



**COMBINED LICENSE AND EARLY SITE PERMIT
COL/ESP-ISG-027**

**Specific Environmental Guidance for Light Water Small
Modular Reactor Reviews**

Interim Staff Guidance

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(Final)

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Issuance Status

Final

Purpose

The purpose of this Interim Staff Guidance (ISG) is to clarify the U.S. Nuclear Regulatory Commission (NRC) guidance and application of NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants," ([NRC 2000](#)) regarding the assessment of environmental reviews for applications for licenses to construct and operate light water small modular reactors (SMRs). This guidance applies to environmental reviews associated with light water SMR applications for limited work authorizations, construction permits (CPs), operating licenses (OLs), early site permits (ESPs), and combined licenses (COLs).

Background

The regulations developed by NRC to implement the National Environmental Policy Act of 1969 (NEPA) are contained in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." As specified in 10 CFR 51.20(a)(1), an environmental impact statement (EIS) is prepared by the NRC for major Federal actions significantly affecting the quality of the human environment." Issuance of limited work authorizations (LWAs), CPs, and OLs under 10 CFR Part 50 and of COLs and ESPs under 10 CFR Part 52 requires an EIS pursuant to 10 CFR 51.20(b). Light water SMRs are defined as light water reactor units with a nominal output of 300 megawatts electric (MWe) or less that are able to be factory fabricated and transported to the site for assembly of components and operation. Fuel would be loaded after modules are installed in the facility. Each module would require a separate license from the Commission ([NRC 2011](#)).

The current NRC licensing structure was developed for large light water reactors (LLWRs). NRC's regulatory approach for conducting environmental reviews of light water SMR applications will generally be the same as the approach for conducting environmental reviews of LLWR applications. The subject areas covered in NUREG-1555 (hereafter referred to as ESRP) ([NRC 2000](#)) and addressed during the environmental review process for analyses of light water SMRs are generally the same as for the LLWR analyses. However, there may be differences in the analyses based on the purpose and need for the action and the design differences between light water SMRs and LLWRs. Appendix A to 10 CFR Part 51 states that the "data and analyses in the [EIS] will be commensurate with the importance of the impact." Design differences between light water SMRs and LLWRs may affect impact levels and the nature of the analyses presented in the EIS.

Issue Discussion

While reviewing preliminary information from light water SMR vendors and potential applicants, the NRC staff identified issues that necessitate additional staff guidance for environmental reviews, such as purpose and need, alternatives, cumulative impacts, the need for power, and

benefit-cost. The purpose of this Interim Staff Guidance (ISG) is to clarify the NRC guidance and application of the ESRP to environmental reviews for applications for licenses to construct and operate light water SMRs. This guidance applies to environmental reviews associated with applications for LWAs, CPs, and OLs and applications for ESPs and COLs.

This ISG also would be useful for applicants in understanding NRC's reviews of environmental reports provided with license applications. For this ISG it is assumed that light water SMRs will, as part of the purpose and need statement, include the production of electricity. In addition to the production of electricity, the purpose and need statement for a light water SMR may address additional needs as discussed later in this ISG. The issues associated with environmental reviews of construction and operation of reactor designs other than light water SMRs, such as high-temperature, gas-cooled and liquid-metal cooled reactors are not addressed in this guidance. It is anticipated that, for issues not explicitly addressed in this ISG, the NRC staff will continue to follow the review procedures in the ESRP as clarified in ISG-026, "Interim Staff Guidance on Environmental Issues Associated with New Reactors" (NRC 2013) and any subsequent staff guidance. This guidance does not address accidents, issues arising out of the events at the Fukushima Daiichi Nuclear Power Plant in Japan, fuel cycle, or radiological issues that are addressed in other NRC guidance.

Rationale

NRC developed this ISG to provide supplemental guidance to the staff for conducting environmental reviews in areas unique to light water SMR applications. This ISG along with the guidance in the ESRP as clarified in ISG-026 (NRC 2013) provides guidance to the staff for the environmental review of light water SMR applications.

