplished by using Regulatory Guide 1.27 as a standard of comparison. Regulatory Guide 4.4 (Ref. 17) discusses the reporting procedure for models selected to predict heated effluent dispersion in natural water bodies.

Estimated water levels and flows provided in subsections 2.4.11.1, 2.4.11.2, 2.4.11.3, and 2.4.11.4 are reviewed to ensure adequate water supply conditions. Each source of water for normal operations, anticipated operational occurrences, or emergency shutdown and cooldown, and the natural phenomena and site-related accident design criteria for each should be identified. A systems analysis is first undertaken of all water supply sources to determine the likelihood that at least one source would survive (1) the most severe of each of the natural phenomena, (2) site-related accident phenomena, and (3) reasonable combinations of less severe natural and accident phenomena. Second, arbitrarily assumed mechanistic failures of water supply structures and conveyance systems are postulated and the systems analysis repeated, to assure that the failure of one component will not cause failure of the entire system. These analyses are coordinated with the review of the ultimate heat sink, to avoid duplication. Operating rules for each portion of the system are ascertained to determine the amount of water that can be assumed available in the event of normal or accidental shutdown. If there is evidence of potential structural or mechanical effects, the staff will ascertain whether the effects are properly considered in the structural or mechanical design bases for a nuclear power plant or plants of type specified by the applicant that might be constructed on the proposed site.

The potential for surges in intake sumps (i.e., seiching in intake structures and surges in intake pipes) that could cause adverse effects are reviewed to ensure that the effects have been properly incorporated for the intake design. The potential for adverse hydrodynamic effects of a trip of the intake pumps is evaluated based on potential surges in intake sumps.

Emergency means for obtaining long-term water supplies will be judged on the basis of the time needed to obtain such supplies, natural or accident phenomena likely to prevail or to have caused the need for such supplies, and the dependability of the supply itself. The ability of the ultimate heat sink to provide a nuclear power plant or plants as specified by the applicant with cooling water below the design maximum temperature will be evaluated. The design maximum temperature and the heat load of the design basis accident, as specified in Regulatory Guide 1.27, will be evaluated. Techniques for selecting the meteorologic conditions for minimum heat transfer and for performing the transient analysis for cooling ponds and spray ponds are provided in References 15 and 16, respectively.

IV. EVALUATION FINDINGS

The findings will indicate the degree of compliance with GDC 44, 10 CFR Parts 52 and 100, and 10 CFR 100.23.

For ESP reviews, the findings will summarize the applicant's and staff's estimates of the site minimum water flows and levels. If the applicant's estimates are no more than 5% less conservative than the staff's estimates, staff concurrence in the applicant's estimates will be stated. If the applicant's estimates are more than 5% less conservative and if a plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site may be adversely affected, a statement of the staff's position (bases) will be made. At COL, a similar finding on the design bases for the ultimate heat sink will be made.

A sample ESP-stage statement follows:

> The normal water supply for the station will be obtained from Lake A. Emergency cooling water will be furnished by the ultimate heat sink reservoir, which is not dependent upon the water level in Lake A for its safety function.

The lowest lake level observed at B City during the 70 years of record was 565.7 feet above International Great Lakes Datum (or 567.2 feet above mean sea level) on February 4, 1936. Recurrence of this low lake level would not affect the ability of a nuclear power plant of type specified by the applicant [or a facility falling within the plant parameter envelope (PPE) submitted by the applicant] that might be constructed on the site to obtain water.

The applicant calculated the probable minimum lake setdown during a postulated probable maximum windstorm using a one-dimensional numerical surge model. The minimum calculated lake level, including an antecedent level equal to the minimum monthly lake level of record, is 167.3 meters (549.0 feet) above International Great Lakes Datum [or 167.8 meters (550.4 feet) above mean sea level]. Since this level is below the minimum necessary for pump submergence, a plant of type specified by the applicant that might be constructed on the site would have to be shut down using water from the ultimate heat sink reservoir, which would not be affected by the postulated low lake level.

The proposed ultimate heat sink would be comprised of Lake A and a rectangular cooling pond located on the site. Normal operation and shutdown would utilize cooling water from the natural draft cooling towers; the makeup for the cooling towers would come from Lake A. If, for any reason, the natural draft cooling towers would be unavailable, the onsite pond would be used to shut down the units. The pond would be 1980 feet long and 940 feet wide. The depth of the water would be 11 feet and the pond's embankment would have a freeboard of 5 feet. The submerged intake and discharge pipes for a plant of type specified by the applicant that might be constructed on the site would be located at the same end of the pond but separated by a dike running almost the entire length of the pond to prevent short-circuiting between the intake and discharge. The pond should be capable of providing cooling water below the plant design temperature of 110° Fahrenheit under normal or emergency conditions.

The applicant analyzed the pond's thermal performance using thermal parameters for a plant of type specified by the applicant and meteorological conditions of the severity specified in Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants." The maximum pond temperature calculated was 109.3° Fahrenheit.

The staff independently modeled the thermal performance of the pond and concluded that it would be capable of providing cooling water below the design temperature of 110° Fahrenheit. The staff conservatively estimated maximum water losses from the pond, assuming meteorological conditions of the severity specified in Regulatory Guide 1.27. The staff concludes that the initial pond inventory would be sufficient to provide at least a 30-day cooling water supply without makeup for the thermal loads of a nuclear power plant of the type specified by the applicant [or a facility falling within the PPE submitted by the applicant] that might be constructed on the proposed site.

The staff evaluated the potential effects of freezing events on the pond's capability of providing emergency cooling water to a nuclear power plant of type specified by the applicant that might be constructed on the proposed site. The

staff concluded that typical plant design measures, such as heating the intake pumphouse and burying the discharge piping below the frost line, could be implemented to prevent such events from affecting plant operation or safety.

Based on the above, the staff has evaluated the performance of the proposed cooling pond and concludes that, under meteorological conditions of the severity described in Regulatory Guide 1.27, (1) the pond would provide sufficient water to cool a nuclear power plant of the type specified by the applicant [or a facility falling within the PPE submitted by the applicant] that might be constructed at the site for at least 30 days without any makeup and (2) the maximum temperature of the water supplied to the plant would be below the design temperature of 43.3°C (110° F). In addition, historical data for the proposed site are consistent with the cooling water temperatures and levels identified in the safety assessment.

Based upon the evaluations described above, the staff concludes that the cooling water supply for a nuclear power plant of the type specified by the applicant [or a facility falling within the PPE submitted by the applicant] that might be constructed on the proposed site meets the requirements of 10 CFR Parts 52 and 100, and 10 CFR 100.23 with respect to hydrologic characteristics and that it meets the requirements of General Design Criterion 44 with respect to thermal aspects of the heat transfer system.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposed 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 and NUREGs.

VI. REFERENCES[1]

1. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."

2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

3. 10 CFR Part 100, "Reactor Site Criteria."

[1] References for analysis of low water resulting from surges and seiches are in Section 2.4.5 of this review standard. References for analysis of low water resulting from tsunami are in Section 2.4.6.

4. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

5. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

6. L. R. Beard, "Statistical Methods in Hydrology," Corps of Engineers (1962).

7. "Scientific Hydrology," Ad Hoc Panel on Hydrology, Federal Council for Science and Technology, Washington, D.C., June 1962.

8. "Hydrologic Engineering Methods for Water Resources Development," Vol. 112, Corps of Engineers Hydrologic Engineering Center, Davis, California (1971).

9. "Reservoir Storage-Yield Procedures," Corps of Engineers Hydrologic Engineering Center, Davis, California (1967).

10. "Design of Small Dams," Second Edition, Bureau of Reclamation, U.S. Department of Interior (1973).

11. "Water Surface Profiles," HEC-2, Corps of Engineers Hydrologic Engineering Center (continuously updated).

12. "Reservoir System Analysis," HEC-3, Corps of Engineers Hydrologic Engineering Center (updated).

13. "Monthly Streamflow Simulation," HEC-4, Corps of Engineers Hydrologic Engineering Center (updated).

14. "Hydrologic Engineering Requirements for Reservoir," Engineer Manual 1110-2-1420, Corps of Engineers, October 1997.

15. R. B. Codell and W. K. Nuttle, "Analysis of Ultimate Heat Sink Cooling Ponds," NUREG-0693, USNRC (1980).

16. R. B. Codell, "The Analysis of Ultimate Heat Sink Spray Ponds," NUREG-0733, USNRC 1981.

17. Regulatory Guide 4.4, "Reporting Procedure for Mathematical Models Selected to Predict Heated Effluent Dispersion in Natural Water Bodies."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.12 GROUNDWATER

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

For review of an early site permit (ESP) application, data presented in the applicant's site safety assessment on local and regional groundwater reservoirs are reviewed to establish the effects of groundwater on foundations of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. Other areas reviewed under this section of this review standard include identification of the aquifers and the type of onsite groundwater use, the sources of recharge, present and future withdrawals, monitoring and protection requirements, design bases for groundwater levels, and hydrodynamic effects of groundwater on safety-related structures and components (the last of these being an item for the combined license [COL] stage). Flow rates, travel time, gradients, other properties pertaining to the movement of accidental contamination, and groundwater levels beneath the site are reviewed, as are seasonal and climatic fluctuations, or those caused by man, that have the potential for long-term changes in the local groundwater regime.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard relate to the following regulations:

1. 10 CFR Parts 52 and 100 (Refs. 1 and 2) require that hydrologic characteristics be considered in the evaluation of the site.

2. 10 CFR 100.23 sets forth the criteria to determine the suitability of design bases for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site with respect to seismic characteristics of the site. It also requires that the adequacy of the cooling water supply for emergency and long-term shutdown decay heat removal be ensured, taking into account information concerning the physical, including hydrological, properties of the materials underlying the site.

As specified in 10 CFR 100.20(c), the site's physical characteristics (including seismology, meteorology, geology, and hydrology) must be considered when determining its acceptability for a nuclear power reactor.

The regulation at 10 CFR 100.20(c)(3) requires that factors important to hydrological radionuclide transport be addressed using onsite characteristics. To satisfy the hydrologic requirements of 10 CFR Part 100, the NRC staff review of the applicant's safety assessment

should verify the description of groundwater conditions at the proposed site and of how those conditions will be affected by the construction and operation of a nuclear power plant or plants of specified type that might be constructed on the site. Meeting this requirement provides reasonable assurance that groundwater at or near a proposed site will not be significantly affected by the release of radioactive effluents from a plant or plants of specified type that might be constructed on the proposed site.

The regulation at 10 CFR 100.23 requires that geologic and seismic factors be considered when determining the suitability of the site and the acceptability of the design for each nuclear power plant. In particular, 10 CFR 100.23(d)(4) requires that the physical properties of materials underlying the site be considered when designing a system to supply cooling water for emergency and long-term shutdown decay heat removal. The regulation at 10 CFR 100.23 is applicable to Section 2.4.12 of this review standard because it addresses requirements for investigating vibratory ground motion, including the hydrologic conditions at and near the site. Static and dynamic engineering properties of the materials underlying the site should be determined, including the properties (e.g., density, water content, porosity, and strength) needed to determine the behavior of those materials in transmitting earthquake-induced motions to the foundations of a plant or plants of specified type (or falling within a PPE) that might be constructed on the site.

Meeting this requirement provides reasonable assurance that the effects of a safe shutdown earthquake would pose no undue risk to the type of facility proposed for the site.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

Note: Though not required at the ESP stage, the applicant for a COL will need to demonstrate compliance with General Design Criterion 2 (Ref. 3) as it relates to structures, systems, and components important to safety being designed to withstand the effects of natural phenomena.

To meet the requirements of the hydrologic aspects of 10 CFR Part 52 and 10 CFR Part 100, the following specific criteria are used:

Safety assessment Section 2.4.12.1: A full, documented description of regional and local groundwater aquifers, sources, and sinks is necessary. (Ref. 4) In addition, the type of groundwater use, wells, pump and storage facilities, and the flow needed for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the site should be described. If groundwater is to be used as an essential source of water for safety-related equipment, the design basis for protection from natural and accident phenomena should compare with Regulatory Guide 1.27 (Ref. 5) guidelines. Bases and sources of data should be adequately described and referenced.

Safety assessment Section 2.4.12.2: A description of present and projected local and regional groundwater use should be provided. Existing uses, including amounts, water levels, location, drawdown, and source aquifers should be discussed and should be tabulated. Flow directions, gradients, velocities, water levels, and effects of potential future use on these parameters,

including any possibility for reversing the direction of groundwater flow, should be indicated. Any potential groundwater recharge area within the influence of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the site and effects of construction, including dewatering, should be identified. The influence of existing and potential future wells with respect to groundwater beneath the site should also be discussed. Bases and sources of data should be described and referenced. References 6 through 12 discuss certain studies concerning groundwater flow problems.

Safety assessment Section 2.4.12.3: The need for and extent of procedures and measures to protect present and projected groundwater users, including monitoring programs, must be discussed. These items are site-specific and will vary with each application.

The following guidance applies to the COL stage. To meet the requirements of 10 CFR Part 50, § 50.55 (Ref. 13) and § 50.55a (Ref. 14); General Design Criteria 2, 4 (Ref. 15), and 5 (Ref. 16); and 10 CFR Part 100, the following specific criteria are used:

Safety assessment Section 2.4.12.4: At the COL stage, the design bases (and development thereof) for groundwater-induced loadings on subsurface portions of safety-related structures, systems, and components should be described. If a permanent dewatering system is employed to lower design basis groundwater levels, the bases for the design of the system and determination of the design basis for groundwater levels should be provided. Information should be provided regarding (1) all structures, components, and features of the system; (2) the reliability of the system as related to available performance data for similar systems used at other locations; (3) the various soil parameters (such as permeability, porosity, and specific yield) used in the design of the system; (4) the bases for determination of groundwater flow rates and areas of influence to be expected; (5) the bases for determination of time available to mitigate the consequences of system failure where system failure could cause design bases to be exceeded; (6) the effects of malfunctions or failures (such as a single failure of a critical active component or failure of circulating water system piping) on system capacity and subsequent groundwater levels; and (7) a description of the proposed groundwater level monitoring program and outlet flow monitoring program. In addition, if wells are proposed for safety-related purposes, the hydrodynamic design bases (and development thereof) for protection against seismically induced pressure waves should be described and should be consistent with site characteristics.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such a permit includes a description of the site's characteristics. For this type of permit, the groundwater data are reviewed as outlined below.

Section 2.4.12 of the applicant's safety assessment is reviewed to identify any missing data, information, or analyses necessary for the staff's evaluation. Applicant responses to the requested information will be evaluated using the methods outlined below, and staff positions will be developed based on the results of the analysis. Resolution, if possible, of potential groundwater problems or of differences between applicant's and staff's design bases will be coordinated through the NRR project manager, and the safety evaluation report (SER) will be written accordingly.

Local and regional groundwater conditions are reviewed by comparing the applicant's description with reports by the U.S. Geological Survey (USGS), other agencies, and professional organizations. Other NRC organizational elements with related review responsibilities will be notified of any applicable groundwater data and analyses. If onsite groundwater use and facilities are safety-related, the criteria of Regulatory Guide 1.27 are applied.

The staff will compare the applicant's description of present and projected local and regional groundwater use, existing users, including ambient use, water levels, location, and drawdown with information and data from references. Drawdown effects of projected future groundwater use, including the possibility for reversing the groundwater flow, will be evaluated and may be checked by independent calculations. Construction effects, including dewatering, on potential recharge areas may also be evaluated.

At the COL stage, the needs and plans for procedures, measures, and monitoring programs will be reviewed based upon site-specific groundwater features. Design bases for groundwater-induced loadings on subsurface portions of safety-related structures are reviewed. Independent calculations are performed to determine the adequacy of the design criteria and the capability to reflect any potential future changes which can be induced by variations in precipitation, construction of future wells and reservoirs, accidents, pipe failures, or other natural events. For dewatering systems, calculations are performed to determine phreatic surfaces, normal flow rates, flow rates into the system as a result of pipe breaks (circulating and service water system pipes), groundwater rebound times assuming total failure of the system, and system capacity.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

IV. EVALUATION FINDINGS

For ESP reviews, the findings will summarize the applicant's and staff's estimates of groundwater levels and, where applicable, groundwater flow directions, gradients, velocities, effects of potential future use on these parameters, and applicability and reliability of dewatering systems. If the groundwater parameters are comparable, staff concurrence in the applicant's estimates will be stated. If the staff predicts substantially more conservative groundwater conditions and a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site may be adversely affected, a statement of the staff bases will be made.

A sample ESP statement follows:

> As set forth above, the proposed site lies within a groundwater region, which is part of the Piedmont Groundwater Province. Groundwater in the area is derived entirely from local precipitation. The water is contained in the pores of the residual soils and in joints and cracks of the rock. There is a north-south groundwater ridge at the area upon which a nuclear power plant would be sited, and groundwater flow is to the north, east, and west. The groundwater gradient in the plant area is about 1.8 to 2.1 m (6 to 7 ft) per 30.5 m (100 ft). Permeability is controlled by the extent and distribution of fractures in the bedrock and by the size and distribution of pores in the overlying soil. The applicant has made laboratory and field permeability tests and has determined values ranging from

zero to about 1500 m (5000 ft) per year. Measured depths from the existing ground surface to the groundwater table on the ridges range from about 12 to 24 m (40 to 80 ft). However, the plant grade would be at about existing groundwater level. The groundwater table is generally at or near the surface in valleys and draws near the site. Groundwater data for the proposed site are consistent with the groundwater level identified in the early site permit application.

Based on these considerations, the staff concludes that the above description of the local groundwater aquifer satisfies the requirements of 10 CFR Parts 52 and 100, which require that hydrologic characteristics be considered in the evaluation of the site.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposed 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 and NUREGs.

VI. REFERENCES

In addition to the following, references on methods and techniques of analysis, published data by Federal and State agencies, such as USGS water supply papers, will be used as available.

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

2. 10 CFR Part 100, "Reactor Site Criteria."

3. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

4. Regulatory Guide 1.70, “Standard Format and Content of Safety Analsysi Reports for Nuclear Power Plants.”

5. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

6. "Finite Element Solution of Steady State Potential Flow Problems," HEC 723-G2-L2440, Corps of Engineers (1970)."

7. T. A. Prickett and C. G. Lonnquist, "Selected Digital Computer Techniques for Groundwater Resource Evaluation," Bulletin 55, Illinois State Water Survey, Urbana, Illinois (1970).

8. D. B. Cearlock and A. E. Reisenauer, "Sitewide Groundwater Flow Studies for Brookhaven National Laboratory, Upton, Long Island, New York," Battelle Pacific Northwest Laboratories, Richland, Washington (1971).

9. K. L. Kipp, D. B. Cearlock, A. E. Reisenauer, and C. A. Bryan, "Variable Thickness Transient Groundwater Flow Model--Theory and Numerical Implementation," BNWL-1703, Battelle Pacific Northwest Laboratories, Richland, Washington (1972).

10. D. R. Friedrichs, "Information Storage and Retrieval System for Well Hydrograph Data--User's Manual," BNWL-1705, Battelle Pacific Northwest Laboratories, Richland, Washington (1972).

11. K. Kipp and D. B. Cearlock, "The Transmissivity Iterative Calculation Routine--Theory and Numerical Implementation," BNWL-1706, Battelle Pacific Northwest Laboratories, Richland, Washington (1972).

12. D. L. Schreiber, A. E. Reisenauer, K. L. Kipp, and R. T. Jaske, "Anticipated Effects of an Unlined Brackish-Water Canal on a Confined Multiple-Aquifer System," BNWL-1800, Battelle Pacific Northwest Laboratories, Richland, Washington (1973).

13. 10 CFR Part 50, § 50.55, "Conditions of Construction Permits."

14. 10 CFR Part 50, § 50.55a, "Codes and Standards."

15. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

16. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.4.13 ACCIDENTAL RELEASES OF LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - Emergency Preparedness and Plant Support Branch (IEPB)

I. AREAS OF REVIEW

The ability of the groundwater and surface water environment to delay, disperse, dilute, or concentrate accidental radioactive liquid effluent releases is reviewed with emphasis on relating the effects of such releases to existing and known future uses of groundwater and surface water resources. (Note: The effects of normal releases and of the more likely accidents are discussed in the applicant's environmental report.)

II. ACCEPTANCE CRITERIA

Acceptance criteria for this section of this review standard relate to 10 CFR Parts 52 and 100 (Refs. 1 and 2) as they require that hydrologic characteristics of the site be evaluated with respect to the consequences of the escape of radioactive material from the facility.

Compliance with 10 CFR Parts 52 and 100 requires that local geological and hydrological characteristics be considered when determining the acceptability of a nuclear power plant site. The geological and hydrological characteristics of the site may have a bearing on the potential consequences of radioactive materials escaping from a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site. Special precautions should be planned if a reactor or reactors would be located at a site where a significant quantity of radioactive effluent could accidentally flow into nearby streams or rivers or find ready access to underground water tables.

These criteria apply to Section 2.4.13 of this review standard because the reviewer evaluates site hydrologic characteristics with respect to the potential consequences of radioactive materials escaping from a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. Radionuclide transport characteristics of groundwater and surface water environments are reviewed with respect to accidental releases in order to ensure that current and future users of groundwater and surface water are not adversely affected by an accidental release from a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. Regulatory Guides 1.113 and 4.4 (Refs. 3 and 4) provide guidance in selecting and using surface water models for analyzing the flow field and dispersion of contaminants in surface waters.

Meeting the requirements of 10 CFR Parts 52 and 100 provides reasonable assurance that accidental releases of liquid effluents to groundwater and surface water, and their adverse impact on public health and safety, will be minimized.

For those cases where a reactor design is not specified, the ESP applicant may instead provide a PPE to characterize a facility or facilities for comparison with the hydrologic characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.4 include but are not limited to precipitation (e.g., maximum design rainfall rate and snow load) and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level).

To meet the requirements of 10 CFR Parts 52 and 100 with respect to accidental releases of liquid effluents, the following specific criteria are used:

1. Radionuclide transport characteristics of the groundwater environment with respect to existing and future users should be described. Estimates and bases for coefficients of dispersion, adsorption, groundwater velocities, travel times, gradients, permeabilities, porosities, and groundwater or piezometric levels between the site and existing or known future surface water and groundwater users should be described and be consistent with site characteristics. Potential pathways of contamination to groundwater users should also be identified. (Ref. 5) Sources of data should be described and referenced.

2. Transport characteristics of the surface water environment with respect to existing and known future users should be described for conditions which reflect worst-case release mechanisms and source terms so as to postulate the most pessimistic contamination from accidentally released liquid effluents. Estimates of physical parameters necessary to calculate the transport of liquid effluent from the points of release to the site of existing or known future users should be described. Potential pathways of contamination to surface water users should be identified. Sources of information and data should be described and referenced. Acceptance is based on the staff's evaluation of the applicant's computational methods and the apparent completeness of the set of parameters necessary to perform the analysis.

3. Mathematical models (Refs. 4 and 6) are acceptable to analyze the flow field and dispersion of contaminants in groundwater and surface water, providing that the models have been verified by field data and that conservative site-specific hydrologic parameters are used. Furthermore, conservatism should be the guide in selecting the proper model to represent a specific physical situation. Radioactive decay and sediment adsorption may be considered, if applicable, providing that the adsorption factors are conservative and site specific. Regulatory Guide 1.113 provides guidance in selecting and using surface water models. References 7 through 15 discuss the discuss the transport of fluids through porous media.

III. REVIEW PROCEDURES

Section 2.4.13 of the applicant's safety assessment is reviewed to identify any missing data, information, or analysis necessary for the staff's evaluation. Applicant responses to the requested information will be evaluated using the methods outlined below, and staff positions will be developed. Resolution, if possible, of differences between the staff's and the

applicant's estimation of liquid effluent dispersion will be coordinated through the NRR project manager; and the safety evaluation report (SER) will be written accordingly.

The staff will make independent calculations of the transport capabilities and potential contamination pathways of the groundwater environment under accidental conditions with respect to existing and future users. Special attention should be directed to planned use of permanent dewatering systems to ensure that pathways created by those systems have been identified. The staff will, in consultation with IEPB and the Plant Systems Branch (SPLB), choose the accident scenarios leading to the most adverse contamination of the groundwater or the surface water via the groundwater pathways. For example, SPLB can provide advice regarding potential radioactive sources from radioactive waste systems. Analysis of the contamination will commence with the simplest models, such as those presented in References 6 and 16, using demonstrably conservative assumptions and coefficients. Dilutions and travel times (or alternatively, concentrations directly) resulting from the preliminary analyses will then be checked by IEPB to determine acceptability. If the indicated concentrations of radionuclides identified by IEPB are less than the values identified in 10 CFR Part 20, Appendix B, Table 2, Column 2 (Ref. 17), no further computational efforts will be warranted. Further analyses using progressively more realistic and less conservative modeling techniques, such as those of References 18 and 19, will be undertaken if the preliminary results are not acceptable.

Independent calculations will be made of liquid effluent transport for the surface pathways identified. For preliminary analysis, the staff will employ simplified calculational procedures or models, such as those contained in References 3 and 20. The analysis will be performed using demonstrably conservative coefficients and assumptions, and the physical conditions (such as lowest recorded river flow) likely to give the most adverse dispersion of the liquid effluent. The applicant's model assumption and results will be compared with the staff's results to ensure that the results are comparably conservative. The estimation of liquid effluent dispersion will reflect potential future changes that might result from variations in use by known future surface and groundwater users.

Concentrations of radionuclides in the body of water under consideration will be calculated based on the staff's dispersion computations and with initial concentrations provided by the IEPB for the most critical event. Acceptability of the resultant concentrations of radioactive effluent at the points of interest will be determined by consultation with IEPB. If the concentrations of the diluted liquid effluents computed by the staff are within acceptable limits of Appendix B, Table 2, Column 2, of 10 CFR Part 20, no further computation effort is indicated. If the concentrations computed by conservative simplified methods exceed the limits of 10 CFR Part 20, more precise and less conservative models, such as those used for hydrothermal prediction (Reference 21), and coefficients will be employed by the staff.

IV. EVALUATION FINDINGS

For early site permit (ESP) reviews, the findings will summarize the applicant's and the staff's estimates of dilution factors, dispersion coefficients, flow velocities, travel times, and potential contamination pathways between the site and the nearest water user in conformance with 10 CFR Parts 52 and 100. If the estimates are comparable, or if no potential problem exists, staff concurrence with the applicant's estimates will be stated. If the staff predicts substantially more conservative conditions, a statement of the staff basis will be made.

