

# U.S. NUCLEAR REGULATORY COMMISSION

## REGULATORY GUIDE 4.27, REVISION 0



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# USE OF PLANT PARAMETER ENVELOPE IN EARLY SITE PERMIT APPLICATIONS FOR NUCLEAR POWER PLANTS

## A. INTRODUCTION

### Purpose

This regulatory guide (RG) provides guidance on the use of the plant parameter envelope (PPE) concept to postulate certain design parameters for an early site permit (ESP) application for nuclear power plants when a specific reactor technology has not been selected for the proposed site. The PPE approach outlined in this guide is acceptable to the staff of the U.S. Nuclear Regulatory Commission (NRC) to meet regulatory requirements for ESP applications.

### Applicability

This RG applies to ESP applicants subject to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Subpart A, “Early Site Permits” (Ref. 1), 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” (Ref. 2), and 10 CFR Part 100, “Reactor Site Criteria,” (Ref. 3).

### Applicable Regulations

- 10 CFR Part 52, Subpart A, governs the issuance of ESPs for nuclear power facilities.
  - 10 CFR 52.24(b), in part, requires an ESP to specify the site characteristics, design parameters, and terms and conditions of the ESP the Commission deems appropriate. These terms and conditions must be met before the issuance of a construction permit (CP) or combined license (COL) referencing the ESP.
- 10 CFR Part 51 provides requirements for NRC’s preparation and processing of environmental impact statements (EIS) and related documents under Section 102(2)(C) of the National Environmental Policy Act of 1969, as amended (NEPA).

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Electronic copies of this RG, previous versions of RGs, and other recently issued guides are also available through the NRC’s public web site in the NRC Library at <https://www.nrc.gov/reading-rm/doc-collections/reg-guides/index.html> under Document Collections, in Regulatory Guides. This RG is also available through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>, under ADAMS Accession Number (No.) ML23010A097. The regulatory analysis may be found in ADAMS under Accession No. ML21049A182. The associated draft guide DG-4029 may be found in ADAMS under Accession No. ML21049A181, and the staff responses to the public comments on DG-4029 may be found under ADAMS Accession No. ML23010A111.

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- 10 CFR 51.45, the NRC sets forth the general requirements for an environmental report (ER). Specific requirements governing ERs for production and utilization facilities are set forth in 10 CFR 51.49 to 10 CFR 51.58.
- 10 CFR Part 100, “Reactor Site Criteria,” Subpart B, “Evaluation Factors for Stationary Power Reactor Site Applications on or after January 10, 1997,” governs the site characteristics for, in part, 10 CFR Part 52 applications.

### **Related Guidance**

- Nuclear Energy Institute (NEI) publication NEI 10-01, Revision 1, “Industry Guideline for Developing a Plant Parameter Envelope in Support of an Early Site Permit,” issued May 2012 (Ref. 4), describes the development and use of an ESP application from the industry’s perspective, including the development of a PPE to bound multiple reactor designs. The PPE in NEI 10-01 is an example of the parameters needed for a PPE. However, not all parameters apply to all designs and additional parameters may be needed depending on the reactor designs that the PPE is bounding.

### **Purpose of Regulatory Guides**

The NRC issues RGs to describe methods that are acceptable to the staff for implementing specific parts of the agency’s regulations, to explain techniques that the staff uses in evaluating specific issues or postulated events, and to describe information that the staff needs in its review of applications for permits and licenses. Regulatory guides are not NRC regulations and compliance with them is not required. Methods and solutions that differ from those set forth in RGs are acceptable if supported by a basis for the issuance or continuance of a permit or license by the Commission.

### **Paperwork Reduction Act**

This RG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Parts 50, 52, and 100 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), under control number 3150-0011, 3150-0151, 3150-0093, respectively. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch ((T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to [Infocollects.Resource@nrc.gov](mailto:Infocollects.Resource@nrc.gov), and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011, 3150-0151, and 3150-0093), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17<sup>th</sup> Street, NW, Washington, DC, 20503; e-mail: [oir\\_submissions@omb.eop.gov](mailto:oir_submissions@omb.eop.gov).

### **Public Protection Notification**

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

## **B. DISCUSSION**

### **Reason for Issuance**

The NRC staff developed this RG to provide guidance to ESP applicants on the PPE concept, which allows an ESP applicant to postulate certain generic design criteria in the ESP application when a specific reactor technology has not been selected for a proposed site.

### **Background**

The NRC published Office of Nuclear Reactor Regulation Review Standard (RS)-002, "Processing Applications for Early Site Permits," in May 2004 (Ref. 5) to provide guidance to the staff on the processing and review of ESP applications. After publishing RS-002, the NRC issued subsequent guidance in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (Ref. 6), and updates to RG 1.206, "Applications for Nuclear Power Plants" (Ref. 7), that superseded portions of the guidance in RS-002. Accordingly, many sections of RS-002 contained outdated guidance that did not fully reflect the NRC's implementation of a risk-informed, performance-based approach to licensing. However, the guidance superseding the outdated portions of RS-002 does not contain all of the PPE information in RS-002. The issuance of this RG allows the NRC staff to withdraw the outdated guidance in RS-002 while retaining the PPE information for future use by prospective ESP applicants.