Staff Guidance

The scope of this ISG is limited to the areas of the environmental review that may be unique to a light water SMR design. The staff evaluated the review procedures in the ESRP in the context of light water SMR designs and determined that, in most of the sections of the ESRP, the staff would not have to deviate from the ESRP guidance to develop a light water SMR EIS. While the impacts to some resource areas may be viewed as being smaller because the reactor is smaller, the review methodology would be the same as for a LLWR. For example, the impacts to consumptive water use may be smaller because less water would be used. However, the methods for analyzing the impacts would be the same; therefore, no additional guidance is needed. The additional guidance presented here discusses issues the staff should consider with respect to the design differences between the light water SMR designs and the current LLWR designs.

There are several possible scenarios for light water SMR applications. The staff's review approach would depend on the types of applications submitted and the timing of actions proposed in the application. Possible scenarios for staff consideration can include, but are not limited to the following:

- *Scenario 1: All Modules in One Application*

A potential applicant could request licenses for multiple modules installed over time. Under this scenario, the proposed action includes licenses for all the modules that would be built at the site. Impacts for constructing and operating these modules would be discussed in Chapters 4 and 5 of the EIS. The applicant should provide a schedule as

to when each module would be constructed and operated to inform the staff of the timing of impacts. The cumulative impact analysis in Chapter 7 would follow the guidance in ISG-026. In Chapter 9, for the alternative site evaluation, the impacts at the alternative sites would be compared to the cumulative impacts of Chapter 7 to determine if an environmentally preferable or obviously superior site exists. The need for power analysis in Chapter 8, alternative energy analysis in Section 9.2, and benefit-cost analysis in Chapter 10 would be based on an accounting of the full capacity of all the modules for which licenses were being requested.¹

- *Scenario 2: Two or More Separate License Applications (Subsequent application considered an expansion of the existing site)*

A potential applicant could request licenses for one or more modules and inform the NRC that it intends to request licenses for additional modules in the future. Under this scenario, the proposed action includes only the licenses requested. The applicant should provide sufficient information that would allow NRC to determine whether or not the additional modules are reasonably foreseeable for the purposes of describing cumulative impacts. In order for the additional modules to be treated as reasonably foreseeable and for the NRC to treat a subsequent application for the additional modules as an expansion of the site, the siting study submitted with the original application must include consideration of all the modules.

Impacts of construction and operation of the modules for which licenses have been requested, as well as of construction of any infrastructure meeting the NRC's definition of construction in 10 CFR 51.4 and proposed to be built with the initial units, would be described in Chapters 4 and 5. The impacts of the additional modules deemed to be reasonably foreseeable would be considered as part of the cumulative impact assessment in Chapter 7. In Chapter 9, the alternative sites would be evaluated based on cumulative impacts and therefore would include evaluations of the same number of modules as in Chapter 7. The need for power analysis in Chapter 8, alternative energy analysis in Section 9.2, and benefit-cost analysis in Chapter 10 would be based on only the modules for which licenses were being requested.

If the applicant requests licenses for the additional modules at a later date, the NRC staff would develop a supplemental EIS for the expansion of the existing site. The environmental report for the additional modules would address all the issues except alternatives sites. The environmental report should tier off the EIS for the original group of modules and evaluate any new and significant information relevant to environmental concerns similar to the supplemental EIS performed for a combined license referencing an early site permit.

- *Scenario 3: Two or More Separate License Applications (Subsequent applications not considered an expansion of the existing site)*

¹ The ESRP and ISG-026 provide four alternative strategies the applicant may use to account for the full capacity of all the units/modules in an application: (1) documentation of the need for the full capacity within the applicant's service area, (2) documentation of the need for the full capacity within the relevant portion of the grid, (3) replacement power for planned retirements, or (4) a combination of the three strategies.

If an applicant requests a license for a certain number of modules and the siting analysis and the environmental report does not consider additional modules at that site as reasonably foreseeable, then the EIS will only consider the modules requested. A subsequent application for additional modules will have to address all issues including alternative sites and alternative energy.

- *Scenario 4: ESP and COL Application*

An applicant could request an ESP for all the modules that are planned, and then request COLs for only those modules it plans to build in the short term. In this scenario, the ESP review would consider all of the modules that are planned, and if the proposed site is found acceptable by the staff, the issue of alternative sites would be resolved for any future COLs referencing the ESP. The issues of alternative energy and need for power (if addressed in the ESP application) would be resolved unless the staff identified new and significant information on these issues in its review of the COL application referencing the ESP. Consideration of the various modules (i.e., those for which licenses are requested and those planned in the future) in the COLs would follow the same steps as described above for Scenario 2.