Sample statements for ESP reviews follow:

> As set forth above, a postulated failure of the miscellaneous waste collection tank (for the plant type specified by the applicant, the tank outside of containment with the highest radioactive inventory) was analyzed to estimate the concentration of radioactive contaminants in nearby wells. The contents of the tank were conservatively assumed to enter the groundwater instantaneously, and the nuclides were assumed to travel with the water with no credit taken for ion exchange processes. The nearest downgradient potable water well is located 880 meters (2900 feet) northeast of the plant site. Assuming a very high permeability of 15 micrometers (590 microinches) per second, the travel time to the nearest down gradient potable well was 9.5 years. The calculated concentrations of all nuclides were well below the maximum permissible concentrations listed in 10 CFR Part 20, Appendix B, Table 2. In this analysis, it was also assumed that the contents of the tank traveled with the groundwater to A Creek. It was then assumed to mix with creek water, flow into Lake B, and then to the water supply intake for the city of C. Concentrations at the water supply intake for the city of C were also small fractions of 10 CFR Part 20 limits for all nuclides.
>
> A postulated failure of the distillate storage tank for a plant of the type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed on the proposed site, which would be located in the plant yard, was also analyzed. It was conservatively assumed that the entire contents of the tank are introduced, as a slug release, into Lake B at the mouth of A Creek. (In reality, a failure of this tank would result in effluent flowing through the site drainage to A Creek, where it would be diluted before entering the lake.) Our analysis showed that the concentration of all nuclides would be small fractions of the 10 CFR Part 20 limits at the water supply intake for the city of C.
>
> Based on these considerations, the staff finds that the applicant has adequately described the site characteristics, and these characteristics are acceptable to ensure that liquid effluent radiological consequences will be within regulatory limits for the facility specified by the applicant [or a facility falling within the PPE submitted by the applicant]. The applicant's site description meets the requirements of 10 CFR Parts 52 and 100 with respect to potential accidental releases of radioactive liquid effluents.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

In addition to the following references describing methods and techniques of evaluation, data published by Federal, State, and other agencies and organizations will be used as available.

1. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

2. 10 CFR Part 100, "Reactor Site Criteria."

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

4. Regulatory Guide 4.4, "Reporting Procedure for Mathematical Models Selected to Predict Heated Effluent Dispersion in Natural Bodies of Water."

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

6. NUREG-0868, "A Collection of Mathematical Models for Dispersion in Surface Water and Groundwater" (June 1982).

7. K. L. Kipp, D. B. Cearlock, and A. E. Reisenauer, "Mathematical Modeling of a Large, Transient, Unconfined Aquifer with a Heterogeneous Permeability Distribution," paper presented at the 54th Annual Meeting of the American Geophysical Union, Washington, DC, April 1973.

8. W. H. Li and G. T. Yeh, "Dispersion of Miscible Liquids in a Soil," Water Resources Research, Vol. 4, pp. 369-377 (1968).

9. D. R. F. Harleman, P. F. Mehlhorn, and R. R. Rumer, "Dispersion Permeability Correlation in Porous Media," Jour. Hydraulics Division, Proc. Am. Soc. Civil Engineers, Vol. 89, No. HY2, pp. 67-85 (1963).

10. "Fundamentals of Transport Phenomena in Porous Media," International Association for Hydraulic Research, Elsevier Publishing Company, New York (1972).

11. American Nuclear Society, "Standards for Evaluating Radionuclide Transport in Groundwater, Draft 2."

12. J. O. Duguid and M. Reeves, "Material Transport Through Porous Media: A Finite Element Galerkin Model," ORNL-4928, Oak Ridge National Laboratory, Environmental Science Division, Publication 733, March 1976

13. J. Rubin and R. V. James, "Dispersion-Affected Transport of Reacting Solutes in Saturated Porous Media: Galerkin Method Applied to Equilibrium Controlled Exchange in Unidirectional Steady Water Flow," Water Resources Research, Vol. 9, No. 5, pp. 1332-1356, October 1973.

14. G. F. Pinder, "A Galerkin-Finite Element Simulation of Groundwater Contamination on Long Island, New York," Water Resources Research, Vol. 9, No. 6, pp. 1657-1669, December 1973.

15. M. Reeves and J. O. Duguid, "Water Movement Through Saturated-Unsaturated Porous Media: A Finite Element-Galerkin Model," ORNL-4927, Oak Ridge National Laboratory, Oak Ridge, Tennessee, February 1975.

16. C. A. Appel and J. D. Bredehoeft, "Status of Groundwater Modeling in the U.S. Geological Survey," USGS Circular 737 (1976).

17. 10 CFR Part 20, "Standards for Protection Against Radiation."

18. R. C. Routson and R. J. Serne, "One-Dimensional Model of the Movement of Trace Radioactive Solutes Through Soil Columns: The PERCOL Model," BNWL-1718, Battelle Pacific Northwest Laboratories, Richland, Washington (1972).

19. R. L. Taylor and C. B. Brown, "Darcy's Flow Solutions with a Free Surface," Journal of the Hydraulics Division, ASCE, Vol. 93, No. HY2, pp. 25-33, March 1967.

20. H. B. Fischer, "Dispersion Predictions in Natural Streams," Jour. Sanitary Engineering Division, Proc. Am. Soc. Civil Engineers, Vol. 94, No. SA5, pp. 927-943 (1968).

21. G. H. Jirka, G. Abraham, D. R. F. Harleman, "An Assessment of Techniques for Hydrothermal Prediction," US NRC, NUREG-0044, 1976.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.5.4 STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

For this section of the site safety assessment for an early site permit (ESP) application, information should be presented by the applicant concerning the properties and stability of all soils and rock, which may affect the facilities for a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site, under both static and dynamic conditions including the vibratory ground motions associated with the safe shutdown earthquake. Stability of these materials, as they influence the safety of seismic Category I facilities, should be demonstrated. Much of the information discussed in this section may be presented in other sections, in which case it may be cross-referenced rather than repeated here.

The staff review covers the following specific areas:

1. Geologic features (Subsection 2.5.4.1) in the vicinity of the site:

    a. Areas of actual or potential surface or subsurface subsidence, solution activity, uplift, or collapse.

    b. Zones of alteration or irregular weathering profiles, and zones of structural weakness.

    c. Unrelieved stresses in bedrock and their potential for creep and rebound effects.

    d. Rocks or soils that might be unstable because of their mineralogy, lack of consolidation, water content, or potentially undesirable response to seismic or other events.

    e. History of deposition and erosion, including glacial and other preloading influence on soil deposits.

    f. Estimates of consolidation and preconsolidation pressures and methods used to estimate these values.

2. The static and dynamic engineering properties of soil and rock strata underlying the site (Subsection 2.5.4.2) as supported by representative field and laboratory test data provided by the applicant.

3. The relationship of the planned foundations for safety-related facilities and the engineering properties of underlying materials as illustrated on plot plans and profiles (Subsection 2.5.4.3) provided by the applicant.

4. The results of seismic refraction and reflection surveys, including in-hole and cross-hole explorations, as presented in the safety assessment by discussions, plot plans, boring logs, tables, and profiles to support the assumed dynamic soil or rock characteristics (Subsection 2.5.4.4) and stratigraphy.

5. Excavation and backfill plans and engineered earthwork analysis and criteria (Subsection 2.5.4.5) as illustrated on plot plans and profiles, discussed in the text, and supported by explorations for borrow material, test fills and adequate representative laboratory test records. This information will be reviewed at the combined license (COL) stage.

6. Groundwater conditions and piezometric pressure in all critical strata (Subsection 2.5.4.6) as they affect the loading and stability of foundation materials. This part of the staff review also includes an evaluation of the applicant's plans for dewatering during construction as well as groundwater control throughout the life of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

7. The responses of site soils or rocks to dynamic loading (Subsection 2.5.4.7), including appropriate laboratory and field test records in sufficient number and detail adequate to support conclusions derived from the analyses. Soil-structure interaction analyses are reviewed to ensure soil properties data for the soil profile model are representative of the in situ soils.

8. The liquefaction potential (Subsection 2.5.4.8) and consequences of liquefaction of all subsurface soils, including the settlement of foundations. These analyses are based on soil properties obtained by state-of-the-art laboratory and field tests and involve application of both deterministic and probabilistic procedures.

9. The site safe shutdown earthquake (SSE) vibratory ground motion (Subsection 2.5.4.9) is evaluated in detail in Section 2.5.2 of the safety assessment. This information is summarized and cross-referenced in this subsection. The SSE is evaluated in combination with other hazards (floods, etc.) to assess the adequacy of the site materials under dynamic conditions.

10. The results of investigations and analyses conducted to determine foundation material stability, deformation and settlement under static conditions (Subsection 2.5.4.10).

11. Criteria, references, and design methods (Subsection 2.5.4.11) used in static and dynamic analyses of foundation materials, including an explanation of computer programs used in the analyses and soil loads on subsurface facilities.

12. Techniques and specifications to improve subsurface conditions (Subsection 2.5.4.12), which are to be used at the site to provide suitable foundation conditions. These items will be reviewed at the COL stage.

The EMEB will perform the following reviews related to the Geotechnical Engineering aspects of the site as follows:

1. EMEB determines the adequacy of the geologic and seismic information cited in support of the applicant's conclusions concerning the suitability of the plant site as part of its primary review responsibility for Section 2.5.1 of NUREG-0800 (Ref. 1).

2. EMEB reviews the seismological and geological investigations carried out to establish the ground motion environment for seismic design of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, the procedures and analyses used by the applicant in establishing the SSE for the site, and the seismic design bases for foundations as part of its primary review responsibility for Section 2.5.2 of NUREG-0800 (Ref. 2).

3. EMEB reviews the geotechnical parameters and methods employed in the analysis of soil and foundation response to the ground motion environment. The results of the stability evaluations of subsurface materials and foundations are reviewed to ensure that the soil loads and structural deflections, including any reduction in support capability of subsurface materials, can safely be accommodated by structural components.

II. ACCEPTANCE CRITERIA

The applicable rules and basic acceptance criteria pertinent to the areas of this section of this review standard are:

1. 10 CFR Part 50, Appendix A, General Design Criterion 44 - "Cooling Water." This criterion requires that a system shall be provided with the safety function of transferring the combined heat load from structures, systems, and components important to safety to an ultimate heat sink under normal operating and accident conditions. (Ref. 3)

2. 10 CFR Part 100, "Reactor Site Criteria." This part describes criteria which guide the evaluation of the suitability of proposed sites for nuclear power and testing reactors. (Ref. 4)

3. 10 CFR Part 100.23, "Geologic and Seismic Siting Criteria." These criteria describe the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identify geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants.

If a reactor design is not specified, the ESP applicant may (instead of providing information on safety-related facilities or systems, structures, and components as called for in this section of this review standard) provide a PPE to characterize a facility or facilities for comparison with the geological, geotechnical and seismological characteristics of the site. A PPE can be developed

for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.5 include, but are not limited to, SSE (e.g., peak ground acceleration, minimum soil shear wave velocity), site water level (e.g., maximum ground water level), and the soil properties design bases (e.g., minimum static bearing capacity and liquefaction).

Note: Though not required at the ESP stage, the COL applicant will need to demonstrate compliance with General Design Criterion 2 (Ref. 5) as it relates to structures, systems, and components important to safety being designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

The following Regulatory Guides provide information, recommendations, and guidance and in general describe a basis acceptable to the staff that may be used to implement the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 44; and 10 CFR Part 100.

1. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants." This guide describes a basis acceptable to the staff that may be used to implement General Design Criterion 44 with regard to the ultimate heat sink, including necessary retaining structures and the canals and conduits connecting the ultimate heat sink with the cooling water system intake structures. (Ref. 6)

2. Regulatory Guide 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites.” This guide describes procedures and criteria acceptable to the staff for assessing the potential for earthquake-induced liquefaction of soils for the design of foundations and earthworks at nuclear power plant sites in accordance with 10 CFR Part 100. (Ref. 7)

3. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants." This guide describes programs of site investigations related to geotechnical engineering aspects that would normally meet the needs for evaluating the safety of the site from the standpoint of the performance of foundation and earthworks under anticipated loading conditions including earthquake in complying with 10 CFR Part 100. It provides general guidance and recommendations for developing site-specific investigation programs as well as specific guidance for conducting subsurface investigations, the spacing and depth of borings and sampling. (Ref. 8)

4. Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants." This guide describes laboratory investigations and testing practices acceptable for determining soil and rock properties and characteristics needed for engineering analysis and design for foundations and earthwork for nuclear power plants in complying with 10 CFR Part 100. (Ref. 9)

A thorough evaluation of the geotechnical engineering aspects of the proposed site as described in the following subsections should be presented along with the basic data supporting all conclusions. Sufficient information should be provided (Ref. 10) to allow the staff and its advisors to conduct independent analyses. The site investigations should be adequate in scope and in technique to provide the necessary data.

Specific criteria necessary to meet the relevant requirements of the Commission regulations identified above are as follows:

Subsection 2.5.4.1. In meeting the requirements of Reference 4 and the regulatory positions of References 8 and 9 the section defining geologic features is acceptable if the discussions, maps, and profiles of the site stratigraphy, lithology, structural geology, geologic history, and engineering geology are complete and are supported by site investigations sufficiently detailed to obtain an unambiguous representation of the geology. The information should be presented in this subsection or cross-referenced to the appropriate subsection in Section 2.5.1 of the safety assessment.

Subsection 2.5.4.2. In meeting the requirements of Reference 4 and the regulatory positions of References 8 and 9, the description of properties of underlying materials is considered acceptable if state-of-the-art methods are used to determine the static and dynamic engineering properties of all foundation soils and rocks in the site area. These methods are described, for example, in geotechnical journals published by the American Society of Civil Engineers (Ref. 11), applicable standards published by the American Society for Testing and Materials (Ref.12), publications of the Institution of Civil Engineers (Ref.13), and various research reports prepared by universities (Refs.14 and 15). The properties of foundation material should be supported by data from field investigations (Refs.16 and 17) and laboratory test records (Ref.18).

Normally, a complete field investigation and sampling program should be performed to define the occurrence and properties of underlying materials at a given site (Refs. 16 and 17). Summary tables should be provided which catalog the important test results; test results should be plotted when appropriate. Also, a detailed discussion of laboratory sample preparation should be given when applicable. For critical laboratory tests, full details should be given, e.g., how saturation of the sample was determined and maintained during testing, how the pore pressures changed.

The applicant should provide a detailed and quantitative discussion of the criteria used to determine that the soil samples were properly taken and tested in sufficient number to define all the soil parameters for the site. For sites that are underlain by saturated soils and sensitive clays, it should be shown that all zones which could become unstable due to liquefaction or strain-softening phenomena have been adequately sampled and tested. The relative density of the soils at the site should be determined. The applicant should also show that the consolidation behavior of the soils as well as their static and dynamic strength have been adequately defined. The discussion should explain how the developed data is used in the safety analyses, how the test data is enveloped for design, why the design envelope is conservative and present a table indicating the value of the parameters used in the analyses.

Subsection 2.5.4.3. In meeting the requirements of Reference 4 and the regulatory positions of References 6 through 9, the discussion of the relationship of foundations and underlying materials is acceptable if it includes:

1. A plot plan or plans showing the locations of all site explorations, such as borings, trenches, seismic lines, piezometers, geologic profiles, and excavations with the locations of the safety-related facilities superimposed thereon. When safety-related structure locations are not provided (e.g., if a PPE is referenced in the ESP application), a bounding footprint for such structures should be provided.

2. Profiles illustrating the detailed relationship of the foundations of all seismic Category I and other safety-related facilities to the subsurface materials.

3. Logs of core borings and test pits.

4. Logs and maps of exploratory trenches in the safety assessment. A supplemental report providing geologic maps and photographs of the excavations for the facilities of a nuclear power plant or plants that might be constructed on the proposed site should be provided at the COL stage.

Subsection 2.5.4.4. In meeting the requirements of Reference 4 and the regulatory positions of References 8 and 9, the presentation of the dynamic characteristics of soil or rock is acceptable if geophysical investigations have been performed at the site and the results obtained therefrom are presented in detail. Completeness of the presentation is judged by whether or not the exploratory techniques used by the applicant yield unambiguous and useful information, whether they represent state-of-the-art exploration methods (Refs. 8, 11, 12, 16, and 17), and whether the applicant's interpretations are supported by adequate field records in the safety assessment. See also Subsection 2.5.2.3 of NUREG-0800.

Subsection 2.5.4.5. In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, the presentation of the data concerning excavation, backfill, and earthwork analyses is acceptable at the COL stage if:

1. The sources and quantities of backfill and borrow are identified and are shown to have been adequately investigated by borings, pits, and laboratory property and strength testing (dynamic and static) and these data are included, interpreted, and summarized.

2. Compaction specifications and embankment and foundation designs are justified by field and laboratory tests and analyses to ensure stability and reliable performance.

3. Quality control methods are discussed.

4. Control of groundwater during excavation to preclude degradation of foundation materials is described and referenced.

Subsection 2.5.4.6. In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, the analysis of groundwater conditions is acceptable if the following are included in this subsection or cross-referenced to the appropriate subsections in Section 2.4 of the safety assessment:

1. Discussion of critical cases of groundwater conditions relative to the foundation stability of the safety-related facilities of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site.

2. Plans for dewatering during construction.

3. Analysis and interpretation of seepage and potential piping conditions during construction.

4. Records of field and laboratory permeability tests.

5. History of groundwater fluctuations as determined by periodic monitoring of local wells and piezometers. Flood conditions should also be considered.

Subsection 2.5.4.7. In meeting the requirements of References 3 and 4 and the regulatory positions of References 7, 8, and 9, descriptions of the response of soil and rock to dynamic loading are acceptable if:

1. An investigation has been conducted and discussed to determine the effects of prior earthquakes on the soils and rocks in the vicinity of the site. Evidence of liquefaction and sand cone formation should be included.

2. Field seismic surveys (surface refraction and reflection and in-hole and cross-hole seismic explorations) have been accomplished and the data presented and interpreted to develop P and S wave velocity profiles.

3. Dynamic tests have been performed in the laboratory on samples of the foundation soil and rock and the results included. The section should be cross-referenced with Subsection 2.5.2.5 of NUREG-0800.

The soil-structure interaction analysis should be described. In the soil-structure interaction analysis, the following parameters are reviewed:

1. The static and dynamic properties of the soil supporting the structure are properly determined and compatible with the characteristics of the analytical model used to evaluate soil-structure interaction effects.

2. The soil profile has been properly modeled when a two-dimensional finite-element analysis is used, or if a half-space analysis method is used, when foundation moduli and damping are consistent with soil properties and soil profiles at the site.

3. The static and dynamic loads, and the stresses and strains induced in the soil surrounding and underlying the structure are adequately and realistically evaluated.

4. The consequences of the induced soil stresses and strains, as they influence the soil surrounding and underlying the structure, have been conservatively assessed.

Subsection 2.5.4.8. In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, if the foundation materials at the site adjacent to and under expected or planned locations of Category I structures and facilities are saturated soils and the water table is above bedrock, then an analysis of the liquefaction potential at the site is necessary. The need for a detailed analysis is determined by a study on a case by case basis of the site stratigraphy, critical soil parameters, and the location of safety-related foundations. Undisturbed samples obtained at the site and appropriate laboratory tests are necessary to show if the soils are likely to liquefy. Liquefaction potential assessments using both deterministic and probabilistic approaches are desirable.

When the need for an in-depth analysis is indicated, it may be based on cyclic triaxial test data obtained from undisturbed soil samples taken from the critical zones in the site area. The shear stresses induced in the soil by the postulated earthquake should be determined in a manner that is consistent with Section 2.5.2 of NUREG-0800. The criterion that should be used to determine when the soil samples tested "liquefied" should be taken as the onset of liquefaction (defined as the cycle when the pore pressure first equals the confining pressure). Test data showing the rate of pore pressure increase with number of cycles should be presented. If the behavior of the pore pressure is such that peak to peak axial strains greater than a few percent occur before liquefaction, then the applicant should include the effects of these strains in its assessment of the potential hazards that complete or partial liquefaction could have on the stability and settlement of any Category I structures.

Nonseismic liquefaction (such as that induced by erosion, floods, wind loads on structures and wave action) should be analyzed using state-of-the-art soil mechanics principles.

Subsection 2.5.4.9. In meeting the requirements of Reference 4, a brief summary of the derivation of the SSE is presented and references are included to Subsection 2.5.2.6 of NUREG-0800.

Subsection 2.5.4.10. In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, the discussions of static analyses are acceptable if the stability of all planned safety-related facilities has been analyzed from a static stability standpoint including bearing capacity, rebound, settlement, and differential settlements under dead loads of fills and plant facilities, and lateral loading conditions. Field and laboratory test procedures and results should be included to document soil and rock properties used in the analyses. The applicant should show that the methods of analysis used are appropriate for the local soil conditions and the function of the facility.

Subsection 2.5.4.11 (applicable to the COL stage). In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, the discussion of criteria and design methods is acceptable at the COL stage if the criteria used for the design, the design methods employed, and the factors of safety obtained in the design analyses are described and a list of references presented. An explanation and verification of the computer analyses used and source references should be included.

Subsection 2.5.4.12 (applicable to the COL stage). In meeting the requirements of References 3 and 4 and the regulatory positions of References 6 through 9, the discussion of techniques to improve subsurface conditions is acceptable at the COL stage if plans, summaries of specifications, and methods of quality control are described for all techniques to be used to improve foundation conditions (such as grouting, vibroflotation, dental work, rock bolting, or anchors).

The technical rationale for application of the above acceptance criteria to the stability of subsurface materials and foundations is discussed in the following paragraphs.

The Commission evaluates the suitability of proposed sites for nuclear power and test reactors to determine if the application complies with 10 CFR Part 100. Section 100.20(c) requires that physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining each site’s acceptability. Meeting this requirement provides

assurance (1) that a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed at the site could be designed to withstand anticipated geologic, geotechnical, and seismic phenomena and (2) that, during normal operations or seismic events, a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site would pose no undue risk to the public as a result of instability, deformation, or failure of structural foundations and earthworks.

Standards developed by the American Society for Testing and Materials (ASTM) are used to perform soil analyses and tests for determining the static and dynamic properties of the soils and rock that will underlie the structures, systems, and components of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site. To satisfy the geotechnical engineering requirements of 10 CFR Part 100, the applicant's safety assessment should contain a description of subsurface soil and rock characteristics for the proposed site and include static and dynamic analyses of plant foundations. This information will permit the staff to assess the acceptability of the site and to determine the potential influence of these characteristics on the design of structures, systems, and components designated as important to safety. Meeting these requirements provides assurance that structures, systems, and components important to safety for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site could be designed to withstand appropriately severe static and dynamic loads on the foundations.

Compliance with 10 CFR 100.23 requires that the geologic and seismic conditions at the proposed site be considered during the siting and design of a nuclear power plant or plants. It describes the investigations needed to obtain geologic and seismic data necessary to determine site suitability and to provide reasonable assurance that a nuclear power plant or plants of specified type (or falling within a PPE) could be constructed and operated at the proposed site without undue risk to the health and safety of the public with respect to those characteristics.

III. REVIEW PROCEDURES

Requirements and procedures governing issuance of ESPs for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52 (Ref. 19). Information required for such a permit includes a description of the site's seismic characteristics. For this type of permit, the application is reviewed as outlined below.

The review process is conducted in a similar manner and concurrent with that described in Section 2.5.1 of NUREG-0800. The services of consultants are used on selected sites to aid the staff in evaluating the geotechnical engineering aspects of particular sites.

The results of site investigations (such as borings, geologic maps, logs of trenches and pits, permeability test records, results of seismic investigations, laboratory test results, profiles, and plot plans) are studied and cross-checked in considerable detail to determine whether or not the assumptions used in the evaluation are conservative. The adequacy of the extent and content of the site investigations (such as borings, trench logs, seismic investigations, and laboratory test results) is reviewed at the COL stage to ascertain that they are within the present state-of-the-art.

Site subsurface investigations supporting the ESP application should be conducted to provide sufficient coverage of the site areas upon which all safety-related structures will be located, such that there is reasonable assurance that the actual site conditions, revealed during excavations or further soil borings, will be consistent with the site subsurface model developed to support the ESP application. The ESP will contain a license condition requiring the reporting of any information the ESP holder has identified as having a significant implication for public health and safety or for common defense and security. The Commission will evaluate any such information reported and will take appropriate action.

Generally, the staff is guided by the criteria in References 3 through 5 and by Regulatory Guides described in References 6 through 10 in reviewing Section 2.5.4.

Following is a brief description of the review procedures conducted by the staff in evaluating the geotechnical engineering aspects of nuclear power plant sites.

Subsection 2.5.4.1. Geologic features are evaluated by conducting an independent literature search and comparing these results with the information included in the applicant's safety assessment. References used in reviewing this subsection include published or unpublished reports, maps, geophysical data, construction records, etc., by the USGS, other Federal agencies, State agencies, and private companies (such as oil corporations and architect engineering firms). In conjunction with the literature search, the staff and its advisors review the geological investigations conducted by the applicant. Using the references listed at the end of this section and other sources, the following questions are considered in detail:

1. Are the exploratory techniques used by the site investigator representative of the present state-of-the-art? Do the samples represent the in situ soil conditions?

2. Do the applicant's investigations provide adequate coverage of the site area and in sufficient detail to define the specific subsurface conditions with a high degree of confidence?

3. Have all areas or zones of actual or potential surface or subsurface subsidence, uplift or collapse, deformation, alteration, solution cavities or structural weakness, unrelieved stresses in bedrock, or rocks or soils that might be unstable because of their physical or chemical properties been identified and adequately evaluated?

Subsection 2.5.4.2. Properties of underlying materials are evaluated to determine whether or not the investigations performed (including laboratory and field testing) were sufficient to justify the soil and rock properties used in the foundation analyses.

To determine whether sufficient investigations were performed, the staff carefully reviews the criteria developed and used by the applicant in laying out the boring, sampling and testing program and evaluates the effectiveness of the program in defining the specific foundation conditions at the site to ensure that all critical conditions have been adequately sampled and tested. If suitable criteria have not been developed and used by the applicant, the staff develops appropriate criteria, using Regulatory Guide 1.132 and the data given in the safety assessment, and determines if sufficient investigation and testing have been carried out. If criteria are given, the staff reviews them to determine if they are appropriate and have been implemented.

If it is the staff's judgment that the applicant's investigations or testing are inappropriate or insufficient, additional investigations will be necessary. The final conclusion is based on professional judgment, considering the complexity of the site subsurface conditions. As part of the review, the staff should ascertain, often with the help of consultants, that state-of-the-art laboratory and field techniques and equipment are employed in determining the material properties.

Subsection 2.5.4.3. Plot plans and profiles are reviewed by comparing the subsurface materials with the proposed locations (horizontal and vertical) of foundations and walls of all seismic Category I facilities. (If such locations are not known at the ESP stage, as would be the case if the applicant references a PPE, the bounding footprint of the facility should be specified.) The profiles and plot plans are cross-checked in detail with the results of all subsurface investigations conducted at the site to ascertain that sufficient exploration has been carried out and to determine whether or not the interpretations made by the investigators are valid and the foundation design assumptions contain adequate margins of safety.