### **The Role of the PPE in the ESP Process**

An ESP is an NRC approval issued under 10 CFR Part 52, for a site for one or more nuclear power facilities. It addresses site suitability issues and environmental protection issues independent of the review of a specific nuclear plant design and may be used to support a request for a limited work authorization associated with an ESP application. Use of a PPE allows an ESP applicant to defer the decision of what design to build to the COL or CP stage. The ESP application requires a determination by the NRC as to the suitability of a site for the construction and operation of one or more nuclear reactors. It is not an authorization to construct or operate the nuclear reactor referenced or described in the ESP application or, in the case of a PPE design, a reactor whose design characteristics fall within the design parameters postulated in the PPE. A PPE is a set of plant design parameter values that an ESP applicant expects will bound the design characteristics of a reactor or reactors that might be constructed at a given site. Therefore, the PPE serves as a surrogate for reactor design information that is not available or for a reactor design that is not final. As documented in J. Lyon's letter to R. Simard (Ref. 8) on the resolution of ESP topic 6, the use of the PPE approach allows an ESP applicant to defer the decision on what reactor design to build to the COL [or CP] stage. An applicant may use a PPE to support demonstration of compliance with 10 CFR 52.17, "Contents of applications; technical information." The combination of site characteristics and PPE values will comprise the ESP bases that will be the focus for comparison in the event a COL or CP application is submitted for the site. At the COL or CP stage, the applicant would determine if the design-specific vendor information for the selected reactor design falls within the PPE values and, if not, would appropriately address the impacts in a CP or COL application. Under 10 CFR 52.26(c), a CP or COL applicant "may, at its own risk, reference in its application a site for which an early site permit application has been docketed but not granted."

## **Consideration of International Standards**

The International Atomic Energy Agency (IAEA) works with member states and other partners to promote the safe, secure, and peaceful use of nuclear technologies. The IAEA develops Safety Requirements and Safety Guides for protecting people and the environment from harmful effects of ionizing radiation. This system of safety fundamentals, safety requirements, safety guides, and other relevant reports, reflects an international perspective on what constitutes a high level of safety. To inform its development of this RG, the NRC considered IAEA Safety Requirements and Safety Guides pursuant to the Commission's International Policy Statement (Ref. 9) and Management Directive 6.6, "Regulatory Guides" (Ref. 10).

The following IAEA Safety Guide includes information on the site evaluations that should be conducted for nuclear reactor sites:

- IAEA Specific Safety Requirements (SSR) -1, "Site Evaluation for Nuclear Installations" (Ref. 11)

Although SSR-1 provides information on performing site evaluations, it does not specifically mention the development of a PPE for sites without a selected reactor technology. SSR-1 discusses the appropriate consideration of the installed nuclear capacity in site evaluations, as well as the characterization of the hazards relevant to the site and the design of the nuclear facility.

## C. STAFF REGULATORY GUIDANCE

This section provides descriptions of the methods, approaches, or data that the staff considers acceptable for meeting the requirements of the regulations cited in the Introduction. The issuance of this guide on the PPE concept for an ESP application is consistent with the NRC's implementation of a risk-informed, performance-based approach to licensing.

1. A PPE is a set of postulated values of plant design parameters that an ESP applicant can use to bound the design characteristics of a reactor or reactors that might be constructed at a given site.
2. An applicant may use a PPE as a surrogate for facility design information to support demonstration of compliance with 10 CFR 52.17, "Contents of applications; technical information."
3. An applicant using a PPE should use reasonable margins to account for potential uncertainties in PPE values in each application. The PPE values should be sufficient to support the ESP review for compliance with 10 CFR Part 52, Subpart A and 10 CFR 51.50, "Environmental report-construction permit, early site permit, or combined license stage."
4. Given that PPE values do not reflect a specific design and are not reviewed by the NRC staff for correctness, the granting of an ESP by the NRC does not indicate its approval of the site for any specific plant or type of plant.
5. In addition to the emergency preparedness and environmental impact findings required by 10 CFR 52.17(b) and 52.17(a)(2), respectively, site approval is contingent on the staff's finding that a reactor or reactors whose design characteristics fall within the PPE satisfy the requirements of 10 CFR Part 100 and the other requirements of 10 CFR 52.17(a)(1). These findings take into consideration the site criteria in 10 CFR Part 100, Subpart B, and may result in terms and conditions on the ESP in specific areas, as set forth in 10 CFR 52.24, "Issuance of early site permit".
6. The combination of site characteristics and PPE values will comprise the ESP bases that will be the focus for comparison should a COL or CP application be submitted for the site. COL and CP applicants who reference an ESP bear the risk that the design ultimately selected for the approved site might fall outside the terms and conditions of the ESP.
7. An applicant using a PPE should refer to the following guidance for developing values or ranges for specific review criteria to be included in the PPE:
  - RG 1.206 contains information related to PPEs, particularly in Section C.1.2, "Safety Analysis Report".
  - NUREG-0800, Chapter 2, "Site Characteristics and Site Parameters," provides guidance to the NRC staff for review of site characteristics where a PPE may be used in place of design-specific information (e.g., to calculate offsite dose).
  - NUREG-0800, Chapter 11, "Radioactive Waste Management," includes information important for the estimation of PPE source term and consequent doses.