All of the scenarios described above are valid approaches for sites intended for light water SMRs only and for sites with one or more existing large light water reactors (LLWR). The outcome of Scenario 1 is that the staff would have completed its environmental analysis for all modules, the licensing action would have been taken, and no further environmental analysis would be required.

The outcome of Scenario 2 is that, if the applicant applies for licenses for future modules, NRC would prepare a supplemental EIS that would tier off the EIS prepared for the initial modules in which the cumulative impacts for the future modules were assessed. The supplemental EIS would evaluate any new and significant information, need for power and the cost benefit for the additional modules being licensed. The supplemental EIS would not evaluate alternative sites.

Under scenario 3 the NRC would evaluate only the requested number of modules and any subsequent application for additional modules at that site would need to address all environmental review areas including alternative sites and alternative energy.

Under Scenario 4, NRC would prepare a supplemental EIS for each COL application referencing the ESP. Key differences between Scenarios 2 and 4 are that, in Scenario 4, an applicant would be resolving siting issues in the ESP and maintain flexibility in selecting the design until submittal of the COL application. All issues resolved in the ESP EIS would be considered resolved for the COL EIS unless the staff identified new and significant information. ESP EISs are intended to facilitate early resolution of siting issues. ESP applications can but are not required to include need for power or alternative energy.

The additional guidance presented below is organized around NRC's current new reactor EIS chapter structure. Chapter 1 of an EIS identifies the proposed action and the purpose and need for the action. The proposed action is the number and location of modules that an applicant is seeking to license and the date(s) the applicant plans to begin operation. Chapter 2 describes the site environs that are important to the impact assessment. Chapter 3 describes all physical activities associated with the proposed action, plus any additional activities that may be undertaken by the applicant in advance of installing additional modules. Chapter 4 describes the impacts of all construction and those pre-construction activities that must be addressed

under NEPA by a cooperating agency. Chapter 5 describes the impacts from operations during the license period. Chapter 6 describes the decommissioning of the modules and associated facilities, plus impacts associated with the fuel cycle and transportation. Chapter 7 describes the cumulative impacts of the project, including construction, pre-construction, and operational impacts in addition to impacts from past, present, and reasonably foreseeable future projects that could impact the same resources. Chapter 8 describes the need for the power from the project. Chapter 9 discusses reasonable alternatives that would meet the purpose and need identified in Chapter 1. The project benefits and costs and a summary of the staff's findings are discussed in Chapter 10.

Chapter 1: Cover, Table of Contents, Foreword, and Introduction

Chapter 1 generally will follow the ESRP guidance for LLWRs; however, the purpose and need statement may be different in the case of light water SMRs. The purpose and need statement is the foundation of the environmental analysis on which the rest of the EIS is built. The purpose and need statement is developed by the staff, but is informed by the applicant's objectives,² as stated in Chapter 1 of its environmental report.

For LLWR COL EISs, the purpose and need has typically been described in terms of a specific quantity of baseload electricity within a service area within a defined time period. For light water SMRs, the purpose and need must include the production of electricity, although not necessarily baseload electricity, whether for a defined service area or for a specific end user. In addition, the purpose and need statement for a light water SMR may address additional needs other than the production of electricity. Additional purposes or needs for the project will provide greater insight to the benefits and assist staff in defining reasonable alternatives to the proposed project. Additional purposes could include, but are not limited to, the following:

- Providing the ability to install additional modules over time and increase capacity incrementally to follow load growth
- Meeting greenhouse gas emission goals
- Replacing existing plants
- Meeting State or Federal energy policy goals
- Enhancing energy diversity
- Consideration of Federal policy not related to environmental quality (10 CFR 51.71(d)).

However, it is the production of electricity that allows the project to be justified in terms of benefits. The purpose and need statement cannot be so restrictive that there are no alternatives, other than the proposed project, that would meet the purpose and need. For example, the purpose and need could not be to build and operate a specific light water SMR at a specific location. In that case, there would be no alternative energy technology or site that would meet that purpose and need statement. An alternative is not reasonable if it does not meet the purpose and need statement.

² 40 CFR 1502.13 defines purpose and need as follows: The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action.