Subsection 2.5.4.4. Staff evaluation consists of a detailed review of all geophysical explorations conducted at the site, including seismic refraction, reflection, and in-hole surveys and magnetic and gravity surveys. Consultant expertise regarding specific techniques may be drawn upon in this review. Logs of core borings, trenches, and test pits are reviewed and compared with data from the seismic surveys and other geophysical explorations. Results should be consistent or additional investigations are necessary, or the applicant should use the most conservative values.

Subsection 2.5.4.5. Excavations, backfill, and earthwork are evaluated by the staff at the COL stage as follows:

1. The investigations for borrow material, including boring and test pit logs, and compaction test data are reviewed and judged as to their adequacy.

2. The records of laboratory static and dynamic tests performed on samples compacted to the design specifications are reviewed to ascertain that state-of-the-art criteria are met.

3. Analyses and interpretations are reviewed to ensure that static and dynamic stability criteria are met.

4. Excavation and compaction specifications and quality control procedures are reviewed to ascertain conformance to state-of-the-art conservative standards.

Subsection 2.5.4.6. Groundwater conditions as they affect foundation stability are evaluated by studying the applicant's records of the historic fluctuations of groundwater at the site as obtained by monitoring local wells and springs and by analysis of piezometer and permeability data from tests conducted at the site. The applicant's dewatering plans during and following construction are also reviewed. Adequacy of these plans is evaluated by comparing with the results of the groundwater investigations and by professional judgment of groundwater and soil conditions at the site.

Subsection 2.5.4.7. Response of soils and rocks to dynamic loading and soil-structure interaction is evaluated by a detailed study of the results of the investigations and analyses

performed. Specifically, the effects of past earthquakes on site soils or rocks (guidance in Section 2.5.2 of NUREG-0800) are determined. The data from core borings, from geophysical investigations, and from dynamic laboratory tests such as sonic and cyclic triaxial tests on undisturbed samples are evaluated. The object of the staff review is to ascertain that reasonably conservative dynamic soil and rock characteristics are used in the design and analyses and that all the significant soil and rock strata have been considered in the analyses. In some cases, independent analyses and interpretations are carried out as outlined in Section 2.5.2 of NUREG-0800, or as needed to verify the liquefaction analysis discussed in Subsection 2.5.4.8.

Subsection 2.5.4.8. Liquefaction potential is reviewed by a study of the results of geotechnical investigations including boring logs, laboratory classification test data and soil profiles to determine if any of the site soils could be susceptible to liquefaction. The results of in-situ tests such as the standard penetration tests and the density and strength data obtained from undisturbed samples obtained in exploration borings are examined and, when appropriate, related to the liquefaction potential of in situ soils.

If it is determined that there may be liquefaction-susceptible soils beneath the site, the applicant's site exploration methods, laboratory test program, and analyses are reviewed for adequacy and reasonableness. The analysis submitted by the applicant is reviewed in detail and compared to an independent study performed by the staff employing both deterministic and probabilistic methods as appropriate. As a minimum, the staff study consists of:

1. A review of appropriate standard penetration test results, other in-situ test data and groundwater conditions to assess liquefaction potential.

2. A careful review of conventional laboratory and cyclic triaxial test data to ensure that appropriate samples were obtained and tested from critical, liquefiable zones.

3. Confirmation that an adequate number of samples were properly tested and that the test results account for the natural variation in different samples as well as define the cyclic resistance to liquefaction of the soils.

4. An assessment of the liquefaction potential using a conservative envelope of the test data submitted.

5. A calculation of the stress induced by the earthquake that has been arrived at by an envelope of critical conditions calculated for the site based on variations in the properties of the soil strata.

6. Assurance that conservative ranges of relative density of the soils are estimated. Estimates of the "safety factor" obtained from the applicant's analyses are compared to the safety margins estimated by the staff. (The applicant's plans to "eliminate" the liquefaction condition, usually by excavation and backfill, vibroflotation, or chemical grouting, are evaluated as discussed in Subsections 2.5.4.5 and 2.5.4.12.)

7. An assessment of post-earthquake stability and settlements due to partial liquefaction using state-of-the-art techniques.

8. An assessment of nonseismic liquefaction based on state-of-the-art techniques.

Subsection 2.5.4.9. The in-depth staff evaluation of the safe shutdown earthquake is contained in Section 2.5.2 of NUREG-0800. The staff's evaluation of the amplification characteristics of specific soils and rocks beneath the site, as determined by procedures discussed in that section and in Subsections 2.5.4.2, 2.5.4.4, and 2.5.4.7, is summarized and cross-referenced herein.

The review of Subsection 2.5.4.9 concentrates on determining its consistency or inconsistency with other subsections. Cross-referencing with other sections is expected.

Subsection 2.5.4.10. Static analyses of the bearing capacity and settlement of the supporting soils under the loads of fills, embankments, and foundations are evaluated by conventional, state-of-the-art methods (Refs. 11, 12, 13, and 17). In general, the evaluation procedure includes:

1. Determining whether or not the soil and rock properties used in the analyses represent the actual site conditions beneath the planned locations of plant facilities. The site investigation, sampling, and laboratory test programs should be adequate for this evaluation.

2. Determining whether or not the methods of analysis are appropriate for the planned earthworks, foundations, and soil conditions at the site.

3. Determining whether or not the bearing capacity, settlement, differential settlement, and tilt estimates indicate conservative and tolerable behavior of the planned plant foundations when these values are compared to design criteria and quality assurance specifications.

4. Evaluation of particularly complex cases on the basis of accepted principles and techniques as supplemented by case histories and confirmatory measurement and analysis programs.

Subsection 2.5.4.11. Site exploration, sampling, testing, and interpretation are judged with respect to completeness, care and technique, meaningful documentation, performance records for similar projects, published guidelines, and state-of-the-art practice. However, unconventional or research-oriented tests and interpretations are encouraged whenever such work aids or supplements conventional practices. Design criteria and methods are compared to similar standards published or utilized by public agencies such as the U.S. Navy Department, U.S. Army Corps of Engineers, and U.S. Department of the Interior. Design safety features, the applicant's proposed confirmatory tests and measurements, and monitoring of performance for planned safety-related foundations and earthworks are reviewed and evaluated at the COL stage on a case-by-case basis.

Subsection 2.5.4.12 (applicable to the COL stage). Planned techniques to improve subsurface conditions are evaluated by reviewing the applicant's specifications and techniques for performance and quality control for such activities as grouting, excavation and backfill, vibroflotation, rock bolting, and anchoring. This evaluation will be performed at the COL stage.

IV. EVALUATION FINDINGS

If the evaluation by the staff, on completion of the review of geotechnical engineering aspects of the plant site, confirms that the applicant has met the requirements referenced in Section II above, the conclusion in the safety evaluation report (SER) will state that the investigations performed at the site are adequate to justify the soil and rock characteristics that may be used in the design. Staff reservations about any portion of the applicant's site investigations will be stated in sufficient detail to make clear the precise nature of the staff concern.

A typical staff SER finding follows:

> The site is located in the Piedmont at an average elevation of +120 meters (+395 feet) mean sea level (msl). Exploratory borings have been made and refraction and reflection seismic surveys conducted to establish the stratigraphy of the site. Additionally, undisturbed samples of representative soils and core borings have been obtained to evaluate the characteristics of the foundation materials; close-centered cross-hole seismic tests have been conducted to determine the elastic properties of these materials. Ground-water at the site varies from +114 to 116 meters (+375 to 380 feet) msl.
>
> The area has been exposed to subaerial weathering and erosion since middle Mesozoic time, and a deep weathering profile has developed. The depth of weathering depends on the location and degree of jointing, orientation of schistosity, and composition of the parent rock.
>
> The applicant has categorized the foundation material into three zones according to the degree of weathering:
>
> 1. Zone 1 contains residual soil derived from severely weathered slate. The soil is a sandy, silty clay containing slate and quartz fragments. Decomposed to severely weathered slate is also present. The slate still retains the original rock structure, although it is soft and partly friable. Quartz veins within the slate are extremely fractured. Seismic compression (P) and shear (S) wave velocities exceed 1200 m/sec (4000 ft/sec) and 500 m/sec (1800 ft/sec), respectively. Zone 1 ranges in thickness from less than 6 meters (20 feet) to more than 15 meters (50 feet).
>
> 2. Zone 2 consists of moderately weathered slate and varies from 5 to 18 meters (16 to 60 feet) thick. P and S wave velocities generally exceed 2000 m/sec (6500 ft/sec) and 800 m/sec (2500 ft/sec), respectively.
>
> 3. Zone 3 contains slightly weathered to unweathered slate and is encountered at depths of 18 to 27 meters (60 to 90 ft) below ground surface.
>
> The applicant states that severely weathered or soft zones of rock will be excavated and replaced with lean concrete. This procedure will also be followed

wherever severe weathering extends along joints, schistosity, etc. Below the base of the foundations, this material will be excavated to a depth 1-½ times the width of the foundation mat and backfilled with concrete.

Category I structural backfill under structures will either be concrete or compacted granular backfill. If granular backfill is used, it will be compacted to at least 85 percent relative density or to 95 percent of the maximum density determined by the Modified Proctor test. These backfill criteria are acceptable criteria for soil pressures on foundations and buried pipes and are suitable and conservative for both static and dynamic conditions.

Suitable borrow materials for dikes, dams and impervious linings are available for the ultimate heat sink ponds. The applicant's tests on these materials and the construction criteria to be followed ensure that leakage, piping and cracking hazards of these vital earthworks are minimal. Filters, blanket drains, relief wells, piezometers and settlement monuments will ensure the reliable performance of the ultimate heat sink water-retention facilities.

The applicant has shown that the appropriate acceleration level on sound rock is 0.12 g for the safe shutdown earthquake (SSE). The applicant has performed a site-dependent analysis to estimate the site amplification effects and found that the weathered rock or structural backfill would amplify the rock motion. An acceleration level of 0.17 g for the SSE will be used for those structures founded on weathered rock or structural backfill over weathered rock. The time history used for seismic design of Category I earth dams and for liquefaction assessment envelopes the response spectra for the site and has a conservative duration.

The staff concludes that the information, including analysis and substantiation, presented by the applicant and discussed above, is sufficient to demonstrate that the properties and stability of all soils and rock, whose performance could adversely affect, directly or indirectly, the safety-related structures of a nuclear power plant of type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed at the proposed site or pose a hazard to the public, meet the requirements of the pertinent Commission regulations (cite appropriate references).

The applicant has met the requirements of the pertinent Commission regulations (cite appropriate references) with respect to defining geologic features; demonstration of the static and dynamic engineering properties of soil and rock strata underlying the site as supported by results of investigations including borings, shafts, pits, trenches, and field and laboratory tests; properties of borrow materials; compaction and excavation specifications; design criteria, methods, and analyses; groundwater conditions and control; response of site soil and rock to static and dynamic loading including evaluation of liquefaction potential; settlement analyses; and, where needed, techniques and specifications to improve subsurface conditions, by meeting the regulatory position in Regulatory Guides (cite appropriate References) or by providing and

meeting an alternative method to these regulatory positions that the staff has reviewed and found to be acceptable.

Based on the results of the applicant's investigations, laboratory and field tests, analyses, and criteria for design and construction, the staff concludes that: (1) the site and plant foundations meet the geologic and seismic siting criteria of 10 CFR 100.23, (2) the stability of subsurface materials and foundations on the site is such that the site would be adequate to support a nuclear power plant of the type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed on the proposed site, and (3) site characteristics are such that safety-related earthworks could be designed to perform their functions reliably.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52. 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.

VI. REFERENCES

1. U.S. NRC Standard Review Plan, Section 2.5.1, "Basic Geologic and Seismic Information," NUREG-0800, Rev. 3, March 1997.

2. U.S. NRC Standard Review Plan, Section 2.5.2, "Vibratory Ground Motion," NUREG-0800, Rev. 3, March 1997.

3. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."

4. 10 CFR Part 100, "Reactor Site Criteria."

5. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena.

6. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

7. Regulatory Guide 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plants.

8 . Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants."

9. Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants."

10. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

11. Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers.

12. Book of ASTM Standards and Special Technical Publications, American Society for Testing and Materials.

13. Geotechnique, The Institution of Civil Engineers, London.

14. Earthquake Engineering Research Center, University of California, Berkeley.

15. Multi-disciplinary Center for Earthquake Engineering, State University of New York, Buffalo, NY.

16. Engineering Manual EM 1110-1-1804, "Geotechnical Investigations," U.S. Army Corps of Engineers, January 2001.

17. Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rock Fill Dams," U.S. Army Corps of Engineers, June 1995.

18. Engineering Manual EM 1110-2-1906, "Laboratory Soil Testing," U.S. Army Corps of Engineers, August 1986.

19. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

2.5.5 STABILITY OF SLOPES

REVIEW RESPONSIBILITIES

Primary - Mechanical and Civil Engineering Branch (EMEB)

Secondary - None

I. AREAS OF REVIEW

Information, including analyses and substantiation, should be presented in the applicant's site safety assessment for an early site permit (ESP) and reviewed by the staff concerning the stability of all earth and rock slopes both natural and planned man-made (cuts, fills, embankments, dams, etc.) whose failure, under any of the conditions to which they could be exposed during the life of a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed on the proposed site, could adversely affect the safety of the plant or plants. The following subjects should be evaluated using the applicant's data in the safety assessment and information available from other sources:

1. Slope characteristics (Subsection 2.5.5.1);

2. Design criteria and design analyses (Subsection 2.5.5.2) (needed at the combined operating license (COL) stage);

3. Results of the investigations including borings, shafts, pits, trenches, and laboratory tests (Subsection 2.5.5.3); and

4. Properties of borrow material, compaction and excavation specifications (Subsection 2.5.5.4) (needed at the COL stage).

The EMEB performs the following reviews under the review standard sections indicated:

1. The EMEB will determine the adequacy of the geologic and seismic information cited in support of the applicant's conclusions concerning the suitability of the plant site and the stability of earth and rock slopes as part of its primary review responsibility for Section 2.5.1 of NUREG-0800 (Ref. 1).

2. The EMEB reviews the seismological and geological investigations carried out to establish the ground motion environment for seismic design of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site, the procedures and analysis used by the applicant in establishing the safe shutdown earthquake (SSE) for the site, as part of its primary review responsibility for Section 2.5.2 of NUREG-0800 (Ref. 2).

3. The EMEB reviews the results of the stability evaluations of earth and rock slopes to ensure that displacements or failure of site slopes as indicated in the safety assessment would not have an adverse impact on structural components.

II. ACCEPTANCE CRITERIA

The applicable rules and basic acceptance criteria pertinent to the areas of this section of the Review Standard are:

1. 10 CFR Part 50, Appendix A, General Design Criterion 44 - "Cooling Water." This criterion requires that a system shall be provided with the safety function of transferring the combined heat load from structures, systems, and components important to safety to an ultimate heat sink under normal operating and accident conditions. (Ref. 3)

2. 10 CFR Part 100, "Reactor Site Criteria." This part describes criteria which guide the evaluation of the suitability of proposed sites for nuclear power and testing reactors. (Ref. 4)

3. 10 CFR 100 .23, “Geologic and Seismic Siting Criteria.” These criteria describe the nature of the investigations required to obtain the geologic and seismic data necessary to determine site suitability and identifies geologic and seismic factors required to be taken into account in the siting and design of nuclear power plants. (Ref. 5)

If a reactor design is not specified, the ESP applicant may (instead of providing information on safety-related facilities or systems, structures, and components as called for in this section of this review standard) provide a PPE to characterize a facility or facilities for comparison with the geological, geotechnical and seismological characteristics of the site. A PPE can be developed for a single type of facility or a group of candidate facilities by selecting limiting values of parameters. Important PPE parameters for safety assessment Section 2.5 include, but are not limited to, SSE (e.g., peak ground acceleration, minimum soil shear wave velocity), site water level (e.g., maximum ground water level), and the soil properties design bases (e.g., minimum static bearing capacity and liquefaction).

Note: Though not required at the ESP stage, the COL applicant will need to demonstrate compliance with General Design Criterion 2 (Ref. 6) as it relates to structures, systems, and components important to safety being designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

The following regulatory guides provide information, recommendations, and guidance and in general describe a basis acceptable to the staff that may be used to implement the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 44; 10 CFR Part 100; and 10 CFR 100.23.

1. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants." This guide describes a basis acceptable to the staff that may be used to implement General Design Criterion 44 with regard to the ultimate heat sink, including necessary retaining structures and the canals and conduits connecting the ultimate heat sink with the cooling water system intake structures. (Ref. 7)

2. Regulatory Guide 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites.” This guide describes procedures and criteria acceptable to the staff for assessing the potential for earthquake-induced liquefaction of soils for the design of foundations and earthworks at nuclear power plant sites in accordance with 10 CFR Part 100. (Ref. 8)

3. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants." This guide describes programs of site investigations related to geotechnical engineering aspects that would normally meet the needs for evaluating the safety of the site from the standpoint of the performance of foundation and earthworks under anticipated loading conditions, including earthquake, in complying with 10 CFR Part 100. It provides general guidance and recommendations for developing site-specific investigation programs as well as specific guidance for conducting subsurface investigations, the spacing and depth of borings, and sampling. (Ref. 9)

4. Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants." This guide describes laboratory investigations and test practices acceptable for determining soil and rock properties and characteristics needed for engineering analysis and design for foundations and earthwork for nuclear power plants in complying with 10 CFR Part 100. (Ref. 10)

The information in the safety assessment should be in compliance with the criteria presented in References 3, 4, and 10. This section of the safety assessment is judged acceptable if the information presented is sufficient to demonstrate the dynamic and static stability of all slopes whose failure could adversely affect, directly or indirectly, safety-related structures of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site or pose a hazard to the public. The emergency cooling water source is of particular interest with regard to slope stability (Refs. 3 and 6). The secondary source of emergency cooling water should survive an earthquake equal to ½ SSE and design basis flood. Completeness is determined by the ability to make an independent evaluation on the basis of information provided by the applicant.

Specific criteria necessary to meet the relevant requirements of the Commission regulations identified above are as follows:

Subsection 2.5.5.1. In meeting the requirements of References 3 and 4 and the regulatory positions contained in References 6 through 9, the discussion of slope characteristics is acceptable if the subsection includes:

1. Cross sections and profiles of the slope in sufficient quantity and detail to represent the slope conditions.

2. A summary and description of static and dynamic properties of the soil and rock expected to comprise seismic Category I embankment dams and their foundations, natural and cut slopes, and all soil or rock slopes whose stability would directly or indirectly affect safety-related and Category I facilities. The text should include a complete discussion of procedures used to estimate, from the available field and laboratory data, conservative soil properties and profiles to be used in the analysis.

3. A summary and description of groundwater, seepage, and high and low groundwater conditions.

Subsection 2.5.5.2. In meeting the requirements of Reference 4 and the regulatory positions of Reference 6, the discussion of design criteria and analyses (needed at the COL stage) is acceptable if the criteria for the stability and design of all seismic Category I slopes are described and valid static and dynamic analyses have been presented to demonstrate that there is an adequate margin of safety. A number of different methods of analysis are available in the literature.

To be acceptable, the static analyses and the dynamic analyses described below (which are necessary at the COL stage) should include calculations with different assumptions and methods of analysis to assess the following factors:

1. The uncertainties with regard to the shape of the slope, boundaries of the several types of soil within the slope and their properties, the forces acting on the slope, and pore pressures acting within the slope.

2. Failure surfaces corresponding to the lowest factor of safety.

3. The effect of the assumptions inherent in the method of analysis used.

4. Adverse conditions such as high water levels due to the probable maximum flood (PMF), sudden drawdown, or steady seepage at various levels. In general, safety factors related to the slope hazard are needed; however, actual values depend somewhat on the method of analysis, on the assumptions concerning the soil properties, on construction techniques, and on the range of material parameters.

To be acceptable, the dynamic analyses should account for the effect of cyclic motion of the earthquake on soil strength properties. Actual test data are needed for the in situ soils. As discussed above, the various parameters, such as geometry, soil strength, modeling method (location and number of elements (mesh) if a finite-element analysis is used), and hydrodynamic and pore pressure forces, should be varied to show that there is an adequate margin of safety (Refs. 11 and 12). Where liquefaction is possible, major dam foundation slopes and embankments should be analyzed by state-of-the-art finite-element or finite difference methods of analysis. Where there are liquefiable soils, changes in pore pressure due to cyclic loading should be considered in the analysis to assess not only the potential for liquefaction but also the effect of pore pressure increase on the stress-strain characteristic of the soil and the post-earthquake stability of the slopes.

Subsection 2.5.5.3. In meeting the requirements of Reference 4 and the regulatory positions of References 8 and 9, the applicant should describe the borings and soil testing carried out for slope stability studies and dam and dike analyses. The test data, which should meet the criteria set forth in Sections 2.5.1 and 2.5.4, could be presented in those sections and referenced in this subsection. Because dams, dikes, and natural or cut slopes are often remote from the main plant area, results of additional exploration, tests, and analyses for these areas should be presented in this subsection.

Subsection 2.5.5.4. In meeting the requirements of Reference 4 and the regulatory positions of References 7, 8, and 9, the applicant should describe the excavation, backfill, and borrow

material planned for any dams, dikes, and embankment slopes. Planned construction procedures and control of earthworks should be described at the COL stage. To be acceptable, the information should be given as discussed in Subsection 2.5.4.5. Some of this information could be presented in Subsection 2.5.4.5. Because dams, dikes, and other earthworks are often remote from the main seismic Category I structures, it is necessary to complete this information in this subsection.

The technical rationale for application of these acceptance criteria to reviewing the stability of slopes is discussed in the following paragraphs:

Compliance with 10 CFR Part 100 requires that the Commission evaluate the suitability of proposed sites for nuclear power and test reactors. Section 100.20(c) requires that physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining each site's acceptability.

To satisfy the geotechnical engineering requirements of 10 CFR Part 100, the applicant's safety assessment should contain a discussion of embankment dams and their foundations, natural and cut slopes, and all soil or rock slopes for which a lack of stability could adversely affect safety-related structures, systems, or components. Subsection 2.5.5.1 provides cross sections and profiles of the slopes and a description of the static and dynamic properties of soils and rock used in the embankments. Groundwater and seepage conditions should also be described. Meeting this requirement provides assurance (a) that a nuclear power plant or plants that might be constructed at the site could be designed to withstand appropriately severe geologic, geotechnical, and seismic phenomena and (b) that, during normal operations or seismic events, the plant or plants would pose no undue risk to the public as a result of instability, deformation, and failure of embankment structures and earthworks.

The safety assessment should also contain a description of soil and rock characteristics and include static and dynamic analyses of all cuts, fills, embankments, dams, and other earthworks at or on the proposed site. This information will permit the staff to assess the acceptability of the proposed site and to determine the potential influence of these characteristics on the design of structures, systems, and components important to safety. Meeting these requirements provides assurance that structures, systems, and components important to safety for a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed on the proposed site could be designed to withstand appropriately severe static and dynamic loads.

In order to comply with 10 CFR 100.23, the geologic and seismic conditions at the proposed site should be considered during the siting and design of a nuclear power plant or plants. It describes the investigations needed to obtain the geologic and seismic data necessary to determine site suitability and to provide reasonable assurance that a nuclear power plant or plants of specified type (or falling within a PPE) could be constructed and operated at a proposed site without undue risk to the health and safety of the public with respect to those characteristics. Meeting these requirements helps provide assurance that structures, systems, and components of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed at the proposed site could be designed to withstand the effects of seismic events, thereby minimizing the probability that a failure would initiate an accident or exacerbate the consequences of an accident.

III. REVIEW PROCEDURES

The review process is conducted in a similar manner and concurrent with that described in Sections 2.5.1 and 2.5.2 of NUREG-0800, and 2.5.4 of this review standard. The services of consultants may be used to aid the staff in geotechnical engineering evaluations regarding foundation engineering and slope stability analyses, particularly in the evaluation of safety-related and seismic Category I earthworks, earth and rock-fill dams, dikes, and reservoirs. Typical references used by the staff are listed in Subsection VI. (Refs. 13 through 22)

An acceptance review is conducted to determine if the provided information is complete as outlined in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," (Ref. 10) and to judge whether or not the information presented is sufficient to permit an independent in-depth review and analysis of the safety of the proposed facility. After acceptance of the safety assessment, the results of site investigations such as borings, maps, logs of trenches, permeability test records, results of seismic investigations, laboratory test results, profiles, plot plans, and stability analyses are studied and cross-checked in considerable detail to determine whether or not the assumptions and analyses used in the design are conservative. The degree of conservatism needed depends upon the type of analysis used, the reliability of parameters considered in the slope stability analysis, the number of borings, the sampling program, the extent of the laboratory test program, and the resultant safety factor. In general, the applicable soil strength data should be conservatively selected for the various possible soil profiles and slope conditions. For lower safety factors, several soil profiles should be analyzed to ensure that reasonable ranges of soil properties have been considered. Other factors such as flood conditions, pore pressure effects, possible erosion of soils, and possible seismic amplification effects should be conservatively assessed.

The design criteria and analyses for earth structures that would bear significantly on the acceptability of the site are reviewed to ascertain that the techniques employed are appropriate and represent the present state-of-the-art. An independent analysis of the design of safety-related earth or rock-fill embankments that would bear significantly on the acceptability of the site may be performed by the staff's advisors or by the staff as deemed necessary. Consultants may also evaluate natural or cut slopes, as needed, on a case-by-case basis.

After completing the review, if the staff's conclusions are consistent with those reached by the applicant, these conclusions are summarized in the safety evaluation report (SER) or in a supplement to the SER. In the event that the applicant's investigation and design are not judged to be sufficiently conservative, a staff position is stated and the applicant is asked to further substantiate its position by additional investigations or monitoring to demonstrate that a failure of the slopes in question will not harm the safety functions of a nuclear power plant or plants of specified type (or falling within a PPE) that might be constructed at the proposed site, or to concur in the staff position.

Site subsurface investigations supporting the ESP application should be conducted to provide sufficient coverage of the site areas upon which all safety-related structures will be located, such that there is reasonable assurance that the actual site conditions, revealed during excavations or further soil borings, will be consistent with the site subsurface model developed to support the ESP application. The ESP will contain a license condition requiring the reporting of any information the ESP holder has identified as having a significant implication for public

health and safety or for common defense and security. The Commission will evaluate any such information reported and will take appropriate action.

All natural safety-related slopes are examined during at least one of the two site visits by the staff. Because excavated slopes or embankments are not usually constructed until after a COL has been granted, detailed as-built documentation of these slopes and embankments, as well as complete stability and safety analyses are necessary but not at the ESP stage.