- NUREG-0800, Chapter 15.0.3 "Design Basis Accident Radiological Consequence Analyses for Advanced Light Water Reactors," includes information important for the estimation of PPE accident source term and consequent doses.
  - NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan (with Supplement 1 for Operating Reactor License Renewal)," (Ref. 12), provides guidance to the NRC staff for environmental reviews for nuclear power plants.
  - RG 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," should be used for developing ERs for ESPs that use a PPE and for COLs that reference an ESP (Ref. 13).
8. 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 CP or COL review with the design of the selected or identified plant to be constructed on the site. Site-specific parameters (such as meteorology, demographics, and hydrology) should be provided in any ESP application.
  9. Detailed design information pertaining to structures, systems, and components 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.
  10. 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 judgment 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.
  11. During the review of a COL or CP 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 or CP stages. 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 or CP stages. As a result of the staff's environmental review of the ESP application, the staff may determine that terms and conditions 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.

## **D. IMPLEMENTATION**

The NRC staff may use this regulatory guide as a reference in its regulatory processes, such as licensing, inspection, or enforcement. However, the NRC staff does not intend to use the guidance in this regulatory guide to support NRC staff actions in a manner that would constitute backfitting as that term is defined in 10 CFR 50.109, “Backfitting,” and as described in NRC Management Directive 8.4, “Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests,” (Ref. 14), nor does the NRC staff intend to use the guidance to affect the issue finality of an approval under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.” The staff also does not intend to use the guidance to support NRC staff actions in a manner that constitutes forward fitting as that term is defined and described in Management Directive 8.4. If a licensee believes that the NRC is using this regulatory guide in a manner inconsistent with the discussion in this Implementation section, then the licensee may file a backfitting or forward fitting appeal with the NRC in accordance with the process in Management Directive 8.4.

## REFERENCES<sup>1</sup>

1. *U.S. Code of Federal Regulation*, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Part 52, Chapter 1, Title 10, “Energy.”
2. *U.S. Code of Federal Regulation*, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions,” Part 51, Chapter 1, Title 10, “Energy.”
3. *U.S. Code of Federal Regulation*, “Reactor Site Criteria,” Part 100, Chapter 1, Title 10, “Energy.”
4. Nuclear Energy Institute, “Industry Guideline for Developing a Plant Parameter Envelope in Support of an Early Site Permit,” NEI 10-01, Revision 1, May 2012, Agencywide Documents Access and Management System (ADAMS) Accession No. ML12144A429.
5. U.S. Nuclear Regulatory Commission (NRC), “Processing Applications for Early Site Permits,” Review Standard RS-002, ML040700236.
6. U.S. Nuclear Regulatory Commission (NRC), “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” NUREG-0800.
7. U.S. Nuclear Regulatory Commission (NRC), RG 1.206, “Applications for Nuclear Power Plants.”
8. Lyons, James E., NRC, letter to Ronald L. Simard, Nuclear Energy Institute, “Resolution of Early Site Permit Topic 6 (ESP-6), Use of Plant Parameter Envelope (PPE) Approach,” February 5, 2003, ML030230071.
9. NRC, “Nuclear Regulatory Commission International Policy Statement,” *Federal Register*, Vol. 79, No. 132, July 10, 2014, pp. 39415–39418.
10. NRC, “Regulatory Guides,” Management Directive 6.6.
11. International Atomic Energy Agency (IAEA), “Site Evaluation for Nuclear Installations,” IAEA Safety Standards Series No. SSR-1, Vienna, 2019.<sup>2</sup>
12. NRC, “Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan (with Supplement 1 for Operating Reactor License Renewal),” NUREG-1555.

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1 Publicly available NRC published documents are available electronically through the NRC Library on the NRC’s public website at <http://www.nrc.gov/reading-rm/doc-collections/> and through the NRC’s Agencywide Documents Access and Management System (ADAMS) at <http://www.nrc.gov/reading-rm/adams.html>. For problems with ADAMS, contact the Public Document Room staff at 301-415-4737 or (800) 397-4209, or email [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov). The NRC Public Document Room (PDR), where you may also examine and order copies of publicly available documents, is open by appointment. To make an appointment to visit the PDR, please send an email to [PDR.Resource@nrc.gov](mailto:PDR.Resource@nrc.gov) or call 1-800-397-4209 or 301-415-4737, between 8 a.m. and 4 p.m. eastern time (ET), Monday through Friday, except Federal holidays.

2. Copies of International Atomic Energy Agency (IAEA) documents may be obtained through their Web site: [WWW.IAEA.Org/](http://WWW.IAEA.Org/) or by writing the International Atomic Energy Agency, P.O. Box 100 Wagramer Strasse 5, A 1400 Vienna, Austria.



13. NRC, "Preparation of Environmental Reports for Nuclear Power Stations," RG 4.2.
14. NRC, "Management of Facility-Specific Backfitting and Information Collection," Management Directive 8.4, Washington, DC.