Chapter 2: Affected Environment

Chapter 2 generally will follow the ESRP guidance for LLWRs. However, because of features specific to a particular light water SMR design, more or less description of the affected environment may be necessary. For example:

- ESRP 2.3.1 directs NRC staff to characterize groundwater. Staff should consider environmental parameters that could be affected by the installation of project structures to a greater depth below grade than current LLWR designs. Staff should confirm that groundwater location and flow is fully characterized at all depths of the excavation.
- ESRP 2.4.2 directs the staff to analyze one year of aquatic data. If the facility uses dry cooling rather than surface water or groundwater, there may be no need for one year of aquatic data because there may be no impacts to aquatic resources.

Chapter 3: Site Layout and Plant Description

Chapter 3 generally will follow the ESRP guidance for LLWRs. However, Chapter 3 should describe the unique features of a light water SMR facility, including a plot plan that shows the location of proposed modules and the locations of environmental interfaces. The site layout and plant description should clearly describe the scope of the project as proposed in the license application, including the total number of modules requested to be licensed and the proposed operational date for each module. Staff should also include any information known about planned installation of future units. Guidance for defining construction and pre-construction activities is provided in the final rule dated October 9, 2007, “Limited Work Authorizations for Nuclear Power Plants” (72 FR 57416) ([NRC 2007](#)). More detailed guidance is provided in COL/ESP ISG 4 “Interim Staff Guidance on the Definition of Construction and on Limited Work Authorizations” (NRC 2009).

Chapter 4: Construction Impacts at the Proposed Site

ESRP Chapter 4 generally provides sufficient staff guidance for reviewing construction and those pre-construction impacts that must be addressed under NEPA by a cooperating agency. However, because modules may be installed over time to meet the demand for electricity, the NRC staff should evaluate construction (and pre-construction impacts to the extent a cooperating agency needs to address them) over the time frame specified in the application.

As part of the proposed action, the applicant may install infrastructure and facilities that could be used to support additional reactor modules. If these activities are NRC-authorized construction activities as defined in 10 CFR 51.4, they would be evaluated as part of the construction impact analysis in Chapter 4.

Chapter 5: Operational Impacts at the Proposed Site

ESRP Chapter 5 generally provides sufficient staff guidance for reviewing operational impacts. However, because modules may be installed over time to meet the demand for electricity, staff should evaluate operational impacts over the time frame specified in the application.

Specific light water SMR designs may have features that differ from LLWR designs that could affect the NRC staff's evaluation of environmental impacts. For example, dry cooling may be proposed resulting in significantly less consumptive water use. In these cases, staff would not need to evaluate impacts from entrainment or impingement, or impacts due to thermal discharges to a water body. Staff should include short statements in the EIS that environmental impacts in these areas are not expected because of the design features of the proposed reactor(s).

Chapter 6: Fuel Cycle, Transportation, and Decommissioning

Generally, ESRP Chapter 6 provides sufficient staff guidance for reviewing fuel cycle, transportation, and decommissioning. Fuel cycle, transportation, and decommissioning are outside the scope of this ISG.

Chapter 7: Cumulative Impacts

Chapter 7 generally will follow the cumulative guidance in ISG-026, "Environmental Issues Associated with New Reactors." In evaluating cumulative impacts, staff should consider impacts from the total number of modules that are being proposed in the licensing action, as described in Chapters 4 and 5, in addition to impacts from other reasonably foreseeable past, present, and future actions.

Under licensing Scenarios 1 and 3 described earlier, the applicant would submit applications for all modules planned for the facility. The impacts of all the modules would be direct impacts and evaluated as such in the EIS. Under Scenario 2, the cumulative impacts section would address those modules for which licenses have been requested plus future modules that the NRC staff has concluded are reasonably foreseeable. Under Scenario 4, the additional modules considered in the ESP would be considered reasonably foreseeable future actions for the evaluation of cumulative impacts of the modules considered in the initial COL applications.

As part of the proposed action, the applicant may install infrastructure and facilities that could be used to support additional reactor modules. If these activities are not NRC-authorized construction activities as defined in 10 CFR 51.4., they would be considered pre-construction activities and would be evaluated as part of the cumulative impact analysis.

Chapter 8: Need for Power

Chapter 8 will follow the guidance for evaluating need for power in the ESRP and ISG-026. For all scenarios, the analysis of the need for power and the cost-benefit analysis would be for only the modules being licensed.