Following is a brief description of the review procedures conducted by the staff in evaluating the slope stability aspects of nuclear power plant sites.

Subsection 2.5.5.1. Plot plans, cross sections, and profiles of all safety-related slopes in relation to the topography and physical properties of the underlying materials are reviewed and compared with exploratory records to ascertain that the most critical conditions have been addressed and that the characteristics of all slopes have been defined. The soil and rock test data are reviewed to ensure that there is sufficient relevant test data to verify the soil strength characteristics assumed for the slopes, dikes, and dams under analysis. The evaluation is to some extent a matter of engineering judgment; however, if the safety factors resulting from the analysis are not appropriate to the hazards posed by a slope failure and other than clearly conservative soil properties and profiles were used, the applicant should obtain additional data to verify its assumptions, or to show that, even if the worst possible conditions are assumed, there is an adequate margin of safety. With respect to seismic analysis, this Subsection and Subsection 2.5.5.2 are reviewed concurrently at the COL stage because different methods of analysis may involve different approximations, assumptions, and soil properties.

In addition to generic state-of-the-art literature, other potential sources of information are those containing design, construction, and performance records of natural slopes, excavation slopes, and dams that may have been constructed in the general vicinity of the site. Examples of such documents are design memoranda and construction reports regarding nearby projects of public agencies such as the U.S. Army Corps of Engineers, the Tennessee Valley Authority, the U.S. Navy, the U.S. Bureau of Reclamation, and private construction contractors or architect-engineers. (Refs. 15 through 20)

Subsection 2.5.5.2. The criteria, design techniques, and analyses are evaluated by the staff at the COL stage to ascertain that:

1. Appropriate state-of-the-art methods have been employed.

2. Conservative assumptions regarding soil and rock properties have been used in the design and analysis of slopes and embankments as discussed above in Subsection 2.5.5.1.

3. Appropriately conservative margins of safety have been incorporated in the design of structures.

The criteria and design methods used by the applicant are reviewed to ascertain that state-of-the-art techniques are being employed. The design analyses are reviewed to be sure that the most conservative failure approach has been used and that all adverse conditions to which the slope might be subjected have been considered. Such conditions include ground motions from the safe shutdown earthquake, settlement, cracking, flood or low-water

steady-state seepage, sudden drawdown of an adjacent reservoir, or a reasonable assumption of the possible simultaneous occurrence of two natural events such as an earthquake and flood. The review is also concerned with determining whether or not the soil and rock characteristics derived from the investigations described in Subsection 2.5.5.3 have been completely and conservatively incorporated into the design. When marginal factors of safety are indicated by the independent analyses performed by the staff and its consultants, additional substantiation and refinement is necessary or the applicant should use more conservative assumptions.

No single method of analysis is entirely acceptable for all stability assessments; thus, no single method of analysis can be recommended. Relevant manuals issued by public agencies (such as the U.S. Navy Department, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation) are often used in reviews to ascertain whether the analyses performed by the applicant are reasonable (Refs. 18, 20, 21, and 22). Many of the important interaction effects cannot be included in current analyses and should be treated in some approximate fashion. Engineering judgment is an important factor in the staff's review of the analyses and in assessing the adequacy of the resulting safety factors.

If the staff review indicates that questionable assumptions have been made by the applicant or some nonstandard or inappropriate method of analysis has been used, then the staff or its consultant may model the dam or slope in a manner which is more consistent with the data and perform an independent analysis employing both deterministic and probabilistic methods as appropriate.

Subsection 2.5.5.3. A comprehensive program of site investigations including borings, sampling, geophysical surveys, test pits, trenches, and laboratory and field testing should be carried out by the applicant to define the physical characteristics of all soil and rock beneath safety-related and seismic Category I slopes, and borrow material that is to be used to construct safety-related dams, fills, and embankments (Refs. 8 and 9). The staff reviews these investigations to ascertain that the program has been adequate to define the in situ and earthwork soil and rock characteristics. The decision as to the adequacy of the investigation program is based on the methods discussed in Section 2.5.4 of this review standard.

Subsection 2.5.5.4. The preliminary specifications and quality control techniques to be used during construction are reviewed by the staff at the COL stage to ascertain that all design conditions are likely to be met. During this part of the review the following are among those subjects reviewed for adequacy:

1. Proposed construction dewatering plan to ensure that it will not result in damage either to the natural or engineered foundation materials or to the structural foundation.

2. The excavation plan to remove all unsuitable materials from beneath the foundations and the quality control procedures which establish suitable materials.

3. The techniques and equipment to be used in compacting foundation and embankment materials.

4. The techniques for improving the stability of natural slopes such as drainage, grouting, rock bolting, and applying gunite.

5. The plans for monitoring during and after construction to detect occurrences that could detrimentally affect the facility. Such monitoring includes periodic examination of slopes, survey of settlement monuments, and measurements of local wells and piezometers.

IV. EVALUATION FINDINGS

Upon completion of the staff's review of the geotechnical engineering aspects of the material presented by the applicant related to the stability of all earth and rock slopes, both natural and manmade, an evaluation of completeness, accuracy and adequacy is made. If the evaluation confirms that the applicant has met the requirements and regulatory positions referenced in Section II above, the conclusion in the SER states that the investigations performed for slope stability studies and dam and dike analyses are adequate to justify the soil and rock characteristics that would be used in the design, and that the design analyses contain margins of safety which adequately demonstrate that natural and manmade slopes would remain stable under SSE conditions and that safety-related earthwork could be designed to function reliably.

The staff's conclusions regarding the stability of slopes are summarized in the safety evaluation report or in a supplement to the SER. The following is an example:

> Both natural and man-made slopes exist at the site. At the plant site, which is located several hundred meters (feet) from the Green Valley and about 85 meters (280 feet) above the level of Jones Pond, the slope is relatively gentle for about 75 meters (250 feet) west of the westernmost planned Category I structures, then steepens, attaining an angle of more than 45° near the bottom of the valley wall. Major structural trends, schistosity, and one of the predominant joint trends are nearly perpendicular to the slope. A second predominant joint set is nearly parallel to the river and dips to the southwest, but no slope movements have apparently affected the valley walls in the vicinity of the site. Seven other joint trends were detected by the applicant. These joint sets are reported to be moderately spaced and discontinuous. The applicant has drilled several exploratory holes and cored others to assess the natural slope characteristics and groundwater regime. Even though the natural slopes are some distance from planned safety-related plant facilities and slope failures are not obvious safety hazards, the applicant has performed stability analyses of these slopes under safe shutdown earthquake (SSE) conditions. The minimum computed safety factor was 1.6 using conservative slope and material parameters.
>
> Planned manmade earth slopes related to the safety of the nuclear power plant of type specified by the applicant that might be constructed on the proposed site include excavation cuts for the ultimate heat sink canal and dams and dikes for the ultimate heat sink storage pond. An extensive investigation and test program has determined all the significant characteristics and properties of cut slopes and fill embankments. Earthwork compaction criteria, construction control, and select fill materials are consistent with high-quality water-retention facilities. Conservative stability analyses of these slopes under SSE conditions indicated minimum safety factors of 1.5.

Based on the foregoing, the staff concludes that information including analysis and substantiation presented by the applicant is sufficient to demonstrate the dynamic and static stability of all slopes whose failure could adversely affect directly or indirectly safety-related structures of a nuclear power plant of the type specified by the applicant [or falling within the PPE submitted by the applicant] that might be constructed at the proposed site or pose a hazard to the public and meets the requirements of the pertinent Commission regulations (cite appropriate references).

Further, the applicant has met the requirements of the pertinent Commission regulations (cite appropriate references) with respect to slope characteristics; design criteria and design analyses; results of investigations including borings, shafts, pits, trenches, and laboratory tests; properties of borrow materials; and compaction and excavation specifications by meeting the regulatory position in Regulatory Guide (cite appropriate references) or by providing and meeting an alternative method to these regulatory positions that the staff has reviewed and found to be acceptable.

In summary, based on the results of the applicant's investigations, laboratory and field tests, analyses, and criteria for design and construction, the staff concludes that natural slopes would remain stable under SSE conditions , and that man-made slopes and safety-related earthworks could be designed and constructed to function reliably and to remain stable under SSE conditions in compliance with 10 CFR Part 100.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52 (Ref. 23). 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.

VI. REFERENCES

1. U.S. NRC Standard Review Plan, Section 2.5.1, "Basic Geologic and Seismic Information," NUREG-0800, Rev. 3, March 1997.

2. U.S. NRC Standard Review Plan, Section 2.5.2, "Vibratory Ground Motion," NUREG-0800, Rev. 3, March 1997.

3. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."

4. 10 CFR Part 100, "Reactor Site Criteria."

5. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

6. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

7. Regulatory Guide 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plants."

8. Regulatory Guide 1.132, "Site Investigations for Foundations of Nuclear Power Plants."

9. Regulatory Guide 1.138, "Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants."

10. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

11. H. Bolton Seed, K. L. Lee, I. M. Idriss, and F. Makdisi, "Analysis of the Slides in the San Fernando Dams During the Earthquake of February 9, 1971," Report No. EERC 73-2, Earthquake Engineering Research Center, University of California, Berkeley (1973).

12. M. Newmark, "Effects of Earthquakes on Dams and Embankments," Geotechnique, 15: 140-141; 156, 1969.

13. Earthquake Engineering Research Center, University of California, Berkeley.

14. Multi-disciplinary Center for Earthquake Engineering, State University of New York, Buffalo, NY.

15. Engineering Manual EM 1110-1-1804, "Geotechnical Investigations," U.S. Army Corps of Engineers, January 2001.

16. Engineering Manual EM 1110-2-1908, "Instrumentation of Earth and Rock Fill Dams," U.S. Army Corps of Engineers, June 1995.

17. Engineering Manual EM 1110-2-1906, "Laboratory Soil Testing," U.S. Army Corps of Engineers, August 1986.

18. Engineering Manual EM 1110-2-1902, "Engineering and Design- Stability of Earth and Rock-Fill Dams," U.S. Army Corps of Engineers, April 1970.

19. ASCE Conference on Stability and Performance of Slopes and Embankments II, Berkeley, CA. (1992).

20. Bureau of Reclamation, "Earth Manual," First Edition, U.S. Dept. of Interior (1968).

21. Corps of Engineers, "Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)," Tech. Report TM 5-818-1 (formerly EM 1110-345-147), Office of the Chief of Engineers, Dept. of the Army (1965).

22. Department of the Navy, "Soil Mechanics, Foundations, and Earth Structures," NAVFAC DM-7, March 1971.

23. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

3.5.1.6 AIRCRAFT HAZARDS

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

For this section of an early site permit application, the staff reviews the applicant's assessment of aircraft hazards. The purpose of the review is to ensure that the risks due to aircraft hazards are sufficiently low. Probabilistic considerations may be used to demonstrate that aircraft hazards need not be a design basis concern. Otherwise, a design basis aircraft event, involving potential effects of aircraft impacts and fires, is identified for consideration with respect to a nuclear power plant or plants of specified type (or falling within a plant parameter envelope [PPE]) that might be constructed and operated on the proposed site.

The SPSB reviews the applicant's assessment of aircraft activities in the vicinity of the proposed site and determines whether or not the hazards associated with these activities should be identified as design basis events for a plant or plants that might be constructed on the site. In such cases, the SPSB identifies and describes the design basis aircraft in terms of aircraft weight, speed, and other appropriate characteristics.

II. ACCEPTANCE CRITERIA

SPSB acceptance criteria are based on meeting the relevant requirements of one of the following sets of regulations:

1. 10 CFR 100.20 as it relates to the requirement that site characteristics be evaluated to determine whether individual and societal risk of potential plant accidents is low. This requirement is met if the probability of aircraft accidents having the potential for radiological consequences greater than 10 CFR Part 100 exposure guidelines is less than about 10^{-7} per year. (See Section 2.2.3 of this review standard.) The probability is considered to be less than about 10^{-7} per year by inspection if the distances from the site meet all the criteria listed below:

    a. The site-to-airport distance D is between 5 and 10 statute miles, and the projected annual number of operations is less than 500 D^2, or the site-to-airport distance D is greater than 10 statute miles, and the projected annual number of operations is less than 1000 D^2,

    b. The site is at least 5 statute miles from the edge of military training routes, including low-level training routes, except for those associated with a usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation, and

c. The site is at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern.

If the above proximity criteria are not met, or if sufficiently hazardous military activities are identified (see item b. above), a detailed review of aircraft hazards should be performed. Aircraft accidents which could lead to radiological consequences in excess of the exposure guidelines of 10 CFR Part 100 with a probability of occurrence greater than about 10^{-7} per year should be considered in the design of a plant or plants that might be constructed and operated on the site. If the results of the review do not support a finding that the risk due to aircraft activities is acceptably low, then a determination of acceptability with respect to protection against aircraft impacts (Ref. 6) and fires (Ref. 3) will need to be made for the specific plant design at the combined license (COL) stage in accordance with the review procedures of NUREG-0800 section 3.5.1.6.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes aspects of the areas covered by this section of this review standard as may be appropriate for a particular case. The judgment on areas to be given attention and emphasis in the review is based on a inspection of the material presented to see whether it is similar to that recently reviewed for other plants and/or sites and whether items of special safety significance are involved.

The staff's review of the aircraft hazard assessment consists of the following steps:

1. Aviation Uses. Data describing aviation uses in the airspace near the proposed site, including airports and their approach paths, federal airways, Federal Aviation Administration (FAA) restricted areas, and military uses is obtained from the site description section of the safety assessment . For many cases, no detailed analysis need be made as the probability can be judged adequately low based on a comparison with analyses previously performed (Refs. 5, 7, 8, and 9). In general, civilian and military maps should be examined to verify that all aviation facilities of interest have been considered. In the process, the reviewer should develop an independent assessment of the aircraft hazards. Communications with agencies responsible for aircraft operations and the evaluation of aircraft operational data may be utilized.

2. Airways. For situations where federal airways or aviation corridors pass through the vicinity of the site, the probability per year of an aircraft crash on the site (P_{FA}) should be estimated. This probability will depend on a number of factors such as the altitude and frequency of the flights, the width of the corridor, and the corresponding distribution of past accidents.

   One way of calculating P_{FA} is by using the following expression:

   $P_{FA} = C \times N \times A/w$

   where:

   C = inflight crash rate per mile for aircraft using airway,

w = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles,

N = number of flights per year along the airway, and

A = site area in square miles.

This gives a conservative upper bound on aircraft impact probability if care is taken in using values for the individual factors that are meaningful and conservative. The use of the site area, in particular, is conservative, since typically plant area is significantly smaller than the site area. In the event that this leads to the identification of an aircraft hazard as a design basis event, the site may still be acceptable if the use of a proposed plant area reduces the crash probability to within the acceptance criteria. For commercial aircraft, a value of $C = 4 \times 10^{-10}$ (Ref. 10) per aircraft mile has been used. For heavily traveled corridors (greater than 100 flights per day), a more detailed analysis may be needed to obtain a proper value for this factor.

3. Civilian and Military Airports and Heli-Ports (Refs. 2, 4, and 12). The probability of an aircraft crashing into the site should be estimated for cases where one or more of the conditions in Item II.1 of the Acceptance Criteria are not met.

The probability per year of an aircraft crashing into the site for these cases (P_A) may be calculated by using the following expression:

$$P_A = \sum_{i=1}^{L} \sum_{j=1}^{M} C_j N_{ij} A_j$$

where:

M = number of different types of aircraft using the airport,

L = number of flight trajectories affecting the site,

C_j = probability per square mile of a crash per aircraft movement for the jth aircraft,

N_{ij} = number (per year) of movements by the jth aircraft along the ith flight path, and

A_j = effective site area (in square miles) for the jth aircraft.

The manner of interpreting the individual factors in the above equation may vary on a case-by-case basis because of the specific conditions of each case or because of changes in aircraft accident statistics.

Values for C_j currently being used are taken from the data summarized in the following table:

Distance From End of Runway (miles)	Probability (x 10^8) of a Fatal Crash per Square Mile per Aircraft Movement			
	U.S. Air Carrier[1]	General Aviation[2]	USN/USM[1]	USAF[1]
0-1	16.7	84	8.3	5.7
1-2	4.0	15	1.1	2.3
2-3	0.96	6.2	0.33	1.1
3-4	0.68	3.8	0.31	0.42
4-5	0.27	1.2	0.20	0.40
5-6	0	NA[3]	NA	NA
6-7	0	NA	NA	NA
7-8	0	NA	NA	NA
8-9	0.14	NA	NA	NA
9-10	0.12	NA	NA	NA

[1]Reference 2.
[2]Reference 4.
[3]NA indicates that data was not available for this distance.

4. Designated Airspaces. For designated airspaces involving military or civilian usage, a detailed quantitative modeling of all operations should be verified. The results of the model should be the total probability (C) of an aircraft crash per unit area and time in the vicinity of the proposed site.

The probability per year of a potentially damaging crash at the site due to operations at the facility under consideration (P_M) is then given for this case by the following expression:

$P_M = C \times A$

where:

C = total probability of an aircraft crash per square mile per year in the vicinity of the site due to the airports being considered, and

A = site area of in square miles.

Where estimated risks due to military aircraft activity are found to be unacceptably high, the site may still be acceptable if suitable airspace or airway relocation is implemented. Past experience has been that military authorities have been responsive to modification of military operations and relocation of training routes in close proximity to nuclear power plant sites. (Ref. 9)

5. Holding Patterns. Holding patterns are race track shaped courses at specified altitudes, associated with one or more radio-navigational facilities, where aircraft can "circle" while awaiting clearance to execute an approach to a landing at an airport or to continue along an airway. Holding patterns which are sufficiently distant from the site need not be considered (See subsection II above). Otherwise, traffic in the holding pattern should be converted into equivalent aircraft passages taking into account the characteristics of the holding pattern. The information in Item III.2 above should be used in this evaluation.

6. The total aircraft hazard probability at the site equals the sum of the individual probabilities obtained in the preceding steps.

7. The site area used in the calculations may exclude those portions of the site which clearly would not be part of a plant area (e.g., significant bodies of water or other topological features which would preclude the location of plant structures). The applicant also may use an estimated effective plant area in place of the site area (as described in this section of this review standard). However, site acceptability would include the criterion that a proposed plant effective area would not exceed this area. Otherwise, the actual plant effective area would need to be evaluated in estimating the aircraft crash probability.

IV. EVALUATION FINDINGS

The reviewer drafts an introductory paragraph for the evaluation findings describing the procedure used in evaluating the aircraft hazards with respect to the probability of a crash on the site. The reviewer verifies that the site location is acceptable and meets the requirements of 10 CFR Parts 52 and 100.

The basis for the above findings may be strictly in terms of the probabilities associated with potential aircraft crashes onsite. If the estimated aircraft crash probability is such that criteria of Section 2.2.3 of this review standard are met , then conclusions of the following type should be included in the staff's safety evaluation report:

> As set forth above, the staff has independently verified the applicant's assessment of aircraft hazards at the site that resulted in a probability less than about 10^{-7} per year for an accident having the potential for radiological consequences worse than the exposure guidelines of 10 CFR Part 100. In addition, plant sites reviewed in the past which had equivalent aircraft traffic in equal or closer proximity were, after careful examination, found to present no undue risk to the safe operation of those plants. Based upon these considerations , in the staff's judgment, no undue risk to the health and safety of the public is present from aircraft hazard at the plant site now under consideration. Therefore, the staff concludes that the proposed site is acceptable for siting a plant of type specified by the applicant and meets the relevant requirements of 10 CFR Parts 52 and 100.

In the event that the staff evaluation of the aircraft hazards does not support the above basis, i.e., if criteria of Section 2.2.3 of this review standard are not met, then the basis for acceptance is addressed at the COL stage with respect to plant design, as well as site characteristics. Specifically, the criteria of 10 CFR Part 50, Appendix A, General Design Criteria 3 and 4 are applied to a specific plant design to be sited on the proposed site. In such cases, a

determination of acceptability with respect to protection against aircraft impacts and fires is made for the specific plant design in accordance with the review procedures of NUREG-0800 Section 3.5.1.6.

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the NRC staff's plan for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of early site permit applications submitted by applicants pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposes an acceptable alternate 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 and NUREG.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria."

2. D. G. Eisenhut, "Reactor Siting in the Vicinity of Airfields." Paper presented at the American Nuclear Society Annual Meeting, June 1973.

3. I. I. Pinkel, "Appraisal of Fire Effects from Aircraft Crash at Zion Power Reactor Facility," July 17, 1972 (Docket No. 50-295).

4. D. G. Eisenhut, "Testimony on Zion/Waukegan Airport Interaction" (Docket No. 50-295).

5. USAEC Regulatory Staff, "Safety Evaluation Report," Appendix A, "Probability of an Aircraft Crash at the Shoreham Site" (Docket No. 50-322).

6. "Addendum to the Safety Evaluation by the Division of Reactor Licensing, USAEC, in the Matter of Metropolitan Edison Company (Three Mile Island Nuclear Station Unit 1, Dauphin County, Pennsylvania)," April 26, 1968 (Docket No. 50-289).

7. Letter to Honorable J. R. Schlesinger from S. H. Bush, Chairman, Advisory Committe on Reactor Safeguards, "Report on Rome Point Nuclear Generating Station," November 18, 1971 (Project No. 455).

8. Letter to Mr. Joseph L. Williams, Portland General Electric Company, from R. C DeYoung (in reference to Mr. Williams' letter of May 7, 1973), November 23, 1973 (Project No.485).

9. Letter to Mr. J. H. Campbell, Consumers Power Company, from Col. James M. Campbell, Dep. Chief, Strategic Division, Directorate of Operations, U.S. Air Force, May 19, 1971 (Docket No.50-155).

10. H. E. P. Krug, "Testimony on Aircraft Operations in Response to a Question from the Board" (Docket Nos. 50-275 and 50-323).

11. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

12. NUREG-0533, "Aircraft Impact Risk Assessment Data Base for Assessment of Fixed Wing Air Carrier Impact Risk in the Vicinity of Airports."

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

13.3 EMERGENCY PLANNING

13.3.1 EARLY SITE PERMITS

REVIEW RESPONSIBILITIES

Primary - Emergency Preparedness and Plant Support Branch (IEPB)

Secondary - Probabilistic Safety Assessment Branch (SPSB)

I. AREAS OF REVIEW

The emergency planning aspects of an early site permit (ESP) application will be reviewed by the Nuclear Regulatory Commission (NRC) for compliance with the applicable requirements of the following:

1. 10 CFR 50.34, "Contents of applications; technical information"

2. 10 CFR 50.47, "Emergency plans"

3. Appendix E of 10 CFR Part 50, "Emergency Planning and Preparedness for Production and Utilization Facilities"

4. Subpart A of 10 CFR Part 52, "Early Site Permits"

Supplement 2 to NUREG-0654, "Criteria for Emergency Planning in an Early Site Permit Application" (Supplement 2), will be used as the primary guidance for the review of radiological emergency preparedness information and plans submitted with an ESP application pursuant to Subpart A of 10 CFR Part 52.

The following guidance documents, as applicable, provide acceptable methods for implementing specific parts of the Commission's regulations:

1. Regulatory Guide 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors"

2. Revision 1 of NUREG-0654/FEMA-REP-1 (NUREG-0654), "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants"

3. Supplement 1 to NUREG-0654, "Criteria for Utility Offsite Planning and Preparedness"

4. Supplement 3 to NUREG-0654, "Criteria for Protective Action Recommendations for Severe Accidents"

5. NUREG-0696, “Functional Criteria for Emergency Response Facilities”

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

7. Supplement No. 1 to NUREG-0737, “Requirements for Emergency Response Capability”

The NRC will consult with the Federal Emergency Management Agency (FEMA) regarding state and local (i.e., offsite) emergency plans and preparedness, in accordance with a September 7, 1993, Memorandum of Understanding between the two agencies. Onsite meteorological measurements programs, including those in support of emergency preparedness planning, are reviewed by SPSB as a primary review responsibility for Section 2.3.3 of this review standard.

II. ACCEPTANCE CRITERIA

The acceptance criteria for emergency planning information submitted in an ESP application are contained in 10 CFR 52.17, “Contents of applications.” The minimum acceptance criteria for all ESP applications, located in 10 CFR 52.17(b)(1), require that ESP applications identify physical characteristics unique to the proposed site that could pose a significant impediment to the development of emergency plans. Applications providing only the information required by 10 CFR 52.17(b)(1) must also include a description of contacts and arrangements made with local, state, and federal governmental agencies with emergency planning responsibilities, in accordance with 10 CFR 52.17(b)(3).

The applicant may choose to submit additional emergency planning information in the ESP application to address the two optional acceptance criteria in 10 CFR 52.17(b)(2). The two options allow an ESP applicant to propose either major features of the emergency plans, or to provide complete and integrated emergency plans. While neither option is required, each would provide for a more definitive finding concerning emergency plans and preparedness at the ESP stage than would be the case for submittal of only the minimum required information.

Emergency planning information (including supporting organization agreements) submitted with an ESP application should be up to date when the application is submitted and should reflect use of the proposed site for possible construction of a new reactor (or reactors).

1. Identification of Physical Characteristics

The ESP application must identify physical characteristics unique to the proposed site, such as egress limitations from the area surrounding the site, that could pose a significant impediment to the development of emergency plans. The ESP applicant should describe the proposed means for resolving any such impediments. An ESP application may identify such unique physical characteristics by performing a preliminary analysis of the time needed to evacuate various sectors and distances within the plume exposure pathway emergency planning zone (EPZ) for permanent and transient populations, as well as persons in special facilities, noting major difficulties for an evacuation (e.g., significant traffic-related delays) or for taking other protective actions.

A preliminary analysis of evacuation times is one example of how some significant impediments to the development of emergency plans may be identified. Other factors, such as the availability of adequate shelter facilities, in consideration of local building practices and land use (e.g., outdoor recreation facilities, including camps, beaches, hunting or fishing areas), and the presence of large institutional or other special needs populations (e.g., schools, hospitals, nursing homes, prisons) should also be addressed when identifying significant impediments to the development of emergency plans. Any evacuation time estimate (ETE) analysis or other identification of physical impediments, which should include the latest population census numbers and the most recent local conditions, will be reviewed in consultation with FEMA.

In addition, an ESP application providing only the information required by 10 CFR 52.17(b)(1) must include a description of contacts and arrangements made with local, state, and federal governmental agencies with emergency planning responsibilities, in accordance with 10 CFR 52.17(b)(3). The descriptions (preferably letters of agreement[1]) should include the names and locations of the organizations contacted, the titles and/or positions of the persons contacted, and the roles of the organizations in emergency planning. Copies of letters of agreement (or other certifications) should be included in the ESP application. The agreement information should be up-to-date when the application is submitted, and should reflect the use of the proposed site for possible construction of a new reactor (or reactors). In addition, a discussion of the details associated with any ambiguous or incomplete language in the letters of agreement should be provided in the application.

For an existing reactor site, the description of contacts and arrangements should clearly address the presence of an additional reactor (or reactors) at the site, and any impact that would have on governmental agency emergency planning responsibilities, including acknowledgment by the agencies of the proposed expanded responsibilities. If the applicant is unable to make arrangements with local, state, and federal governmental agencies with emergency planning responsibilities, for whatever reason, the applicant should discuss its efforts to make such arrangements along with a description of any compensatory measures the applicant has taken or plans to take because of the lack of such arrangements.

Additional guidance concerning identifying physical characteristics unique to the proposed site, and describing agency contacts and arrangements, is provided in Supplement 2 to NUREG-0654.

2. Major Features of the Emergency Plans

In addition to the minimum requirements to identify physical characteristics unique to the proposed site, and describe contacts and arrangements with governmental agencies, as indicated above, the ESP applicant may propose major features of the emergency plans, such as the exact sizes of the EPZs, for review and approval by NRC, in consultation with FEMA, in the absence of complete and integrated emergency plans.

For a pre-existing nuclear facility, all Supplement 2 major features of the emergency plan (i.e., all 14 planning standards) should be addressed in the ESP application. The detailed, specific

[1] SECY-91-041, "Early Site Permit Review Readiness," February 13, 1991 (p. 6), indicates staff's preference for the development of letters of agreement.

evaluation criteria for each of the major features in Supplement 2 should be addressed for both a pre-existing nuclear facility, as well as for applicable major features associated with a site without a pre-existing nuclear facility. If emergency planning information is not provided on all 14 major features (including the detailed, specific evaluation criteria) in Section V of Supplement 2, the ESP application will not be rejected. The review and evaluation will, however, be based on, and specifically limited to, the submitted information only. Additional guidance concerning major features of the emergency plans is provided in Supplement 2 to NUREG-0654.

3. Complete and Integrated Emergency Plans

In addition to the minimum requirements to identify physical characteristics unique to the proposed site, and describe contacts and arrangements with governmental agencies, as indicated above, the ESP applicant may propose complete and integrated emergency plans for review and approval by NRC, in consultation with FEMA, in accordance with the applicable provisions of 10 CFR 50.47. The planning standards and evaluation criteria for preparing and evaluating these emergency plans are provided in NUREG-0654.

Under this option, the applicant should make good-faith efforts to obtain from the same governmental agencies certifications that (1) the proposed emergency plans are practicable; (2) these agencies are committed to participating in any further development of the plans, including any required field demonstrations; and (3) these agencies are committed to executing their responsibilities under the plans in the event of an emergency.

The ESP application must contain any certifications that have been obtained. If these certifications cannot be obtained, the application must contain information, including a utility plan, sufficient to show that the proposed plans nonetheless provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at the site. The utility-prepared offsite emergency plans and preparedness will be reviewed and evaluated using the guidance in Supplement 1 to NUREG-0654.

III. REVIEW PROCEDURES

1. Identification of Physical Characteristics

If the applicant chooses to provide only the minimum required information, NRC will review, in consultation with FEMA, the feasibility of emergency planning for the site, including the anticipated support from various governmental agencies, and the adequacy of the information provided in the application, to determine whether any identified physical characteristics unique to the proposed site pose a significant impediment to the development of emergency plans. Additional guidance concerning identifying physical characteristics unique to the proposed site, and describing agency contacts and arrangements, is provided in Supplement 2 to NUREG-0654.

2. Major Features of the Emergency Plans

An ESP application that proposes major features of the emergency plans will be reviewed by NRC, in consultation with FEMA, and evaluated against the selected and modified planning standards and evaluation criteria from Section II of NUREG-0654. These planning standards

and evaluation criteria for major features of the emergency plans, which are provided in Section V of Supplement 2 to NUREG-0654, have been selected to:

a. highlight the need for cooperation among the applicant, local, state, and federal agencies, as addressed in 10 CFR 52.17(b)(3);

b. address potential emergency planning issues early in the licensing process, before large commitments of resources are made; and

c. reflect that an ESP applicant may not have certain information and resources, or should not be expected to expend resources on various aspects of emergency planning and preparedness that will be required, and may best be addressed, at the combined license (COL) stage.

In addition, the standards and criteria that refer to facilities, systems, and equipment have been modified to address only descriptions, rather than in-place capabilities. The modifications to the emergency planning standards and evaluation criteria in Section V of Supplement 2 apply only to an ESP application.

3. Complete and Integrated Emergency Plans

As indicated in 10 CFR 52.17(b)(2)(ii), an ESP application may propose complete and integrated emergency plans for review and approval by NRC, in consultation with FEMA, in accordance with the applicable provisions of 10 CFR 50.47. Guidance for preparing and evaluating these emergency plans is provided in the planning standards and evaluation criteria of NUREG-0654, as clarified, interpreted, and modified by FEMA.

All of the standards of 10 CFR 50.47(b), as supported by the guidance in the corresponding planning standards and evaluation criteria of NUREG-0654, must be met before an operating license is issued pursuant to 10 CFR 50.57 or a COL is issued pursuant to Subpart C of 10 CFR Part 52. In addition, for the first reactor at a site, Appendix E of 10 CFR Part 50 requires that a full-participation exercise be conducted within two years before NRC issuance of an operating license for full power (i.e., one authorizing operation above five percent of rated power). Because this exercise would be included in the inspections, tests, and analyses required for a combined license, it would have to be satisfied before fuel loading pursuant to a COL.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided, and that the staff's evaluation supports concluding statements of the following type, to be included in the staff's safety evaluation report.

1. Identification of Physical Characteristics

The staff has reviewed the physical characteristics unique to the proposed site, and the description of contacts and arrangements made with local, state, and federal governmental agencies with emergency planning responsibilities, for the [indicate applicant] early site permit (ESP) application for [indicate site name].

The staff concludes, after consultation with the Federal Emergency Management Agency (FEMA), the following.

[Summarize important NRC and FEMA review findings.]

Therefore, based on the review and for the reasons set forth above, the staff finds that there are no significant impediments to the development of emergency plans, and that the emergency planning information meets the requirements of 10 CFR 52.17(b)(1), 10 CFR 52.17(b)(3), and 10 CFR 52.18.

2. Major Features of the Emergency Plans

The staff has reviewed the proposed major features of the emergency plans for the [indicate applicant] early site permit (ESP) application for [indicate site name]. The staff concludes, after consultation with the Federal Emergency Management Agency (FEMA), the following:

[Summarize important NRC and FEMA review findings; including the extent to which the emergency plans do, or do not, satisfy the planning standards and evaluation criteria in Supplement 2 (Section V), and applicable FEMA criteria.]

Therefore, based on the review and for the reasons set forth above, the staff finds that, in the absence of complete and integrated plans, the major features of the emergency plans proposed in the [indicate applicant] [indicate site name] ESP application, and indicated above as having satisfied applicable guidance criteria, are acceptable, and meet the requirements of 10 CFR 52.17(b)(2)(i), 10 CFR 52.17(b)(3), and 10 CFR 52.18.

3. Complete and Integrated Emergency Plans

The staff has reviewed the complete and integrated emergency plans provided in the [indicate applicant] early site permit (ESP) application for [indicate site name]. In addition, the staff has reviewed the Federal Emergency Management Agency (FEMA) interim findings and determinations on the state and local emergency plans, and the adequacy of certifications from the applicable local, state, and federal governmental agencies with emergency planning responsibilities, identified in accordance with 10 CFR 52.17(b)(3), and applicable FEMA criteria. The staff concludes, after consultation with FEMA, the following:

[Summarize important NRC and FEMA review findings, including the specific bases for the conclusions and how the plans meet each of the standards of 10 CFR 50.47(b).]

Based on the review and the reasons set forth above, the staff finds that the ESP is subject to the following required conditions and limitations:

[List the required conditions and limitations of the ESP.]

Therefore, based on the review and for the reasons set forth above, and provided that the required conditions and limitations of the ESP are met, the staff finds that the complete and integrated emergency plans proposed in the [indicate applicant] ESP application provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at [indicate site name], and that the plans meet the emergency plan requirements of 10 CFR 50.34, 10 CFR 50.47, Appendix E of 10 CFR Part 50, 10 CFR 52.17(b)(2)(ii), 10 CFR 52.17(b)(3), and 10 CFR 52.18.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the staff's plans for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of ESP applications submitted pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the methods described herein will be used by the staff in its evaluation of compliance with Commission regulations on emergency planning.

Implementation schedules for conformance to parts of the methods discussed herein are contained in the referenced regulations, a Regulatory Guide, and NUREGs.

VI. REFERENCES

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 10 CFR Part 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

4. Regulatory Guide 1.101, Rev. 4, "Emergency Planning and Preparedness for Nuclear Power Reactors," July 2003.

5. NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," November 1980.

6. Supplement 1 to NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Utility Offsite Planning and Preparedness" (Draft Report for Interim Use and Comment), November 1987.

7. Supplement 2 to NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Emergency Planning in an Early Site Permit Application" (Draft Report for Comment), April 1996.

8. Supplement 3 to NUREG-0654/FEMA-REP-1, Rev. 1, “Criteria for Protective Action Recommendations for Severe Accidents” (Draft Report for Interim Use and Comment), July 1996.

9. NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 1981.

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

11. Supplement No. 1 to NUREG-0737, “Requirements for Emergency Response Capability,” January 1983.

12. NRC/FEMA Memorandum of Understanding, September 7, 1993 (58 FR 47996, September 14, 1993).

13. SECY-91-041, “Early Site Permit Review Readiness,” February 13, 1991.

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

15.0 RADIOLOGICAL CONSEQUENCES OF DESIGN BASIS ACCIDENTS

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

The NRC regulations in 10 CFR Part 100, "Reactor Site Criteria," present a framework that guides the staff in its evaluation of the suitability of proposed sites for stationary power and testing reactors. Under 10 CFR 52.17(a)(1), "Contents of Applications," early site permit (ESP) applications must contain an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site with respect to the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1). This review standard applies to postulated design basis accident (DBA) radiological consequences for the exclusion area boundary (EAB) and low population zone (LPZ). Radiological consequences related to control room personnel will be evaluated as part of the combined license (COL) review.

1. ESP applications that reference the standard reactor designs certified by NRC

The standard reactor designs are certified with a reference set of short-term atmospheric relative concentration (χ/Q) values at an EAB and LPZ in lieu of site-specific meteorological data and specific distances to the EAB and LPZ. The NRC has determined, for purposes of the ESP review, that the certified standard reactor designs meet the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1), provided that the site parameters are consistent with the assumptions made in the design certification. The staff reviews meteorological data, inputs, assumptions, and the dispersion model used to estimate the site-specific χ/Q values in the ESP application using the guidance of Section 2.3.4 of this review standard. The staff then compares the site-specific χ/Q values in the ESP application with the referenced χ/Q values in the design certification to verify that the site-specific values are within the bounds of the values specified in the design certification.

2. ESP applications that use the plant parameter envelope (PPE) approach

A PPE is a set of plant design parameters that are expected to bound the characteristics of a reactor or reactors that may be constructed at a site, and it serves as a surrogate for actual reactor design information. The PPE values are selected by the applicant to bound a range of possible current and future reactor designs. The PPE values and associated information in the ESP application must contain sufficient information for the staff to make a determination regarding the acceptability of the proposed site using the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1).

The staff reviews the proposed PPE values and associated information in the ESP application to determine whether the set of PPE values is sufficient to enable the staff to conduct its evaluation of the radiological consequences. The PPE values should not be unreasonable for consideration in the staff findings regarding compliance with Subpart A of 10 CFR Part 52 (Ref. 2). The staff evaluation of radiological consequences at the EAB and LPZ will be made using the site-specific χ/Q values in ESP applications in conjunction with the PPE values and associated information in the ESP application.

3. ESP applications that neither reference the standard reactor designs certified by NRC nor use the PPE approach

Applications may be received that neither reference a certified design nor use the PPE approach. For example, an application may reference a "standard" design that is not yet certified, or a custom design. In such cases, the staff reviews the radiological consequences of potential DBAs in six parts: (1) review of selected bounding design basis accidents, (2) review of accident source terms, (3) review of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site for mitigating the radiological consequences of a DBA under the radiological consequence evaluation, (4) review of the characteristics of fission product release from the site to the environment, (5) review of the meteorological characteristics of the proposed site, and (6) review of the total calculated radiological consequence dose at the EAB and LPZ from the bounding DBAs.

The application must contain sufficient nuclear plant design information for the staff to review in making a determination regarding the acceptability of the proposed site using the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1).

II. ACCEPTANCE CRITERIA

The acceptance criteria are based on the requirements of 10 CFR 50.34(a)(1) as related to mitigating the radiological consequences of an accident in accordance with 10 CFR 52.17(a)(1).

The distances to the EAB and to the LPZ outer boundary are acceptable if the total calculated radiological consequences for the postulated fission product release fall within the following exposure acceptance criteria specified in 10 CFR 50.34(a)(1):

1. an individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 25 rem total effective dose equivalent (TEDE), and

2. an individual who is located at any point on the boundary of the LPZ and who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage), would not receive a radiation dose in excess of 25 rem TEDE.

For ESP applications that neither reference the standard reactor designs certified by NRC nor use the PPE approach, the staff may establish exposure acceptance criteria lower than those stated above for certain DBAs based on the probability of occurrence. Examples of such criteria are illustrated in Table 1, "Accident Dose Criteria" of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 15.0.1,

"Radiological Consequence Analyses Using Alternative Source Terms." For ESP applications using the PPE approach, these acceptance criteria may be applied at the COL stage.

For ESP applications that do not reference a standard reactor design certified by the NRC, particularly those ESP applications that reference a PPE value, applicants bear the burden of ensuring sufficient margin is provided in the design parameters (PPE values) in the ESP application to compensate for uncertainty in those parameters. The margin should be large enough such that the actual design submitted at the COL stage, coupled with the site characteristics as described in the ESP, will comply with NRC regulations.

III. REVIEW PROCEDURES

1. ESP applications that reference the standard reactor designs certified by NRC

   a. Using the guidance in Section 2.3.4 of this review standard, the staff reviews the applicant's meteorological data, inputs, assumptions, and dispersion model used to estimate the site-specific χ/Q values in the ESP application.

   b. The staff compares the site-specific χ/Q values in the ESP application with χ/Q values specified in the reactor design certification.

   c. If the site-specific χ/Q values are within the bounds of those specified in the design certification, no further radiological consequence evaluation is needed.

   d. If the site-specific χ/Q values exceed the bounds of those specified in the design certification, the staff verifies that the applicant has demonstrated that the radiological consequences associated with the bounding DBAs using the applicant's site-specific χ/Q values meet the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1).

   NOTE: At the COL stage, the staff verifies that no changes from the site-specific χ/Q values specified in the ESP application have occurred due to changes in plant design, plant location on the site, building orientation, or fission product release points. The staff performs independent confirmatory radiological consequence dose calculations using the site-specific χ/Q values and the source term provided in the certified reactor design control document to determine the resulting radiological consequences at the EAB and LPZ for public information and to supplement the design basis.

2. ESP applications that use the PPE approach

   a. The staff reviews the proposed PPE values to determine whether the set of PPE values is sufficient to enable the staff to conduct its evaluation of the radiological consequences. The PPE values should not be unreasonable for consideration in the staff's findings regarding compliance with Subpart A of 10 CFR Part 52.

   b. The PPE values should include, but are not limited to, the following design basis accident source term parameters to allow the staff to perform its independent radiological consequence analyses:

(1) The isotopic quantities of fission products released in curies to the environment from the site.

(2) Rates of fission product release to the environment from the site as a function of time.

c. The staff reviews the following information if available: (1) the times and rates of fission product release from the fuel and (2) the isotopic quantities and the chemical forms of fission products released from the fuel, following selected bounding DBAs. This information will help the staff determine whether the proposed PPE values are not unreasonable. The fission product appearance rates should be fractions of fission product inventory in the reactor core at the ultimate maximum power level.

d. In accordance with the guidance in Section 2.3.4 of this review standard, the staff reviews the site-specific χ/Q values determined by the applicant and performs an independent evaluation of atmospheric dispersion.

e. The staff performs independent confirmatory radiological consequence analyses using the docketed PPE values and the site-specific χ/Q values provided in ESP applications to determine whether the proposed site meets the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1) at the nearest EAB and LPZ outer boundary as described in Chapter 2 of the site safety assessment.

f. For the methodology and assumptions for calculating the radiological consequence, the staff will use, where applicable, the regulatory positions stated in Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (Ref. 3), and NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (Ref. 4), Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms."

NOTE: If a COL application references a certified design and an ESP that referenced a PPE, the staff reviews (at the COL stage) the site-specific χ/Q values specified in the ESP to confirm that the site-specific χ/Q values are bounded by those χ/Q values provided in the reactor design certification based on the proposed plant design, the plant location on the site, and the fission product release points.

NOTE: At the COL stage, in the event that the site-specific χ/Q values exceed the bounds of those specified in the referenced design certification, the staff verifies that the COL applicant has demonstrated that the radiological consequences associated with the bounding DBAs using its site-specific χ/Q values continue to meet the radiological consequence evaluation factors of 10 CFR 50.34(a)(1).

3. ESP applications that neither reference the standard reactor designs certified by NRC nor use the PPE approach

a. The staff reviews the sequences of DBA events as described by the applicant to ensure that the spectrum of DBAs includes the bounding DBA with respect to the calculated fission product releases. The spectrum of DBAs has generally been assumed to reflect a substantial meltdown of the reactor core (a major reactor accident) with subsequent release of appreciable quantities of fission products to the environment. Although the loss-of-coolant (LOCA) is typically the maximum credible accident associated with the light-water reactor design, the applicant should consider other accident sequences of greater radiological consequence for the specific reactor designs selected by the applicants or for reasonably foreseeable future reactor designs if the applicant has not selected the specific reactor designs at the time of ESP application.

b. The staff reviews a spectrum of representative DBAs selected and evaluated by the applicants for determining the bounding DBA radiological consequences. The selected DBA should cover a spectrum of reactor transients and accidents.

c. The applicant's proposed accident source terms are reviewed in the following areas:

(1) Fission product inventory in the reactor core operated at the ultimate maximum proposed power level with the limiting condition which maximizes fission product releases.

(2) Times and rates of fission product release from the fuel following selected DBAs. The fission product appearance rates should be fractions of fission product inventory in the reactor core based on the maximum full power operation.

(3) The isotopic quantities in curies and the chemical forms of fission products released to the containment and to the environment. The staff reviews changes in chemical form as the releases are processed by mitigating systems.

(4) Rates of fission product release to the environment from the site during the entire period of the DBAs as a function of time.

d. The staff reviews the fission product transport and removal models between the major structures and systems, as well as the engineered safety feature (ESF) components of the facility, that bear significantly on the acceptability of the site with respect to the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1). The staff reviews the efficiencies of fission product removal by the ESF systems and components.

e. The staff reviews the points of fission product release from the major structures and systems, and from the ESF components of the facility.

f. In accordance with the guidelines provided in Section 2.3.4 of this review standard, the staff reviews the site-specific χ/Q values determined by the applicant and provided in the applicant's ESP site safety assessment, and the staff performs an independent evaluation.

g. The staff performs an independent confirmatory radiological consequence analysis using pertinent information in the applicant's site safety assessment to determine whether the proposed site meets the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1).

h. The calculated doses from all postulated fission product release pathways from the site are combined, and the calculated doses are compared with the radiological consequence evaluation factors identified in 10 CFR Part 50.34(a)(1) at the nearest EAB and LPZ outer boundary stated in the applicant's site safety assessment.

i. For the methodology and assumptions for calculating the radiological consequences, the staff will use the regulatory positions stated in Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," and NUREG-800, Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms."

IV. EVALUATION FINDINGS

A conclusion of the following type for the radiological consequence analyses will be included in Section 15 of the site safety evaluation:

1. ESP application that references a standard reactor design certified by NRC

As set forth above, the staff has reviewed the site-specific atmospheric dispersion (χ/Q) values at the exclusion area boundary (EAB) and at the boundary of the low population zone (LPZ) for the proposed site in the early site permit (ESP) application and has verified that they are within the design reference set of χ/Q values specified in the [name of certified reactor design] design control document.

[or:] As set forth above, the staff has reviewed the site-specific χ/Q values at the EAB and at the boundary of the LPZ for the proposed site in the ESP application and found that they exceed the design reference set of χ/Q values specified in the [name of certified reactor design] design control document. However, the staff has verified that the applicant has demonstrated that the radiological consequences associated with the bounding DBAs using its site-specific χ/Q values meet the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1).

Therefore, the staff concludes that the distance to the EAB and to the LPZ boundary of the (name) site, in conjunction with the engineered safety features as described in the (name) certified standard design, are sufficient to provide reasonable assurance that the total radiological consequences of the design

basis accidents considered in the (name) certified design will be within the radiological consequence evaluation factors of 10 CFR 50.34(a)(1).

2. ESP application that uses the PPE approach

As set forth above, the applicant submitted its radiological consequence analyses using the site-specific χ/Q values and the plant parameter envelope (PPE) source term values and concluded that the proposed site meets the radiological consequence evaluation factors identified in Section 50.34(a)(1). The results of the applicant's radiological consequence dose calculation are provided in Table [ ], and the PPE values and the site-specific χ/Q values used by the applicant and the staff are listed in Tables [ ] through [ ].

The staff reviewed the radiological consequence analyses submitted by the applicant and finds that the PPE values that are inputs to these analyses are not unreasonable based on information provided by the applicant, on the staff's experience in evaluating similar parameters, and where deemed necessary, on the staff's confirmatory investigation and evaluation.

To verify the applicant's radiological consequence analyses, the staff performed its confirmatory radiological consequence dose calculation using the site-specific χ/Q values and the PPE source term values provided by the applicant, and the staff finds that its results are within the radiological consequence evaluation factors identified in Section 50.34(a)(1). Although the staff performed its independent radiological consequence dose calculation as a means of confirming the applicant's results, the staff's approval of the ESP is based on the applicant's analyses.

Therefore, the staff concludes that the distances to the EAB and the LPZ outer boundary of the [name] site, in conjunction with the source term and the fission product release rates from the site to the environment provided by the applicant, are sufficient to provide reasonable assurance that the total radiological consequences of the design basis accidents will be within the dose evaluation factors set forth at 10 CFR 50.34(a)(1). This conclusion is subject to confirmation at the combined license (COL) stage that the relevant design parameters specified by the applicant in the COL application are bounded by the applicant's PPE submitted with the ESP application.

3. ESP application that neither references a standard reactor design certified by NRC nor uses the PPE approach

As set forth above, the applicant has selected and analyzed the bounding design basis accidents and has determined that the total radiological consequence of such accidents meets the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1). The results of the applicant's radiological consequence dose calculation are provided in Table [ ].

The staff reviewed the radiological consequence analyses provided by the applicant and has performed an independent analysis of the radiological

consequences of each design basis accident considered in the application using the site-specific χ/Q values at the EAB and LPZ proposed in the ESP application. The staff finds that its results are also within the radiological consequence evaluation factors identified in 10 CFR 50.34(a)(1). Although the staff performed its independent radiological consequence dose calculation as a means of confirming the licensee's results, the staff's approval of the ESP is based on the applicant's analyses. Details of the staff's analyses are presented in Section [ ] of this safety evaluation report, and the results are listed in Table [ ].

Therefore, the staff concludes that the distances to the EAB and the LPZ outer boundary of the [name] site, in conjunction with the source term and the fission product release rates from the site to the environment provided by the applicant, are sufficient to provide reasonable assurance that the total radiological consequences of the design basis accidents will be within the dose evaluation factors set forth at 10 CFR 50.34(a)(1). This conclusion is based on the staff review of the applicant's analysis and on the staff's independent analysis, which confirms that the calculated total doses are within the dose evaluation factors set forth at 10 CFR 50.34(a)(1).

V. IMPLEMENTATION

The following provides guidance to applicants regarding the staff's plans for using this review standard section.

This review standard will be used by the staff when performing site safety evaluation of early site permit applications submitted by the applicants pursuant to 10 CFR Part 52.

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

VI. REFERENCES

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

3. Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (July 2000).

4. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms" (July 2000).

RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

17.1.1 EARLY SITE PERMIT QUALITY ASSURANCE MEASURES

REVIEW RESPONSIBILITIES

Primary - Emergency Preparedness and Plant Support Branch (IEPB)

Secondary - Mechanical and Civil Engineering Branch (EMEB)
Probabilistic Safety Assessment Branch (SPSB)

I. AREAS OF REVIEW

The IEPB reviews and evaluates the description of the quality assurance (QA) measures of each early site permit (ESP) applicant in accordance with the applicable portions of this guidance. To support this review, inspections of QA measures are also conducted. As requested by IEPB, the secondary review branches will review the scope of ESP activities within their area of responsibility and determine if the applicant has included within the scope of the QA measures activities that would affect the capability of systems, structures, and components (SSCs) important to safety that would be constructed at the site. The EMEB will determine the appropriateness of site exploration and laboratory tests, if any, in accordance with applicable regulatory guides, and will provide input to the safety evaluation, if needed.

Regulatory Basis

Under 10 CFR 52.18, "Standard for Review of Applications," the staff reviews ESP applications in accordance with the applicable regulations of 10 CFR Part 50 and its appendices and Part 100 as they apply to construction permits. The current regulations do not require implementation of a QA program compliant with Appendix B to 10 CFR Part 50. However, the applicant is expected to implement quality assurance measures equivalent in substance to the measures described in Appendix B to 10 CFR Part 50 to provide reasonable assurance that information derived from ESP activities that would be used in design and/or construction of SSCs important to safety would support satisfactory performance of such SSCs in service.

In accordance with 10 CFR 52.79(a)(1), if an application for a combined license (COL) references an ESP, it must contain information sufficient to demonstrate that the design of the facility falls within the site characteristics specified in the ESP. If the COL applicant references a certified design and an ESP, and does not request a variance from the ESP in accordance with 10 CFR 52.39(b), the applicant must show that the site parameters postulated for the certified design fall within the parameters specified in the ESP. If the COL applicant submits a custom design (one not certified) or has requested a variance, the site characteristics specified in the ESP could be inputs to that design. In either case, there must be reasonable assurance of the reliability and integrity of data contained in or supporting the ESP application, which in turn supports the COL application. Therefore, QA measures are needed whether an ESP is coupled with a certified or custom design. For consistency with Appendix B to 10 CFR Part 50,

this guidance is written in terms of information that would affect the design of SSCs important to safety that might be constructed on the proposed site.