Chapter 9: Environmental Impacts of Alternatives

Staff should identify reasonable alternatives that are able to achieve the purpose and need of the proposed action as defined in Chapter 1. Generally, ESRP Chapter 9 provides sufficient staff guidance for reviewing project alternatives. Identification and evaluation of reasonable alternatives to a proposed action is the intent of NEPA:

Reasonable alternatives include those that are *practical or feasible* from the technical and economic standpoint and using common sense, rather than simply *desirable* from the standpoint of the applicant. (From the Council on Environmental Quality [\[CEQ\]](#))

[1981](#) | Question 2a, CEQ, Forty Most Asked Questions Concerning CEQ's NEPA Regulations, March 23, 1981)).

With LLWRs, reasonable alternatives to the proposed action may be limited because of the plant's large installed capacity. Because light water SMRs are much smaller in generating capacity, installations of individual renewable energy technologies (or combinations of renewable and non-renewable energy technologies), conservation, and/or energy efficiency could potentially meet the project's purpose and need. An alternative is not reasonable if it does not meet the purpose and need statement. NRC staff should identify alternative energy sources that would meet the purpose and need of the proposed action as defined in Chapter 1. For example, the alternative power source would generate the same amount of electrical energy [i.e., MWh/yr] with the same reliability as that generated by the total number of light water SMR modules for which the applicant has requested licenses, as well as any additional purposes identified in the purpose and need statement in Chapter 1.

For the site selection process, the staff should consider sites that could support all the modules that the applicant is requesting for licensing, plus any planned future modules that the staff concludes are reasonably foreseeable. The light water SMRs require a smaller site footprint than LLWRs, which may allow for a larger set of potential sites to be included in the site selection process.

An applicant may request construction at a specific location to meet their purpose and need for a light water SMR facility. For example, an applicant may propose to use excess heat for industrial processes or station heating. A proposed light water SMR may be used to provide a secure energy source for military, government, or critical industrial facilities. In these cases, the applicant must still submit and the staff must review alternative sites. However, the region of interest used for the site selection process may be much smaller than is typical for LLWRs (e.g., within the confines of a military installation).

Chapter 10: Conclusion and Recommendation

ESRP Chapter 10 provides sufficient staff guidance for preparing concluding remarks and discussing the project's electrical benefits and the environmental costs for the modules for which a license is being requested. However, the reviewer should note that any additional purposes and needs that were defined in Chapter 1 of the EIS should be accompanied by description (quantified or qualified as the subject requires) of the benefits of each additional purpose in sufficient detail so that a fully informed benefit-cost conclusion can be reached.

Final Resolution Method

This issue will be resolved in the next revision to NUREG-1555, "The Environmental Standard Review Plan" and related guidance documents.

Applicability

This ISG is applicable to the review of ESP, LWA, OL, CP, and COL applications for light water SMR reactor technologies.

References

1. 10 CFR Part 50. *Code of Federal Regulations*, Title 10, *Energy*, Part 50, “Domestic Licensing of Production and Utilization Facilities.”
2. 10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”
3. 10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”
4. 40 CFR Parts 1500-1508. *Code of Federal Regulations*, Title 40, Parts 1500-1508, “Protection of Environment, Chapter V – Council on Environmental Quality.”
5. Council on Environmental Quality (CEQ). 1981. *Forty Most Asked Questions Concerning CEQ's NEPA Regulations*. March 23, 1981.
6. National Environmental Policy Act of 1969, as amended (NEPA). 42 U.S.C. 4321 et seq.
7. Nuclear Regulatory Commission (NRC). 2000-. *Environmental Standard Review Plan — Standard Review Plans for Environmental Reviews for Nuclear Power Plants*. NUREG-1555, Vol. 1. Includes 2007 revisions. U.S. Nuclear Regulatory Commission.
8. Nuclear Regulatory Commission (NRC). 2007. 72 FR 57416. October 9, 2007. “Limited Work Authorizations for Nuclear Power Plants.” *Federal Register*. U.S. Nuclear Regulatory Commission.
9. Nuclear Regulatory Commission (NRC). 2011. SECY-11-0079 - Staff Memorandum from R.W. Borchardt, NRC, to the Commissioners, dated June 12, 2011, “License Structure for Multi-Module Facilities Related to Small Modular Nuclear Power Reactors.” Accession No. ML110620459
10. Nuclear Regulatory Commission (NRC). 2013. COL/ESP-“ISG-026, Interim Staff Guidance on Environmental Issues Associated with New Reactors.” Accession No. ML12326A925