“Equivalent in substance" to Appendix B to 10 CFR Part 50, means that the applicant's QA measures should provide reasonable assurance of integrity and reliability of data that would affect design or construction of SSCs important to safety. Appendix B defines a substantive and procedural framework of measures that collectively help provide such assurance, and that framework has been proven through many years of safe nuclear power plant operation. This section of RS-002 describes a QA control framework that the staff considers to be equivalent in substance to 10 CFR Part 50, Appendix B. The staff will not base a regulatory finding on the ESP application solely on the equivalence of the applicant’s QA measures to 10 CFR Part 50, Appendix B measures. While these criteria closely parallel those of Appendix B to 10 CFR Part 50 and some are identical, the staff does not intend to focus on strict adherence to Appendix B. Rather, staff findings will be based on whether or not the applicant has provided adequate measures to provide reasonable assurance of the integrity and reliability of data that supports the site safety assessment and would be used as input in design or construction of SSCs important to safety. Therefore, any deviations of the applicant’s QA measures from this guidance will be evaluated for their effect on the integrity and reliability of data supporting the ESP application.

Quality assurance criteria are applicable to those ESP activities that are directly related to the pedigree or genesis of SSCs important to safety. For example, activities involved in data collection, analysis, and evaluation for soil composition, geology, hydrology, meteorology, and seismology determinations should be controlled at an equivalent level of quality to that provided by the measures described in Appendix B to 10 CFR Part 50, to the extent such activities would affect SSCs important to safety. Further, some information is derived from recognized authorities (such as the Census Bureau or the National Oceanic and Atmospheric Administration). Evaluations and analyses that use such information and would affect the design or construction of SSCs important to safety should be subjected to quality measures comparable to the measures described in Appendix B to 10 CFR Part 50. Processes for maintaining data integrity, traceability, document control, and record storage for this information should also be subjected to quality measures comparable to the measures described in Appendix B to 10 CFR Part 50.

The site safety assessment establishes information, such as analyses and data, that is material to the reliable performance of SSCs important to safety and would be used in the design, construction, and operation of reactor systems that might be constructed on the proposed site. The regulations at 10 CFR 52.39 provide for finality of determinations made at the ESP stage, in that matters resolved in the ESP proceeding remain resolved at the COL stage, except under certain limited conditions specified in the regulations. Therefore, the staff plans to evaluate quality measures for activities associated with generation of this design-related information to ensure the measures are adequate to provide reasonable assurance of the integrity and reliability of the information, using the criterion that these measures be equivalent in substance to Appendix B to 10 CFR Part 50.

Pre-Docketing

The IEPB staff should plan to meet with the applicant prior to tendering of the application (preferably prior to commencement of significant site characterization activities) to discuss what constitutes acceptable QA measures for ESP activities.

IEPB may also conduct a pre-docketing inspection of the applicant's QA measures to facilitate this review. Although there is no regulatory requirement for a pre-docketing review of an applicant's quality control processes, this review is likely to be beneficial to both the staff and the applicant in that it facilitates early identification of issues and supports timely completion of the ESP application review. The decision to perform this inspection will be made by IEPB on a case-by-case basis with agreement by the potential applicant. Since the pre-docketing review places particular emphasis on ongoing ESP activities, the inspection should be conducted during a period of significant site exploration and characterization activities.

Post-Docketing of ESP Application

The IEPB post-docketing review covers QA measures to be applied by the applicant and principal contractors to activities that may affect the capability of SSCs important to safety to perform adequately in service. This review and associated inspection are performed shortly after tendering of an ESP application to determine that satisfactory QA measures have been established and implemented. The scope of this review includes determination of the equivalence between the applicant's QA measures and the corresponding criteria of Appendix B to 10 CFR Part 50. The applicant's implemented quality measures should provide reasonable assurance of the integrity and reliability of data that support the site safety assessment and would be used as input to design or construction of SSCs important to safety.

The following areas should be reviewed, from the perspective that they are indicators of the effectiveness of quality assurance measures. As stated in Subsection IV, the staff's findings will be based on judgments about the effectiveness of the QA measures. The applicant may choose to use different methods of ensuring quality from those described below. In such cases, the NRC staff will evaluate the applicant's measures to ensure they are adequate to provide reasonable assurance of the integrity and reliability of the data that support the site safety assessment and would be used as input in design or construction of SSCs important to safety, with the expectation that they be equivalent in substance to those stated below.

It is possible that not all QA measures described below will be applicable to a given ESP application, depending on the applicant's organization, as well as the type and extent of ESP-related activities. The staff will make a determination of which QA measures are applicable on an application-specific basis.

1. ORGANIZATION

   A. Organizational description and charts of the lines, interrelationships, and areas of responsibility and authority for all organizations performing quality-related activities, including the applicant's organization and principal contractors, are provided.

B. Organizational location of QA organization, degree of independence from the organization performing ESP activities, and authority of the individuals assigned the responsibility for performing QA functions, are described.

C. Organizational provisions exist for ensuring the proper implementation of QA measures.

2. QUALITY ASSURANCE PROGRAM

A. Scope of the QA measures is adequate to ensure that appropriate quality controls are applied to all site characterization data that relate to the design and analysis of SSCs important to safety that might be constructed on the proposed site.

B. Provisions exist to ensure proper definition of QA measures.

C. Programmatic provisions exist to ensure proper implementation of QA measures.

D. Provisions exist to ensure adequacy of personnel qualifications.

3. DESIGN CONTROL

A. Scope of QA measures covers ESP activities that would affect design and construction activities for SSCs important to safety that might be constructed on the site.

B. The organizational structure, activity, and responsibility of the positions or groups responsible for design activities important to safety (if any) are defined.

C. Provisions exist to carry out design activities important to safety in a planned, controlled, and orderly manner (if such activities occur at the ESP stage).

D. Provisions exist for interface control between functional units of the applicant's organization.

E. Provisions exist to verify the technical adequacy of design documents (if any) applicable to ESP activities that would affect SSCs important to safety.

F. Provisions exist to control design changes applicable to ESP activities that would affect SSCs important to safety (if any).

4. PROCUREMENT DOCUMENT CONTROL

A. Provisions exist to ensure that applicable technical requirements and QA measures are included or referenced in procurement documents related to ESP activities that would affect SSCs important to safety.

B. Provisions exist for review and approval of procurement documents for ESP activities that would affect SSCs important to safety.

5. INSTRUCTIONS, PROCEDURES, AND DRAWINGS

A. Provisions exist for ensuring that ESP activities that would affect SSCs important to safety are prescribed by and accomplished in accordance with documented instructions, procedures, or drawings.

B. Provisions exist for including quantitative and qualitative acceptance criteria in instructions, procedures, and drawings related to ESP activities that would affect SSCs important to safety.

6. DOCUMENT CONTROL

Provisions exist to ensure that documents related to ESP activities that would affect SSCs important to safety, including changes, are reviewed for adequacy, approved for release by authorized personnel, and distributed and used at the location where the prescribed activity is performed.

7. CONTROL OF PURCHASED MATERIAL, EQUIPMENT, AND SERVICES

A. Provisions exist for the control of purchased material, equipment, and services related to ESP activities that would affect SSCs important to safety; for selection of suppliers; and for assessing the adequacy of quality.

B. Provisions exist to ensure that documented evidence of the conformance to procurement specifications of material and equipment related to ESP activities that would affect SSCs important to safety is available at the site prior to installation or use.

8. IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS

A. Provisions exist to identify and control materials, parts, and components related to ESP activities that would affect SSCs important to safety.

B. Provisions exist to ensure that incorrect or defective items are not used in ESP activities that would affect SSCs important to safety.

9. CONTROL OF SPECIAL PROCESSES

A. Provisions exist to ensure the acceptability of special processes used for ESP activities that would affect SSCs important to safety.

B. Provisions exist to ensure that special processes related to ESP activities that would affect SSCs important to safety are performed by qualified personnel using qualified procedures and equipment.

10. INSPECTION

A. Provisions exist for the inspection of activities affecting the quality of ESP activities that would affect SSCs important to safety, including the items and activities to be covered.

B. Organizational responsibilities and qualifications are established for individuals or groups performing inspections of ESP activities that would affect SSCs important to safety.

C. Provisions exist for inspection personnel to be independent of the performance of the activity being inspected.

11. TEST CONTROL

A. Provisions exist to ensure that tests performed related to ESP activities that would affect SSCs important to safety are appropriately controlled to provide confidence that these SSCs would perform adequately in service.

B. Provisions exist to ensure that prerequisites are provided in written test procedures and test results are documented and evaluated for activities related to ESP activities that would affect SSCs important to safety.

12. CONTROL OF MEASURING AND TEST EQUIPMENT

Provisions exist to ensure that tools, gages, instruments, and other measuring and testing devices are properly identified and controlled, and are calibrated and adjusted at specified intervals.

13. HANDLING, STORAGE, AND SHIPPING

Provisions exist to control handling, storage, shipping, cleaning, and preservation of items related to ESP activities that would affect SSCs important to safety in accordance with work and inspection instructions to prevent damage, loss, and deterioration by environmental conditions such as temperature or humidity.

14. INSPECTION, TEST, AND OPERATING STATUS

Provisions exist to indicate the inspection, test, and operating status of items related to ESP activities that would affect SSCs important to safety in order to prevent inadvertent use or bypassing of inspection and tests.

15. NONCONFORMING MATERIALS, PARTS, OR COMPONENTS

Provisions exist to control the use or disposition of nonconforming materials, parts, or components related to ESP activities that would affect SSCs important to safety.

16. CORRECTIVE ACTION

Provisions exist to ensure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, those provisions should preclude recurrence.

17. QUALITY ASSURANCE RECORDS

Provisions exist for the identification, retention, retrieval, and maintenance of quality records.

18. AUDITS

A. Provisions exist for audits to verify compliance with all aspects of QA measures and to determine the effectiveness of the QA measures.

B. Responsibilities and procedures are provided for conducting, documenting, and reviewing results of audits (including designating management levels to review and assess audit results).

II. ACCEPTANCE CRITERIA

The applicant and its principal contractors should establish QA measures to provide adequate confidence that SSCs important to safety designed and constructed using data and/or analyses derived from ESP activities would perform satisfactorily in service. For example, activities involved with data collection, as well as analysis and evaluation of site characteristics (such as geology, hydrology, and seismology) should be subjected to adequate quality measures. The applicant is expected to demonstrate that quality measures equivalent in substance to 10 CFR Part 50, Appendix B have been implemented. The applicant is also expected to demonstrate that these measures provide reasonable assurance of the integrity and reliability of data that support the site safety assessment and that would be used as input to design or construction of SSCs important to safety. The acceptance criteria used to evaluate the QA measures are listed in the following 18 subsections. The IEPB review allows flexibility in defining methods and measures that are equivalent in substance to the pertinent Appendix B criteria.

“Equivalent in substance" to 10 CFR Part 50, Appendix B means that the applicant's QA measures should provide reasonable assurance of integrity and reliability of data that would affect design or construction of SSCs important to safety that might be constructed on the proposed site. Appendix B to 10 CFR Part 50 defines a substantive and procedural framework of measures that helps provide such assurance, and that framework has been proven through many years of safe nuclear power plant operation. This Section of RS-002 describes a QA control framework that the staff considers to be equivalent in substance to 10 CFR Part 50, Appendix B. The staff will not base a regulatory finding on the ESP application on the equivalence of the applicant’s QA measures to 10 CFR Part 50, Appendix B. Rather, staff findings will be based on whether or not the applicant has provided adequate measures to provide reasonable assurance of the integrity and reliability of data that supports the site safety assessment and would be used as input in design or construction of SSCs important to safety. Therefore, any deviations of the applicant’s QA measures from this guidance will be evaluated for their effect on the integrity and reliability of data supporting the ESP application.

The Organization (17.1.1.1) elements responsible for QA measures are acceptable if:

1A1.[1] The responsibility for QA measures is retained and exercised by the applicant.

1A2. The applicant has identified and described major delegation of work involved in establishing and implementing QA measures, or any part thereof, to other organizations.

1A3. Clear management measures and effective lines of communication exist for QA activities among the applicant and the principal contractors.

1A4. Organization charts clearly identify all the "onsite" and "offsite" organizational elements which function under the cognizance of the applicable QA measures (such as design, engineering, procurement, manufacturing, construction, inspection, testing, instrumentation and control, nuclear engineering), the lines of responsibility, and a description of the criteria for determining the size of the QA organization, including the inspection staff.

1A5. The applicant and its principal contractors describe the QA responsibilities of each of the organizational elements noted on the organization charts.

1B1. The applicant and its principal contractors identify a management position that retains overall authority and responsibility for QA measures, and this position has the following characteristics:

a. Has the organizational freedom and authority to report to a management level that assures organizational freedom and authority.

b. Has effective communication channels with other senior management positions.

1B2. Persons and organizations performing QA functions have direct access to management levels which will ensure the ability to:

a. Identify quality problems.

b. Initiate, recommend, or provide solutions through designated channels.

c. Verify implementation of solutions.

Those persons and organizations with the above authority are identified and a description of how those actions are carried out is provided.

1B3. Designated QA personnel, sufficiently free from direct pressures for cost/schedule, have the responsibility delineated in writing to identify quality problems; initiate, recommend, or provide solutions; and verify implementation of solutions.

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[1] The alphanumeric designation for each acceptance criterion in subsection II indicates its relationship to areas of review identified in subsection I.

1B4. Provisions are established for the resolution of disputes involving quality, arising from a difference of opinion between QA personnel and other department personnel.

1B5. Designated QA individuals are involved in site activities important to safety, and there is adequate QA coverage relative to procedural and inspection measures, acceptance criteria, and QA staffing and qualification of personnel to carry out QA assignments.

1C1. Policies regarding the implementation of the QA measures are documented and followed.

1C2. The position description (see 1B1) ensures that the individual with direct overall responsibility for the definition, direction, and effectiveness of QA measures has sufficient authority to effectively implement responsibilities.

Activities related to Quality Assurance (17.1.1.2) are acceptable if:

2A1. The scope of the QA measures includes:

a. A commitment that activities affecting SSCs important to safety will be subject to the applicable QA measures.

b. A commitment that the development, control, and use of computer code programs related to ESP activities that would affect SSCs important to safety will be conducted in accordance with QA measures, and a description of how the QA measures will be applied.

c. A commitment that appropriate equipment, environmental conditions, skills, or processes will be provided as necessary for ESP activities that would affect SSCs important to safety.

2B1. a. Provisions are established to ensure that procedures needed to implement QA measures are properly documented, controlled, and followed as set forth in a policy statement or equivalent document signed by the responsible official.

b. The QA organization reviews and documents concurrence with procedures necessary to implement QA measures.

c. The procedures used by principal contractors to implement QA measures should be provided for the applicant's review with documented agreement of acceptance prior to initiation of activities affected by the measures.

2B2. Changes to QA measures will be evaluated to ensure that changes have not degraded the previously approved quality assurance measures.

2B3. The QA organization and the necessary technical organizations participate early in the QA measures definition stage to determine and identify the extent QA measures are to be applied to specific activities or SSCs.

2B4. Existing or proposed QA procedures are identified reflecting how 10 CFR Part 50, Appendix B criteria (or criteria equivalent in substance) will be implemented through documented procedures.

2C1. A description is provided of how management (above or outside the QA organization) regularly assesses the scope, status, and adequacy of the QA measures. These measures should include:

a. Frequent contact with QA measures status through reports, meetings, and/or audits.

b. Performance of regular preplanned and documented assessments. Corrective action is identified and tracked.

2C2. Quality-related activities (such as design, procurement, and site investigation related to ESP activities that would affect SSCs important to safety) initiated prior to docketing are controlled under QA measures in accordance with guidance in this section of this review standard. Approved procedures and a sufficient number of trained personnel should be available to implement applicable QA measures prior to the initiation of quality-related activities.

2D. Indoctrination, training, and qualification programs are established such that:

a. Personnel responsible for performing activities related to quality are instructed as to the purpose, scope, and implementation of the associated manuals, instructions, and procedures.

b. Personnel verifying activities affecting quality are trained and qualified in the principles, techniques, and requirements of the activity being performed.

c. Proficiency of personnel performing and verifying activities affecting quality is maintained by retraining, reexamining, and/or recertifying as determined by management or program commitment.

Activities related to Design Control (17.1.1.3) are acceptable if:

3A. The scope of the design control program related to ESP activities that would affect SSCs important to safety includes design activities associated with the preparation and review of design documents, including the correct translation of applicable regulatory requirements and design bases into design, procurement, and procedural documents.

3B. Organizational responsibilities are described for preparing, reviewing, approving, and verifying design documents such as system descriptions, design input and criteria, design drawings, design analyses, computer programs, specifications, and procedures, if any, that are related to ESP activities that would affect SSCs important to safety.

3C1. Errors and deficiencies in approved design documents, including design methods (such as computer codes), that would adversely affect SSCs important to safety are documented; and action is taken to ensure that all errors and deficiencies are corrected.

3C2. Deviations from specified quality standards are identified and procedures are established to ensure their control.

3D. Internal and external design interface measures, procedures, and lines of communication among participating design organizations and across technical disciplines are established and described for the review, approval, release, distribution, and revision of documents involving design interfaces, if any, related to ESP activities that would affect SSCs important to safety.

3E1. Procedures are established and described providing for a documented check to verify the dimensional accuracy and completeness of design drawing and specifications, if any, related to ESP activities that would affect SSCs important to safety.

3E2. Procedures are established and described providing that design drawings and specifications related to ESP design activities (if any) that would affect SSCs important to safety be reviewed by the QA organization to ensure that the documents are prepared, reviewed, and approved in accordance with procedures and that the documents contain the necessary quality assurance provisions such as inspection and test criteria, acceptance criteria, and the extent of documenting inspection and test results.

3E3. Guidelines or criteria are established and described for determining the method of design verification (design review, alternate calculations, or tests) for ESP design activities (if any) that would affect SSCs important to safety.

3E4. Procedures are established and described for design verification activities (related to ESP activities that would affect SSCs important to safety, (if any) which ensure the following:

a. The verifier is qualified and is not directly responsible for the design (i.e., the verifier is neither the performer nor the immediate supervisor of the performer).

b. The responsibilities of the verifier, the areas and features to be verified, the pertinent considerations to be verified, and the extent of documentation are identified in procedures.

3E5. Verification by test is performed under conditions that simulate the most adverse design conditions as determined by analysis.

3E6. Procedures are established to ensure that verified computer codes are certified for use and that their use is specified for ESP activities that would affect SSCs important to safety.

3F1. Design and specification changes, if any, related to ESP activities that would affect SSCs important to safety, including fields changes, are subject to the same design measures that were applicable to the original design.

Activities related to Procurement Document Control (17.1.1.4) are acceptable if:

4A1. Procedures are established for the review of procurement documents related to ESP activities that would affect SSCs important to safety to determine that quality standards are correctly stated, inspectable, and controllable; there are adequate acceptance and rejection criteria; and procurement documents have been prepared, reviewed, and approved in accordance with QA measures. To the extent necessary, procurement documents related to ESP activities that would affect SSCs important to safety should provide that contractors and subcontractors establish an acceptable quality assurance plan.

4A2. Procedures are established to ensure that procurement documents related to ESP activities that would affect SSCs important to safety identify applicable regulatory, technical, administrative, and reporting guidelines; drawings; specifications; codes and industrial standards; test and inspection standards; and special process instructions with which suppliers should conform.

4B1. Organizational responsibilities are described for (a) procurement planning; (b) the preparation, review, approval, and control of procurement documents; (c) supplier selection; (d) bid evaluations; and (e) review and concurrence of supplier QA programs prior to initiation of activities affected by QA measures. The involvement of the QA organization is described.

Activities related to Instructions, Procedures, and Drawings (17.1.1.5) are acceptable if:

5A. Organizational responsibilities are described for ensuring that ESP activities that would affect SSCs important to safety are (a) prescribed by documented instructions, procedures, and drawings and (b) accomplished through implementation of these documents.

5B. Procedures are established to ensure that instructions, procedures, and drawings related to ESP activities that would affect SSCs important to safety include quantitative acceptance criteria (such as dimensions, tolerances, and limits) and qualitative acceptance criteria (such as workmanship samples) for determining that important activities have been satisfactorily accomplished.

Activities related to Document Control (17.1.1.6) are acceptable if:

6A1. The scope of the document control program for ESP activities that would affect SSCs important to safety is described, and the types of controlled documents are identified. Controlled documents may include:

a. Design documents (e.g., calculations, drawings, specifications, analyses), including documents related to computer codes.

b. Procurement documents.

c. Instructions and procedures for such activities as fabrication, construction, modification, installation, testing, and inspection.

d. Quality assurance and quality control manuals and quality affecting procedures.

e. Nonconformance reports.

6A2. Procedures for the review, approval, and issuance of documents related to ESP activities that would affect SSCs important to safety and changes thereto are established and described to ensure technical adequacy and inclusion of appropriate quality standards prior to implementation. The QA organization, or an individual other than the person who generated the document but who is qualified in quality assurance, reviews and concurs with these documents with regard to their QA-related aspects.

6A3. Procedures are established to ensure that changes to documents related to ESP activities that would affect SSCs important to safety are reviewed and approved by the same organizations that performed the initial review and approval or by other qualified responsible organizations to which the applicant has delegated review and approval authority.

6A4. Procedures are established to ensure that documents related to ESP activities that would affect SSCs important to safety are available at the location where the activity will be performed before the work begins.

6B1. Procedures are established and described to ensure that obsolete or superseded documents related to ESP activities that would affect SSCs important to safety are removed from work areas and replaced by applicable revisions in a timely manner.

Activities related to Control of Purchased Material, Equipment, and Services (17.1.1.7) are acceptable if:

7A1. Organizational responsibilities are described for the control of purchased material, equipment, and services related to ESP activities that would affect SSCs important to safety, including interfaces between design, procurement, and QA organizations.

7A2. Verification of suppliers' activities during fabrication, inspection, testing, and shipment of materials, equipment, and components related to ESP activities that would affect SSCs important to safety is planned and performed with QA organization participation in accordance with written procedures to ensure conformance to the purchase order specifications. These procedures, as applicable to the method of procurement, provide for:

a. Specifying the characteristics or processes to be witnessed, inspected or verified, and accepted; the method of surveillance and the extent of documentation provided; and those responsible for implementing these procedures.

b. Audits, surveillance, or inspections to ensure that the supplier complies with the quality standards.

7A3. The selection of suppliers for ESP activities that would affect SSCs important to safety is documented and filed.

7A4. Procurement of parts related to ESP activities that would affect SSCs important to safety is subject to present QA measures, to codes and standards, and to technical criteria specified by the applicant's procurement documents.

7B1. A receiving inspection of incoming material associated with ESP activities that would affect SSCs important to safety is performed to ensure:

a. The material, component, or equipment is properly identified and corresponds to the identification on the purchase document and the receiving documentation.

b. Material, components, equipment, and acceptance records satisfy the inspection instructions prior to installation or use.

c. Specified inspection, test, and other records (such as certificates of conformance attesting that the material, components, and equipment conform to specified standards) are available at the site prior to installation or use.

7B2. Items related to ESP activities that would affect SSCs important to safety that are accepted and released are identified as to their inspection status prior to forwarding them to a controlled storage area or releasing them for installation or further work.

7B3. The supplier for items related to ESP activities that would affect SSCs important to safety furnishes the following records to the purchaser:

a. Documentation that identifies the purchased item and the specific procurement specifications (e.g., codes and standards) met by the item.

b. Documentation identifying any procurement specifications that have not been met.

c. A description of those nonconformances with the procurement specifications dispositioned "accept as is" or "repair."

The review and acceptance of these documents should be described in the purchaser's description of its QA measures.

7B4. Suppliers' certificates of conformance for activities that would affect SSCs important to safety are periodically evaluated by audits, independent inspections, or tests to ensure they are valid and the results documented.

Activities related to Identification and Control of Materials, Parts, and Components (17.1.1.8) are acceptable if:

8A. Measures are established and described to identify and control materials (including consumables), parts, and components, including partially fabricated subassemblies, if any, that are related to ESP activities that would affect SSCs important to safety. The description should include organizational responsibilities.

8B. Procedures are established to ensure that identification of items related to ESP activities that would affect SSCs important to safety is maintained either on the item or on records traceable to the item to preclude use of incorrect or defective items.

Activities related to Control of Special Processes (17.1.1.9) are acceptable if:

9A1. The criteria for determining those processes that are controlled as special processes are described.

9A2. Organizational responsibilities, including those for the QA organization, are described for qualification of special processes, equipment, and personnel related to ESP activities that would affect SSCs important to safety.

9B1. Procedures, equipment, and personnel associated with special processes related to ESP activities that would affect SSCs important to safety are qualified and are in conformance with applicable codes, standards, QA procedures, and specifications. The QA organization is involved in the qualification activities to ensure they are satisfactorily performed.

9B2. Procedures are established for recording evidence of acceptable accomplishment of special processes related to ESP activities that would affect SSCs important to safety using qualified procedures, equipment, and personnel.

9B3. Qualification records of procedures, equipment, and personnel associated with special processes related to ESP activities that would affect SSCs important to safety are established, filed, and kept current.

Activities related to Inspection (17.1.1.10) are acceptable if:

10A. The scope of the inspection program described indicates that an effective inspection program has been established for ESP activities that would affect SSCs important to safety. Program procedures provide criteria for determining the accuracy criteria for inspection equipment and criteria for determining when inspections are necessary, or defining how and when inspections are performed. The QA organization participates in the above functions.

10B1. Organizational responsibilities for inspection of ESP activities that would affect SSCs important to safety are described. Individuals performing inspections are other than those who performed or directly supervised the activity being inspected and do not report directly to the immediate supervisors who are responsible for the activity being inspected. If the individuals performing inspections are not part of the QA organization, the inspection procedures, personnel qualification criteria, and independence from undue pressure such as cost and schedule constraints should be reviewed and found acceptable by the QA organization prior to the initiation of the activity.

10B2. A qualification program for inspectors of ESP activities that would affect SSCs important to safety is established and documented, and the qualifications and certifications of inspectors are kept current.

10C1. Inspection procedures, instructions, or checklists related to ESP activities that would affect SSCs important to safety provide for the following:

a. Identification of characteristics and activities to be inspected.

b. A description of the method of inspection.

c. Identification of the individuals or groups responsible for performing the inspection operation in accordance with the provisions of item 10B1.

d. Acceptance and rejection criteria.

e. Identification of needed procedures, drawings, and specifications and revisions.

f. Recording inspector or data recorder and the results of the inspection.

g. Specifying necessary measuring and test equipment, including accuracy criteria.

10C2. Procedures are established and described to identify, in pertinent documents related to ESP activities that would affect SSCs important to safety, inspection hold-points beyond which work would not proceed until inspected by a designated inspector.

10C3. Inspection results related to ESP activities that would affect SSCs important to safety are documented and evaluated, and their acceptability is determined by a responsible individual or group.

Activities related to Test Control (17.1.1.11) are acceptable if:

11A1. The description of the scope of the test control program indicates that tests related to ESP activities that would affect SSCs important to safety are appropriately controlled to provide confidence that SSCs important to safety that might be constructed on the proposed site would perform adequately in service. Program procedures provide standards for ensuring the accuracy of test equipment and for determining when a test is needed or how and when testing activities are performed.

11B1. Test procedures or instructions for ESP activities that would affect SSCs important to safety provide, as needed, for the following:

a. The standards and acceptance criteria contained in applicable design and procurement documents.

b. Instructions for performing the test.

c. Test prerequisites such as calibrated instrumentation; adequate test equipment and instrumentation, including their accuracy criteria; suitable and controlled environmental conditions; and provisions for data collection and storage.

d. Inspection hold-points for witness by owner, contractor, or inspector (as needed).

e. Acceptance and rejection criteria.

f. Methods of documenting or recording test data and results.

g. Provisions for ensuring test prerequisites have been met.

11C1. Test results are documented and evaluated, and their acceptability is determined by a responsible individual or group.

Activities related to Control of Measuring and Test Equipment (17.1.1.12) are acceptable if:

12.1 The scope of the program for the control of measuring and test equipment related to ESP activities that would affect SSCs important to safety is described and the types of equipment to be controlled are established. This information indicates an effective calibration program has been established.

12.2 QA and other organizations' responsibilities are described for establishing, implementing, and ensuring effectiveness of the calibration program related to ESP activities that would affect SSCs important to safety.

12.3 Procedures are established and described for calibration (technique and frequency), maintenance, and control of the measuring and test equipment (instruments, tools, gages, fixtures, reference and transfer standards, and nondestructive test equipment) that is used in the measurement, inspection, and monitoring of ESP activities that would affect SSCs important to safety. The review of and documented concurrence in these procedures is described and the organization responsible for these functions is identified.

12.4 Measuring and test equipment related to ESP activities that would affect SSCs important to safety is identified and traceable to the calibration test data.

12.5 Measuring and test equipment related to ESP activities that would affect SSCs important to safety is labeled or tagged or otherwise controlled to indicate the due date of the next calibration. The method of control should be described.

12.6 Measuring and test equipment related to ESP activities that would affect SSCs important to safety is calibrated at specified intervals based on the needed accuracy, purpose, degree of usage, stability characteristics, and other conditions affecting the measurement.

12.7 Reference and transfer standards related to ESP activities that would affect SSCs important to safety should be traceable to nationally recognized standards; where national standards do not exist, provisions are established to document the basis for calibration.

12.8 Measures should be taken and documented to determine the validity of previous inspections of ESP activities that would affect SSCs important to safety and the acceptability of items inspected or tested since the last calibration when measuring and

test equipment is found to be out of calibration. Inspections or tests are repeated on items that may not be reliable.

Activities related to Handling, Storage, and Shipping (17.1.1.13) are acceptable if:

13.1 Special handling, preservation, storage, cleaning, packaging, and shipping specifications for ESP activities that would affect SSCs important to safety are established and accomplished in accordance with predetermined work and inspection instructions.

13.2 Procedures are established and described to control the cleaning, handling, storage, packaging, and shipping of materials, components, and systems related to ESP activities that would affect SSCs important to safety in accordance with design and procurement requirements to preclude damage, loss, or deterioration by environmental conditions such as temperature or humidity.

Activities related to Inspection, Test, and Operating Status (17.1.1.14) are acceptable if:

14.1 Procedures are established to indicate the inspection, test, and operating status of equipment used to establish information that would be used to design and construct SSCs important to safety.

14.2 Procedures are established and described to control the application and removal of inspection and welding stamps and status indicators such as tags, markings, labels, and stamps, as appropriate, related to ESP activities that would affect SSCs important to safety.

14.3 Procedures are established and described to control altering the sequence of specified tests, inspections, and other operations related to ESP activities that would affect SSCs important to safety. Sequence alterations should be subject to the same measures as the original review and approval.

14.4 The status of nonconforming, inoperative, or malfunctioning equipment used to establish information that would be used to design and construct SSCs is documented and identified to prevent inadvertent use. The organization responsible for this function is identified.

Activities related to Nonconforming Materials, Parts, or Components (17.1.1.15) are acceptable if:

15.1 For ESP activities that would affect SSCs important to safety, procedures are established and described for identification, documentation, segregation, review, disposition, and notification to affected organizations of nonconforming materials, parts, components, and as applicable to services (including computer codes) if disposition is other than to scrap. The procedures provide identification of authorized individuals for independent review of nonconformances, including disposition and closeout.

15.2 QA and other organizational responsibilities are described for the definition and implementation of activities related to nonconformance control for ESP activities that

would affect SSCs important to safety. This includes identifying those individuals or groups with authority for the disposition of nonconforming items.

15.3 Documentation identifies the nonconforming item; describes the nonconformance, the disposition of the nonconformance, and the inspection standards; and includes signature approval of the disposition.

15.4 Reworked, repaired, and replacement items related to ESP activities that would affect SSCs important to safety are inspected and tested in accordance with the original inspection and test standards or acceptable alternatives.

15.5 Nonconformance reports related to ESP activities that would affect SSCs important to safety are periodically analyzed by the QA organization to show quality trends, and the significant results are reported to upper management for review and assessment.

Activities related to Corrective Action (17.1.1.16) are acceptable if:

16.1 Procedures are established and described indicating that an effective corrective action program for ESP activities that would affect SSCs important to safety has been established. The QA organization reviews and documents concurrence with the procedures.

16.2 Corrective action is documented and initiated following the determination of a condition adverse to quality (such as a nonconformance, failure, malfunction, deficiency, deviation, or defect in material and equipment) for ESP activities that would affect SSCs important to safety to preclude recurrence. The QA organization is involved in the documented concurrence in the adequacy of the corrective action.

16.3 Follow-up action is taken by the QA organization to verify proper implementation of corrective action and to close out the corrective action in a timely manner.

16.4 For significant conditions adverse to quality associated with ESP activities that would affect SSCs important to safety, the cause of the conditions, and the corrective action taken to preclude repetition are documented and reported to immediate management and upper levels of management for review and assessment.

Activities related to Quality Assurance Records (17.1.1.17) are acceptable if:

17.1 The scope of the records program for ESP activities that would affect SSCs important to safety is described. QA records include results of reviews, inspections, tests, audits, and material analyses; monitoring of work performance; qualification of personnel, procedures, and equipment; and other documentation such as drawings, specifications, procurement documents, calibration procedures and reports, nonconformance reports, and corrective action reports.

17.2 QA and other organizations are identified and their responsibilities are described for the definition and implementation of activities related to QA records.

17.3 Inspection and test records related to ESP activities that would affect SSCs important to safety contain the following, where applicable:

a. A description of the type of observation.

b. The date and results of the inspection or test.

c. Information related to conditions adverse to quality.

d. Inspector or data recorder identification.

e. Evidence as to the acceptability of the results.

f. Action taken to resolve any discrepancies noted.

Activities related to Audits (17.1.1.18) are acceptable if:

18A1. Audits to ensure that procedures and activities related to ESP activities that would affect SSCs important to safety conform to overall QA measures are performed by:

a. The QA organization to provide a comprehensive independent verification and evaluation of quality-related procedures and activities.

b. The applicant (and principal contractors) to verify and evaluate QA measures, procedures, and activities of suppliers.

18A2. An audit plan is prepared identifying audits to be performed, their frequencies, and schedules. Audits should be regularly scheduled based upon the status and safety importance of the activities being performed and are initiated early enough to ensure effective QA during ESP activities that would affect SSCs important to safety.

18A3. Audits include an objective evaluation of quality-related practices, procedures, instructions, activities, and items, as well as a review of documents and records to ensure that QA measures are effective and properly implemented.

18A4. Provisions are established providing that audits be performed in all areas related to ESP activities that would affect SSCs important to safety. Areas which may often be neglected but should be included are activities associated with:

a. The determination of site features which would affect plant safety (e.g., core sampling, site and foundation preparation, and methodology).

b. The preparation, review, approval, and control of early procurements.

c. Indoctrination and training programs.

d. Interface control among the applicant and the principal contractors.

e. Corrective action, calibration, and nonconformance control systems.

f. Safety assessment commitments.

g. Activities associated with computer codes.

18B1. Audit data are analyzed by the QA organization, and the resulting reports indicating any quality problems and the effectiveness of the QA measures, including the need for re-audit of deficient areas, are reported to management for review and assessment.

18B2. Audits are performed in accordance with preestablished written procedures or checklists and conducted by trained personnel having no direct responsibilities in the areas being audited.

III. REVIEW PROCEDURES

Each element of the applicable QA measures will be reviewed against the acceptance criteria described in Subsection II. Secondary review branches will assist IEPB in determining that the specified QA measures (or measures equivalent in substance) are applied to all ESP activities that would affect SSCs important to safety. IEPB will process any necessary requests for additional information to the applicant and coordinate the response with the appropriate branches for acceptance. Any exceptions or alternatives to this guidance will be carefully reviewed to ensure that they are clearly defined and that an adequate basis exists for acceptance.

The acceptability of the QA measures is determined by the following review procedures:

1. QA measures are reviewed in detail to determine if each applicable criterion in Subsection II above (or criteria equivalent in substance, if elected by the applicant), has been acceptably addressed.

2. The applicant's measures are evaluated for:

   a. Technical acceptability

   b. Workability (i.e., Do they seem to fit into an overall plan of action that can be implemented?)

   c. Management support (i.e., Do QA measures have adequate review, approval, and endorsement of management?)

   This evaluation is based primarily on the acceptance criteria contained in Subsection II.

3. The duties, responsibility, and authority of personnel performing QA functions are reviewed to ensure they provide sufficient independence to effectively perform these functions.

4. Through review of information provided; through meetings with the applicant; by review of the acceptability of QA measures and site activities, including performance and capability of personnel; and by review of inspection reports, a judgment is made of the

applicant's capability to assure the reliability and integrity of the information supporting the ESP application.

5. Satisfaction of commitments related to QA measures and descriptions of how the commitments will be met, organizational arrangements, and the applicant's capability to implement the QA measures should lead to the conclusion of acceptability, as described in Subsection IV.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that the review is sufficiently complete and adequate to support conclusions of the following type to be included in the staff's safety evaluation report:

> Based on review and evaluation of the quality assurance (QA) measures contained in the safety assessment for [site] as set forth above, the staff concludes that:
>
> 1. The organizations and persons performing QA functions have the independence and authority necessary to effectively carry out QA measures without undue influence from those directly responsible for costs and schedules.
>
> 2. The QA procedures and measures, when properly implemented, are equivalent in substance to the criteria of Appendix B to 10 CFR Part 50 and conform to the guidance in Review Standard (RS)-002, Section 17.1.1.
>
> 3. The QA measures are applied to all ESP activities that establish information material to (1) the design and construction of SSCs important to safety that might be constructed on the proposed site or (2) the establishment of site characteristics for comparison to the values of site parameters postulated in a certified design. The measures provide adequate confidence that information provided in the ESP application and accepted by the NRC is reliable and, when used as input for design or construction of SSCs important to safety, would not adversely impact their ability to perform satisfactorily in service. In addition, use of that information to establish the site characteristics for comparison to the values of site parameters postulated for a certified design is acceptable.

Therefore, the staff concludes that the applicant's QA measures conform to the guidance in RS-002 and appropriate industry standards, and can be implemented for the early site permit.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plan for using guidance in this review standard, Section 17.1.1. Guidance in this section

will be used by the staff when performing safety evaluations of ESP applications submitted by applicants pursuant to 10 CFR Part 52.

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 compliance with Commission regulations.

VI. REFERENCES

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

2. 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

4. NRC Inspection Manual Chapter 2501, "Nuclear Reactor Inspection Program - Early Site Permit."

ATTACHMENT 3

Early Site Permit
Scope and Associated Review Criteria for Environmental Report
Primary Source of Review Guidance: NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants" (1999)

INTRODUCTION

During the development of the Environmental Standard Review Plan (ESRP) (NUREG-1555, issued March 2000), the NRC staff ensured that the ESRP provided guidance for conducting the environmental review of several different licensing actions in a thorough and disciplined manner. These licensing actions include limited work authorizations, construction permits, operating licenses, combined licenses (COLs), and early site permits (ESPs).

In October 2002, the NRC staff conducted an internal ESRP workshop to review the completeness of the ESRP and determine whether it was up-to-date, identify how to use it during the staff's review of the expected ESP applications, and consider the implications to its review of an ESP application employing the plant parameter envelope (PPE) approach[1] instead of a specific nuclear power plant design. At the end of the workshop, the staff concluded that

- The ESRP is sufficiently up-to-date to support the review of the ESP applications.
- It is unnecessary to segregate portions of the ESRP guidance specifically for ESP reviews.
- Certain areas of the ESRP should be clarified.
- The PPE approach can serve as the foundation for an environmental report (ER).
- The robustness of the environmental impact statement (EIS) will depend on the level of detail and analyses provided in the application

This attachment to RS-002 provides guidance to staff reviewers to help ensure that review of any ESP application (PPE-based or otherwise) would be conducted using updated guidance where appropriate.

The ESP application should include sufficient information for the staff to determine what the environmental impacts of constructing and operating nuclear power plant(s) could be. For an ESP application employing the PPE approach, site characteristics, PPE values, and analyses will comprise the ESP bases that will be the focus for comparison during a COL review with the

[1]For an ESP application that employs the PPE approach, the applicant's assessment of the environmental impacts of constructing and operating a nuclear plant(s) will not be based on a specific design. Rather, PPE values will be provided as a surrogate for the design information identified in the ESRP. These PPE values will provide bounding design parameter information for a range of reactor designs, instead of for only one design.

design of the actual plant to be constructed on the site. Site-specific parameters (such as meteorology, demographics, and hydrology) should be provided in any ESP application. However, detailed design information pertaining to structures, systems, and components called for in the ESRP need not be submitted by the applicant in an ESP application employing the PPE approach. If PPE values are used as a surrogate for design-specific values, the ESP applicant need not provide a one-to-one replacement for the design-specific values, but should provide sufficient information for the staff to develop a reasonable independent assessment of potential impacts to specific environmental resources. The design-specific information called for in the ESRP may not exist for applicants using the PPE approach, so the NRC review staff should use their experience and judgment accordingly.

PPE values do not reflect a specific design and are not to be reviewed by the NRC staff for correctness. However, the NRC staff must determine (1) whether the application is sufficient to enable the NRC staff to conduct its required environmental review, and (2) whether the PPE values are not unreasonable for consideration by the staff when making its findings in accordance with Subpart A of 10 CFR Part 52. The staff should use its judgement to determine whether sufficient information has been provided by the applicant in order for the staff to perform its independent assessment of the environmental impacts of constructing and operating nuclear power plant(s). If a reasonable estimate of the impact to a resource cannot be evaluated from the information provided in the environmental report, then the staff may request additional information so that a reasonable estimate can be made.

The ESRP and this attachment to RS-002 provide guidance to NRC staff reviewers to help ensure a thorough, consistent, and disciplined review of any ESP application. The staff's June 23, 2003 responses to comments received on draft RS-002 (ML031710698) provide additional insights on the staff's expectations and potential approach to the review of an application employing the PPE approach. During the review of a COL application referencing an ESP, the staff will assess the environmental impacts of the construction and operation of a specific plant design. If the environmental impacts addressed in the EIS written at the ESP stage are found to be bounding by the staff, no additional analysis of these impacts is required, even if the ESP applicant employed the PPE approach. However, environmental impacts not considered or not bounded at the ESP stage should be assessed at the COL stage. In addition, measures and controls to limit adverse impacts should be identified and evaluated for feasibility and adequacy in limiting adverse impacts at the ESP stage, where possible, and at the COL stage. As a result of the staff's environmental review of the ESP application, the staff may determine that conditions or limitations on the ESP may be necessary in specific areas, as set forth in 10 CFR 52.24. Therefore, the staff should identify in the EIS when and how assumptions and bounding values limit its conclusions on the environmental impacts to a particular resource.

Early Site Permit
Scope and Associated Review Criteria for Environmental Report
Primary Source of Review Guidance: NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants" (1999)

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Primary Review Branch: RLEP				
Introduction to the Environmental Impact Statement	RLEP	None	1.0	
The Proposed Project	RLEP	None	1.1	
Status of Reviews, Approvals, and Consultations	RLEP	None	1.2	
Environmental Description	RLEP	SPSB	2.0	
Station Location	RLEP	SPSB	2.1	
Land	RLEP	SPSB	2.2	
The Site and Vicinity	RLEP	SPSB	2.2.1	
Transmission Corridors and Offsite Areas	RLEP	None	2.2.2	
The Region	RLEP	SPSB	2.2.3	
Water	RLEP	EMEB	2.3	
Hydrology	RLEP	EMEB	2.3.1	Also consider requirements of Section 404 of the Clean Water Act.
Water Use	RLEP	EMEB	2.3.2	Also consider requirements of Section 404 of the Clean Water Act.
Water Quality	RLEP	EMEB	2.3.3	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Ecology	RLEP	None	2.4	
Terrestrial Ecology	RLEP	None	2.4.1	
Aquatic Ecology	RLEP	None	2.4.2	
Socioeconomics	RLEP	SPSB	2.5	
Demography	RLEP	SPSB	2.5.1	For ESP purposes, ignore references to 10 CFR 100.10(b); instead use 10 CFR 100.20(a).
Community Characteristics	RLEP	None	2.5.2	
Historic Properties	RLEP	None	2.5.3	36 CFR 800.8 of the revised National Historic Preservation Act (NHPA) strengthened need for early identification and contact with tribes, the State Historic Preservation Officer and others. To reflect this revision, consider the following additional guidance in conjunction with the review procedures in this section: "Initiate early consultation with any Indian tribe that may attach religious and cultural significance to resources or properties that may be affected by an undertaking."
Environmental Justice	RLEP	SPSB	2.5.4	Office Letter 906 is now Office Instruction LIC-203. For ESP purposes, ignore references to 10 CFR 100.10; instead use 10 CFR 100.20 and 10 CFR 100.21.
Geology	RLEP	EMEB	2.6	
Meteorology and Air Quality	RLEP	SPSB	2.7	
Related Federal Project Activities	RLEP	None	2.8	
Plant Description	RLEP	None	3.0	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
External Appearance and Plant Layout	RLEP	None	3.1	
Reactor Power Conversion System	RLEP	None	3.2	
Plant Water Use	RLEP	EMEB	3.3	
Water Consumption	RLEP	EMEB	3.3.1	
Water Treatment	RLEP	None	3.3.2	
Cooling System	RLEP	None	3.4	
Description and Operational Modes	RLEP	None	3.4.1	
Component Descriptions	RLEP	None	3.4.2	
Radioactive Waste Management System	RLEP	IEPB	3.5	Defer to COL stage unless specific plant design is given.
Nonradioactive Waste Systems	RLEP	None	3.6	
Effluents Containing Chemicals or Biocides	RLEP	None	3.6.1	
Sanitary System Effluents	RLEP	None	3.6.2	
Other Effluents	RLEP	None	3.6.3	Address Solid Waste Disposal Act of 1965.
Power Transmission Systems	RLEP	None	3.7	
Transportation of Radioactive Materials	RLEP	IEPB	3.8	See NRC letter dated July 21, 2003 (ML031540694) for additional guidance concerning evaluation of impacts of transportation of radioactive materials.
Environmental Impacts of Construction	RLEP	None	4.0	
Land Use Impacts	RLEP	SPSB	4.1	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
The Site and Vicinity	RLEP	SPSB	4.1.1	Includes review criteria for review of redress plan (if submitted). See NRC letter dated January 16, 2003 (ML023510553) for additional guidance concerning review of redress plans.
Transmission Corridors and Offsite Areas	RLEP	None	4.1.2	Includes review criteria for review of redress plan (if submitted). See NRC letter dated January 16, 2003 (ML023510553) for additional guidance concerning review of redress plans.
Historic Properties	RLEP	None	4.1.3	
Water-Related Impacts	RLEP	EMEB	4.2	
Hydrologic Alterations	RLEP	EMEB	4.2.1	
Water Use Impacts	RLEP	EMEB	4.2.2	
Ecological Impacts	RLEP	None	4.3	
Terrestrial Ecosystems	RLEP	None	4.3.1	- Section III(2)(a), Page 4.3.1-7, top of page, address the following additional bullets- (1) “the cumulative impacts of construction on terrestrial resources,” (2) “effects of dust on “important” species,” (3) “migration/nesting,” and (4) “nuisance species.” -Page 4.3.1-7, 4th bullet, “vertebrates” should be read as “animals.” -Page 4.3.1-7, last bullet under item (b), “good practice” should be read as “best management practices.”

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Aquatic Ecosystems	RLEP	None	4.3.2	-Page 4.3.2-7, item (b) should be clarified by including “or critical habitat” after “endangered species” and before “evaluating.” -Page 4.3.2-9, address additional issue: “Examine cumulative impacts of construction activities on aquatic resources.” Page 4.3.2-10, address additional item: “Evaluate nuisance species” as part of the bulleted list right before “evaluation findings.”
Socioeconomic Impacts	RLEP	SPSB	4.4	
Physical Impacts	RLEP	None	4.4.1	
Social and Economic Impacts	RLEP	SPSB	4.4.2	
Environmental Justice Impacts	RLEP	SPSB	4.4.3	Office Letter 906 is now Office Instruction LIC-203.
Measures and Controls to Limit Adverse Impacts during Construction	RLEP	None	4.6	
Environmental Impacts of Station Operation	RLEP	None	5.0	
Land Use Impacts	RLEP	SPSB	5.1	
The Site and Vicinity	RLEP	SPSB	5.1.1	
Transmission Corridors and Offsite Areas	RLEP	None	5.1.2	
Historic Properties	RLEP	None	5.1.3	
Water-Related Impacts	RLEP	EMEB	5.2	
Hydrologic Alterations and Plant Water Supply	RLEP	EMEB	5.2.1	
Water Use Impacts	RLEP	EMEB	5.2.2	
Cooling System Impacts	RLEP	None	5.3	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Intake System	RLEP	None	5.3.1	
Hydrodynamic Descriptions and Physical Impacts	RLEP	EMEB	5.3.1.1	Need to address scouring, dredging, turbidity and silt buildup issues. Include consideration of new Environmental Protection Agency (EPA) requirements for intake structures (40 CFR Part 9, §122 through 125 - 66 FR 65256, December 18, 2001).
Aquatic Ecosystems	RLEP	None	5.3.1.2	Page 5.3.1.2-3, "Acceptance Criteria", first line- "construction" should be read as "operational"; address 40 CFR Part 9, §122 through 125 - 66 FR 65256, December 18, 2001 with respect to the design requirements of intake structures. -Page 5.3.1.2-5, item in Section III(1) starting with "Determine whether" should be read as "Determine whether the applicant is in compliance with NPDES-regulations addressing cooling water intake structures for new facilities." -Page 5.3.1.2-6, under item (3) "HIGH, MEDIUM, or LOW" should be read as "LARGE, MODERATE or SMALL." -Page 5.3.1.2-7, the first bullet should be read as "Assess mortality for all entrained biota, considering the following:" Ignore the first bullet under item (7). -Page 5.3.1.2-9, consider additional reference: 40 CFR Part 9, §122 through 125 - 66 FR 65256, December 18, 2001.
Discharge System	RLEP	None	5.3.2	
Thermal Description and Physical Impacts	RLEP	None	5.3.2.1	
Aquatic Ecosystems	RLEP	None	5.3.2.2	
Heat Discharge System	RLEP	None	5.3.3	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Heat Dissipation to the Atmosphere	RLEP	SPSB	5.3.3.1	
Terrestrial Ecosystems	RLEP	None	5.3.3.2	-Page 5.3.3.2-2, under “Data and Information Needs,” also address “cooling tower design information for noise and aesthetics.” -Page 5.3.3.2-4, in the 4th paragraph, 3rd line, “cooling towers” should be read as “elevated structures.” -Page 5.3.3.2-5, also consider impacts to birds from cooling towers and their operation (elevated structures and elevated structure vision obstructed by vapor plume Page 5.3.3.2-6, 5th bullet, “minor” should be read as “small”; 6th bullet, “adverse” should be read as “moderate” in the first line of that bullet; 7th bullet, “adverse” should be read as “large” in the first line of that bullet.
Impacts to Man	RLEP	None	5.3.4	Analysis should include review of microorganisms from heating systems (thermophyllic microorganisms). This analysis can be conducted at the ESP stage with adequate information related to the cooling system (type of heat sink) but it will be important to look for new and significant information for issues like thermophyllic microorganisms at the COL stage.
Environmental Impacts of Waste	RLEP	None	5.5	
Nonradioactive Waste System Impacts	RLEP	None	5.5.1	
Mixed Waste Impacts	RLEP	IEPB	5.5.2	
Transmission System Impacts	RLEP	None	5.6	
Terrestrial Ecosystems	RLEP	None	5.6.1	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Aquatic Ecosystems	RLEP	None	5.6.2	
Impacts to Man	RLEP	None	5.6.3	
Uranium Fuel Cycle Impacts	RLEP	None	5.7	See NRC letter dated July 21, 2003 (ML031540694) for additional guidance concerning evaluation of uranium fuel cycle impacts.
Socioeconomic Impacts	RLEP	SPSB	5.8	
Physical Impacts of Station Operation	RLEP	None	5.8.1	
Social and Economic Impacts of Station Operation	RLEP	SPSB	5.8.2	
Environmental Justice Impacts	RLEP	SPSB	5.8.3	
Decommissioning	RLEP	None	5.9	
Measures and Controls to Limit Adverse Impacts during Operation	RLEP	None	5.10	
Environmental Measurements and Monitoring Programs	RLEP	None	6.0	
Thermal Monitoring	RLEP	None	6.1	
Hydrological Monitoring	RLEP	EMEB	6.3	
Meteorological Monitoring	RLEP	SPSB	6.4	For ESP purposes, ignore references to 10 CFR 100.10(c)(2) and 10 CFR 100.11; instead use 10 CFR 100.20(c)(2) and 10 CFR 100.21.
Ecological Monitoring	RLEP	None	6.5	
Terrestrial Ecology and Land Use	RLEP	None	6.5.1	
Aquatic Ecology	RLEP	None	6.5.2	

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Chemical Monitoring	RLEP	None	6.6	
Summary of Monitoring Programs	RLEP	None	6.7	
Environmental Impacts of Postulated Accidents Involving Radioactive Materials	RLEP	SPSB	7.0	
Severe Accidents	RLEP	SPSB	7.2	See NRC letters dated Feb 12, 2003 (ML030280518) and June 25, 2003 (ML031430282) for additional guidance concerning severe accident impacts analysis.
Transportation Accidents	RLEP	None	7.4	See NRC letter dated July 21, 2003 (ML031540694) for additional guidance concerning evaluation of impacts of transportation of radioactive materials.
Need for Power	RLEP	None	8.0	Need not be included unless applicant seeks approval.
Description of Power System	RLEP	None	8.1	Need not be included unless applicant seeks approval.
Power Demand	RLEP	None	8.2	Need not be included unless applicant seeks approval.
Power and Energy Requirements	RLEP	None	8.2.1	Need not be included unless applicant seeks approval.
Factors Affecting Growth of Demand	RLEP	None	8.2.2	Need not be included unless applicant seeks approval.
Power Supply	RLEP	None	8.3	Need not be included unless applicant seeks approval.
Assessment of Need for Power	RLEP	None	8.4	Need not be included unless applicant seeks approval.

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Alternatives to the Proposed Action	RLEP	None	9.0	Includes unresolved conflicts concerning alternative uses of available resources. See 10 CFR 51.45(b)(3).
No-Action Alternatives	RLEP	None	9.1	In accordance with the requirements of 10 CFR 52.18 and 10 CFR 52.21, the portions of this section dealing with the need for power are applicable to the review of an ESP application only in those cases in which an applicant elects to include the information for consideration at the time of the ESP review.
Energy Alternatives	RLEP	None	9.2	In NRC letters dated June 2, 2003 (e.g., ML031480443), the staff informed potential applicants for an ESP that the Commission has determined that an ESP applicant need not include an assessment of alternative energy sources in its environmental report. Accordingly, this section is applicable to the review of an ESP application only in those cases in which an applicant elects to include the information for consideration at the time of the ESP application review.
Alternatives Not Requiring New Generating Capacity	RLEP	None	9.2.1	See comment for Section 9.2 above.
Alternatives Requiring New Generating Capacity	RLEP	None	9.2.2	See comment for Section 9.2 above. Should also include consideration of a combination of different alternatives.
Assessment of Alternative Energy Sources and Systems	RLEP	None	9.2.3	See comment for Section 9.2 above.
Alternative Sites	RLEP	None	9.3	See NRC letter dated March 7, 2003 (ML030520434) for additional guidance concerning reviews of alternative sites.

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Alternative Plant and Transmission Systems	RLEP	None	9.4	
Heat Dissipation Systems	RLEP	None	9.4.1	
Circulating Water Systems	RLEP	None	9.4.2	
Transmission Systems	RLEP	None	9.4.3	Environmental Justice should also be considered in evaluation.
Environmental Consequences of the Proposed Action	RLEP	None	10.0	
Unavoidable Adverse Environmental Impacts	RLEP	None	10.1	
Irreversible and Irretrievable Commitments of Resources	RLEP	None	10.2	
Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment	RLEP	None	10.3	
Benefit-Cost Balance	RLEP	None	10.4	Need not be included unless applicant seeks approval.
Benefits	RLEP	None	10.4.1	Need not be included unless applicant seeks approval.
Costs	RLEP	None	10.4.2	Need not be included unless applicant seeks approval.
Summary	RLEP	None	10.4.3	Need not be included unless applicant seeks approval.

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Primary Review Branch: IEPB				
Radiation Exposure to Construction Workers	IEPB	None	4.5	See Note 1. Also: references to 10 CFR 20.1205 should be changed to 10 CFR 20.1502. Footnote should be added after the term "construction worker" which states: "During the ESP stage, the term 'construction worker' also refers to all other personnel on the proposed site who may be performing surveys, taking measurements, clearing land, etc."
Radiological Impacts of Normal Operation	IEPB	RLEP	5.4	
Exposure Pathways	IEPB	RLEP	5.4.1	10 CFR Part 50 Appendix I is applicable at COL stage. If ER provides adequate information on dose receptors and pathways, analysis can be performed at ESP stage; otherwise, it will be deferred to COL stage.
Radiation doses to Members of the Public	IEPB	RLEP	5.4.2	
Impacts to Man	IEPB	RLEP	5.4.3	
Impacts to Biota other than Members of the Public	IEPB	RLEP	5.4.4	
Radiological Monitoring	IEPB	RLEP	6.2	If ER provides adequate information on dose receptors and pathways, analysis can be performed at ESP stage; otherwise, it will be deferred to COL stage.

Area of Review	Primary Review Branch	Secondary Review Branch	SRP Section	Comment/Additional Guidance
Primary Review Branch: SPSB				
Design Basis Accidents	SPSB	None	7.1	
Severe Accident Mitigation Design Alternatives	SPSB	None	7.3	Calls for detailed design information and design-specific probabilistic risk assessment. If not available in ESP application, review and staff findings on these sections will be deferred to COL stage.

Note 1: The following paragraphs address the radiation protection/dosimetry/site monitoring related responsibilities as they pertain to an ESP site.

Where a proposed ESP site is not adjacent to or near an existing operating reactor or materials facility and where it is apparent that no individual, in the course of employment related to a proposed ESP site, will exceed applicable exposure limits for members of the public, the ESP application need not address radiological assessment or protection for workers associated with the proposed site (or with construction of a reactor at that site).

If the proposed site is adjacent to or near an existing operating reactor or materials facility, the licensee (of the existing facility) is responsible for ensuring that the radiation dose to members of the public (including workers associated with the proposed site or any facility that might be constructed on the proposed site) will comply with the applicable requirements of 10 CFR Parts 19 and 20. The ESP applicant (existing facility licensee if this licensee is also the ESP applicant) will be responsible for providing, in the environmental report that supports the ESP application, the impact analysis with respect to construction worker doses as discussed in Section 4.5 (Radiation Exposure to Construction Workers) of NUREG-1555.

ATTACHMENT 4

SAFETY EVALUATION REPORT TEMPLATE FOR EARLY SITE PERMIT APPLICATIONS

Suggested use: This document provides a basic organization for the NRC staff's safety evaluation report (SER) on an early site permit (ESP) application. Suggested sample language for some parts of the safety evaluation is also provided. In general, sample language for the specific technical sections of the SER can be found in the relevant guidance sections appended to Attachment 2 to RS-002 (or in those sections of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," shown as applicable in Attachment 2 to RS-002). These guidance sections also provide appropriate language for the evaluation findings in corresponding sections of the SER. Therefore, such language is not contained in this sample SER.

Text in the sample SER that appears outside brackets may be suitable as is for use in an SER for an ESP, unless site-specific considerations require that it be modified. Text inside brackets should be replaced with text appropriate for the ESP application under consideration.

Another good source of information on writing an SER for an ESP is the Early Site Review (performed using a similar process to that currently prescribed in 10 CFR Part 52, Appendix Q) for the Blue Hills site. While this document is dated (1977), and the scope of an ESP review differs somewhat from that performed for Blue Hills, the text of the Early Site Review is an example of previously approved text for topics similar to those that will need to be addressed in an SER for an ESP. The Blue Hills Early Site Review document can be found in ADAMS (ML022970348).

Recent SERs for license renewals have been used as partial examples for an ESP SER. These documents have been issued as NUREGs and are available on the NRC's Web site for reference. In addition, numerous recent SERs for power uprates and license amendments are available for reference in ADAMS.

NUREG-XXXX
Month year

U.S. Nuclear Regulatory Commission
Safety Evaluation of Early Site Permit Application
in the Matter of [Applicant and Site]
Docket No. 52-XXX

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Note: The structure identified below for the SER retains the NUREG-0800/Regulatory Guide 1.70 chapter and section numbering format to minimize confusion in cross-referencing among these documents and the guidance sections appended to Attachment 2 to the ESP Review Standard. Because many chapters and sections of those two documents are not applicable, there will be gaps (missing sections) in the SER. The New, Test and Research Reactors Program (RNRP) staff will insert placeholders and explanations into the SER for the missing chapters and sections, simply stating that they are not required for the SER to support the ESP.

2.4 Hydrology

2.4.1 Hydrologic Description
2.4.2 Floods
2.4.3 Probable Maximum Flood on Streams and Rivers
2.4.4 Potential Dam Failures
2.4.5 Probable Maximum Surge and Seiche Flooding
2.4.6 Probable Maximum Tsunami Flooding
2.4.7 Ice Effects
2.4.9 Channel Diversions
2.4.11 Low Water Considerations
2.4.12 Groundwater
2.4.13 Accidental Releases of Liquid Effluents
2.4.14 Conclusions

2.5 Geology and Seismology

2.5.1 Basic Geologic and Seismic Information
2.5.2 Vibratory Ground Motion
2.5.3 Surface Faulting
2.5.4 Stability of Subsurface Materials and Foundations
2.5.5 Stability of Slopes
2.5.6 Conclusions

3.5.1.6 Aircraft Hazards

13.3 Emergency Planning

13.6 Physical Security

15.0 Accident Analyses

17.1.1 Quality Assurance

18. Review by the Advisory Committee on Reactor Safeguards

19. Overall Conclusions

APPENDICES

Appendix A Chronology of Early Site Permit Application for [Site name]

Appendix B Bibliography for [Site name] Safety Evaluation Report

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

This safety evaluation report (SER) documents the technical review of the early site permit (ESP) application for the [site name] by the U.S. Nuclear Regulatory Commission (NRC) staff. By letter dated [month day, year], [applicant name] submitted the ESP application for [site name] in accordance with Part 52 of Title 10 of the Code of Federal Regulations.

The [site name] is located [briefly describe site location].

[Language for draft SER:] This SER presents the results of the staff's review of information submitted in conjunction with the ESP application.

[Language for final SER for the case in which no open items remain:] This SER presents the results of the staff's review of information submitted in conjunction with the ESP application. In an earlier version of this SER issued on [date], the staff identified a number of open and confirmatory items. All of those items have been resolved, as discussed in this SER.

On the basis of its evaluation of the application, the staff concludes that the [site name] is acceptable under the requirements of 10 CFR Parts 52 and 100 for an ESP. This conclusion is based on the site characteristics identified in this SER and on the number, type, and thermal power level of the nuclear power plant[s] specified in the application [or on the assumed PPE values specified in the application]. The staff's conclusion is subject to the conditions and limitations identified in this SER.

[Language for final SER for the case in which open items remain:] This SER presents the results of the staff's review of information submitted in conjunction with the ESP application. In an earlier version of this SER issued on [date], the staff identified a number of open and confirmatory items. All of those items have been resolved, as discussed in this SER, except [identify any items not closed that are the basis for denial of the application]. Based on [describe open items and regulations not satisfied, or describe undue risk], as described in detail in [identify sections] of this SER, the staff concludes that the [site name] is not acceptable under the requirements of 10 CFR Parts 52 and 100 for construction and operation of a nuclear power plant [specify type of power plant and size, if appropriate].

SUMMARY

This report describes the results of a review by the U.S. Nuclear Regulatory Commission (NRC) staff of an application for an early site permit (ESP) at the [site name]. The requirements for an ESP are presented in Part 52 of Title 10 of the Code of Federal Regulations (10 CFR Part 52). When those requirements are satisfied, an ESP can be issued. Part 52 also contains requirements for an applicant to submit an environmental report pursuant to 10 CFR Part 51. The NRC reviews the environmental report as part of the agency's responsibilities under the National Environmental Policy Act (NEPA) of 1969, as amended. The results of that review are presented in an environmental impact statement (EIS), which is a separate report from this SER.

By letter dated [month day, year], [applicant name] submitted the ESP application for [site name]. [Provide a description of the site.]

In accordance with Part 52, [applicant name] submitted information in its ESP application that includes (1) a description of the site and nearby areas that could affect or be affected by a nuclear power plant [or plants] located at the site; (2) a safety assessment of the site on which the facility would be located, including an analysis and evaluation of the major structures, systems, and components of the facility that bear significantly on the acceptability of the site; and (3) [describe emergency planning information provided]. The application describes how the site complies with the requirements of 10 CFR Part 52 and the siting criteria of 10 CFR Part 100.

In this report, the staff documents the bases for its conclusion that [applicant name] has [or has not] demonstrated that the [site name] is acceptable under the requirements of 10 CFR Part 52 and 10 CFR Part 100 for siting of a nuclear power plant [or plants] of [describe type, number, and size of proposed nuclear power plants] [or is acceptable under the requirements of 10 CFR Part 52 and 10 CFR Part 100 for siting of a nuclear power plant whose design parameters fall within the plant parameter envelope specified for the ESP]. [Summarize here any notable application-specific aspects of the application or the safety evaluation, such as limitations on information provided that will require additional review at the COL stage.]

The conclusions in this report have been verified where appropriate by inspections conducted by the NRC. The scope of the inspections consisted of selected information in the ESP application and information in this report. Applicable inspection reports are identified as reference documents.

[Language for draft SER:] The bases for the conclusions in this report are also reviewed by the NRC's Advisory Committee on Reactor Safeguards. The Committee independently reviews the application and submits its recommendations directly to the Commission. The Committee's recommendations, and the NRC staff's responses to them, will be included in the final version of this report.

[Language for final SER:] The bases for the conclusions in this report were also reviewed by the NRC's Advisory Committee on Reactor Safeguards. The Committee independently reviewed the application and submitted their recommendations directly to the Commission. The Committee's recommendations, and the NRC staff's responses to them, are included in this report.

As required by 10 CFR 52.21, the review process for the ESP will include a public hearing. A notice of hearing was published in the Federal Register (FR _____). [Provide any other information regarding plans for a hearing available at time of completion of the SER.]

1. INTRODUCTION AND GENERAL DISCUSSION

1.1 Introduction

[The applicant] filed with the U.S. Nuclear Regulatory Commission (NRC) an application, docketed on [date], for an early site permit (ESP) for the [site name]. The proposed site is located in [county, State] at [description of location].

The staff has completed its review [add the following phrase for the draft SER:] to the extent possible at this time, in the areas of seismology, geology, meteorology, and hydrology; and in the area of hazards to a nuclear power plant that could result from man-made facilities and activities on or in the vicinity of the site. The staff has also evaluated risks of potential accidents at the site that could occur as a result of operation of a nuclear plant of [specify general design as applicable] at the site, and has evaluated whether the site would support provision of adequate physical security measures for a nuclear power plant or plants. The staff has evaluated the applicant's quality assurance measures to ensure appropriate quality controls have been applied to information supporting the application for an ESP. Finally, the staff has evaluated [specify extent to which emergency preparedness information has been provided by applicant and reviewed by NRC].

The information provided for the staff's review consisted of the ESP application, which included a description and a safety assessment of the site as required by 10 CFR 52.17, as well as [specify emergency planning information provided]. Copies of these documents are available for public inspection via the NRC's Agencywide Documents Access and Management System (ADAMS), Accession Nos. _____. The documents are also available for public inspection at the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, MD, and at [location near site].

This report summarizes the results of the NRC staff's technical evaluation of the suitability of the proposed [site name] site for a nuclear power plant [or more than one, as applicable]. It delineates the scope of technical matters considered in evaluating the suitability of the site. Additional details on the scope and bases used by the NRC staff to evaluate the radiological safety aspects of a proposed nuclear power plant site are provided in NRC Review Standard RS-002, "Processing Applications for Early Site Permits." This document contains regulatory guidance based on the NRC's Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (hereinafter also referred to as the Standard Review Plan), NUREG-0800. The Standard Review Plan is the result of many years of experience of the NRC staff in establishing and promulgating guidance to enhance the safety of nuclear facilities and in evaluating safety assessments.

The applicant has filed an environmental report for the [site name] in which it evaluates those matters relating to the environmental impact assessment that can be reasonably reviewed at this time. The staff will report [or has reported] on the results of its evaluation of the environmental report for the [site name] in an environmental impact statement to be issued about [date] [or that was issued on (date)]. [If the applicant has submitted information to justify granting a limited work authorization:] The applicant has also provided a site redress plan in accordance with 10 CFR 52.25(a) for the purpose of seeking authorization for limited site activities allowed by 10 CFR 50.10(e)(1). The results of the staff's evaluation of that plan will be [or are] contained in the environmental impact statement.

[If the application is to be denied, the following paragraph does not apply and should be deleted.] The ESP and the findings contained therein can be referenced at some future date should the applicant decide to request the NRC staff to review an application for a combined license (COL) to construct and operate a nuclear power plant [or plants, as appropriate] at the [site name]. At that time, the applicant will identify any information in the safety assessment of the [site name] that has changed significantly since the publication of this report. [The following should be added if the ESP applicant provides a PPE.] In addition, the COL applicant will demonstrate that the design parameters for the plant design or designs for which a COL or COLs is sought fall within the plant parameter envelope submitted by the ESP applicant.

A chronology of the principal actions related to the staff's review of the ESP application for the [site name] is included as Appendix A to this report. The bibliography for this report is in Appendix B.

1.2 General Description of Site

[Provide here a brief summary of the site description provided in more detail in Section 2.1. Include a description of nearby roads, towns, state lines, etc., a figure showing the general location of the site, the Universal Transverse Mercator coordinates of the site location, site elevation, and description of locations of major nearby rivers and lakes. Make reference to the applicant's submittal for creeks and other small geographic features within five miles of the site. State the size of the site.]

[Describe site ownership, discuss the applicant's authority over and control of the exclusion area, and describe the location of the planned exclusion area within the site boundary.]

1.3 Identification of Agents and Contractors

[Applicant name(s)] was/were the applicant(s) for the ESP for [site name] and subsequently has/have been the only participant(s) in the review of [site name] suitability for a nuclear power plant. [Types of services] for the development of the ESP application were provided by [contractor names, if any].

[Describe contractor responsibilities related to development of the ESP application or the supporting information.]

Other consultants retained by the applicant to perform or verify studies for this review are identified in the applicant's safety assessment.

1.4 Summary of Principal Review Matters

This safety evaluation report summarizes the results of the technical evaluation of the [site name] performed by the NRC staff. The staff's evaluation included a technical review of the information and data submitted by the applicant with emphasis on the following principal matters:

(1) The staff evaluated the population density and land use characteristics of the site environs and the physical characteristics of the site, including seismology, meteorology, geology, and hydrology. The purpose of the evaluation was to

determine whether these characteristics had been adequately described and were given appropriate consideration to identify the significant site-related design parameters and determine whether the site characteristics are in accordance with the Commission's siting criteria (10 CFR Part 100).

(2) The staff evaluated the hazards to a nuclear power plant that could result from man-made facilities and activities; e.g., mishaps involving storage of hazardous materials (toxic chemicals, explosives) or transportation accidents (aircraft, marine traffic, railways, pipelines).

(3) The staff evaluated the potential capability of the site to support the construction and operation of a nuclear power plant of the design specified by the ESP applicant [or of a nuclear power plant whose design parameters would fall within those specified in the applicant's plant parameter envelope] under the requirements of 10 CFR Parts 52 and 100.

(4) The staff evaluated the suitability of the site for development of adequate physical security plans and measures for a nuclear power plant or plants.

(5) The staff evaluated [describe emergency plan information evaluated. One of the following conclusions will be made:] After consultation with the Federal Emergency Management Agency, the staff has determined that there is no significant impediment [or, if applicable, that there are significant impediments] to development of emergency plans for the [site name]. [Or:] After consultation with the Federal Emergency Management Agency, the staff has determined that the major features of the emergency plans submitted by [applicant name] for [site name] are [or are not] acceptable. [Or:] After consultation with the Federal Emergency Management Agency, the staff has determined that the emergency plans submitted by [applicant name] for [site name] provide [or do not provide] reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

(6) The staff evaluated the applicant's quality assurance measures applied to the information submitted in support of its ESP application and safety assessment.

(7) [Add other principal matters as applicable]

During the staff's review, several meetings (see Appendix A to this report) were held with representatives of the applicant and the applicant's contractors and consultants to discuss various technical matters related to the staff's review of the [site name]. The staff also visited the site to assess specific safety matters related to the staff's review of the site.

1.5 Summary of Open and Confirmatory Items

[This section will exist only in the draft SER. The section will list the open items using a numbering system that identifies the sections of the SER in which discussion of each open item is provided. In preparing SE inputs, technical staff will identify open items to the Project Manager for inclusion in this section.]

NOTE: For the remainder of the document, the format will follow the subsection format specified below. Guidance for the specific content of those sections, including wording for the Conclusions subsection, is found in the guidance sections appended to Atatchment 2 to RS-002, or in sections of NUREG-0800 referenced in Attachment 2.

NOTE: The sample evaluation findings in each guidance section appended to Attachment 2 to RS-002, as well as those in NUREG-0800, use language appropriate for the case in which the applicant has met the acceptance criteria in the section. Should the staff make the determination for a given section that one or more of the acceptance criteria have not been met, the actual findings for that section will need to describe how each criterion has been met or not met.

2.0 SITE CHARACTERISTICS

2.1 Site Location and Description

[In this brief introductory text, state that this section provides a description of the geographic and demographic characteristics of the site and its vicinity. Also note that a description of the applicant's authority over and control of the planned exclusion area is provided.]

2.1.1 Geography

2.1.1.1 Technical Information in the Application

[Describe the key technical points that were made in the application. It is not necessary to restate the application verbatim or to address all the details in the application.]

2.1.1.2 Regulatory Evaluation

[Summarize, as applicable, any regulations and other regulatory references, including regulatory guides, generic letters, or NRC staff positions, that are applicable to this topic. These documents should be referenced in the applicant's safety analysis. If the staff agrees with the applicant's regulatory analysis, the staff may quote the applicant.]

[A statement similar to the following should be made.] The staff finds that the applicant in section __ of its submittal identified the regulatory requirements applicable to geography. The regulatory requirements that the staff considered in the review of the application are the regulations at 10 CFR 52.17(a)(1), which require that the applicant for an ESP provide a description of the site. Section 2.1 of NUREG-0800 (as marked up and attached to the ESP Review Standard, RS-002) and Section 2.1 of Regulatory Guide 1.70 provide guidance on information appropriate for presentation on geography. [Cite other applicable regulations and documents. These may be some or all of the regulations the applicant identified.]

2.1.1.3 Technical Evaluation

[Document the staff's evaluation of site geography against the relevant regulatory criteria. The evaluation should support the staff's conclusions as to whether the regulations are met. State what the staff did to evaluate the applicant's submittal. The staff's evaluation may include

verification that the applicant followed applicable regulatory guidance, performance of independent calculations, and validation that the appropriate assumptions were made. The staff may state that certain information provided by the applicant was not considered essential to the staff's review and was not reviewed by the staff. While the staff may summarize or quote the information offered by the applicant in support of its application, the staff should clearly articulate the bases for its conclusions.]

2.1.1.4 Conclusions

[Summarize the staff's conclusions regarding geography, including words such as the following.] As set forth above in Sections 2.1.1.2 and 2.1.1.3 of this report, [provide specific bases for conclusions that follow]. Accordingly, the staff concludes that the site geography meets [or, if applicable, does not meet] the relevant requirements of 10 CFR Part 100 and is [or, if applicable, is not] acceptable for an ESP.

2.1.2 Exclusion Area Authority and Control

2.1.2.1 Technical Information in the Application

[Apply guidance for 2.1.1.1 above using wording specific to this topic.]

2.1.2.2 Regulatory Evaluation

[Apply guidance for 2.1.1.2 above using wording specific to this topic.]

2.1.2.3 Technical Evaluation

[Apply guidance for 2.1.1.3 above using wording specific to this topic.]

2.1.2.4 Conclusions

[See guidance section 2.1.2 appended to Attachment 2 to RS-002 for sample wording.]

NOTE: Remaining sections of the SER should use the same format as that provided above. Each section should contain a technical information section, regulatory evaluation, technical evaluation, and conclusions. The staff has the latitude to use subsections in addition to those listed above as needed to clearly present the information. The following sections are not addressed elsewhere in RS-002 nor in NUREG-0800, so guidance is provided for their content.

NOTE: If the application is to be denied, the SER should set forth the staff's determination on every matter within the scope of the ESP, acceptable or not, and the basis for each determination.

18.0 REVIEW BY THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

[For draft SER:] The application for an early site permit at [site name], as well as this SER, are expected to be reviewed by the Advisory Committee on Reactor Safeguards. The staff intends

to issue a final SER [after resolution of open items regarding this SER, if any] and after receipt of the Committee's report to the Commission relative to its review. This final SER will append a copy of the Committee's report and will address each of the comments made by the Committee. It will also describe any steps taken by the staff to resolve any issues raised as a result of the Committee's review.

[For final SER:] The Advisory Committee on Reactor Safeguards (ACRS) completed its review of the request of the [applicant name] for an early site permit for the [site name] at its [meeting number] meeting on [dates], in [location], and of the staff's SER for this application. [Describe any other Committee activities, such as site visits or subcommittee meetings related to the ESP application.] The ACRS report for the [site name] early site permit review is included in this report as Appendix __. The report contains comments and recommendations to the Commission regarding the [site name] early site permit review. The report concludes that [summarize conclusions]. The staff has transmitted the ACRS report to [applicant name] for its consideration in the use of the [site name] for a nuclear power plant.

The actions the staff has taken and additional actions the staff plans to take in response to the comments and recommendations identified by the ACRS in its report of [date] are described in the paragraphs below.

[For each ACRS item, describe or quote the comment and discuss the staff's actions in response.]

19.0 CONCLUSIONS

[Language for case in which the ESP is to be issued:] Based on the staff's analysis of the proposed [site name], the staff has reached the following conclusions, subject to the conditions discussed in this report, for the site-related issues covered by the [site name] safety assessment:

(1) [Applicant name] has described, analyzed, and evaluated the proposed [site name] to establish the acceptability of the site for an ESP based on the site characteristics identified in this SER and on the number, type, and thermal power level of nuclear power plants specified in the application [or on the assumed PPE values specified in the application]. This description and the staff's evaluation include a definition of site-related parameters that the staff would evaluate in determining the acceptability of a nuclear power plant [or plants] to be constructed at the [site name].

(2) On the basis of the foregoing, the staff concludes that the ESP for the [site name] is acceptable under 10 CFR Parts 52 and 100 for referencing in a COL application, subject to [state any conditions or limitations on this conclusion]. In accordance with 10 CFR 52.39, matters resolved in this SER will be treated as resolved in a future COL application unless a contention is admitted that the proposed reactor does not fit within one or more of the site parameters evaluated in this SER, or a petition is filed which alleges that either the site is not in compliance with the terms of the ESP or that the terms of the ESP should be modified.

[Language for case in which the ESP is to be denied:] Based on the staff's analysis of the proposed [site name], the staff has reached the following conclusions for the site-related issues covered by the [site name] safety assessment:

(1) [Applicant name] has described, analyzed, and evaluated the proposed [site name] to establish the acceptability of the site for construction and operation of a nuclear power plant of [specify type, number, etc. as appropriate]. However, the staff has determined that the site is not acceptable for the proposed purpose because [identify all matters resulting in denial].

(2) On the basis of the foregoing, the staff concludes that the [site name] is not acceptable under 10 CFR Parts 52 and 100 for reference in a COL application. Accordingly, the staff has determined that the application should be denied.