FINAL

MICRO-REACTOR APPLICATIONS
COL-ISG-029

Environmental Considerations Associated with Micro-reactors

Interim Staff Guidance

ML20252A076 –FINAL

ISSUANCE STATUS

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I. PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) staff is preparing for the environmental reviews[1] of prospective design, license, and permit applications for advanced nuclear power reactors (advanced reactors), including micro-reactors. Characteristics shared by designs referred to as micro-reactors include the low potential for transients and accidents, low potential for radioactive releases, low potential consequences from radiological release, small building and site footprints, operating power levels on the order of tens of megawatts-thermal or less, and increased reliance on passive systems and inherent characteristics used to control power and prevent radioactive releases.

The purpose of this interim staff guidance (ISG) is to modify existing guidance and provide supplemental guidance to assist the NRC staff in determining the scope and scale of environmental reviews of micro-reactor applications. The guidance highlights unique considerations for micro-reactors in each resource area typically covered in the staff's environmental review. This document also offers guidance on scaling the analyses. The staff should be familiar with the following guidance documents that may inform the preparation of a prospective applicant's environmental report (ER):

- NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan, issued October 1999;
- COL/ESP-ISG-026, "Environmental Issues Associated with New Reactors," issued August 2014;
- NUREG-1537, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," issued October 2012; and
- Final Interim Staff Guidance Augmenting NUREG 1537, Part 1, 'Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors: Format and Content,' for Licensing Radioisotope Production Facilities and Aqueous Homogenous Reactors," dated October 17, 2012, specifically related to Chapter 19, "Environmental Review".

The NRC staff may also consider the guidance in this ISG along with that in Regulatory Guide (RG) 4.2, "Preparation of Environmental Reports for Nuclear Power Stations," when preparing

[1] The regulations at Title 10 of the *Code of Federal Regulations* (10 CFR) 51.20, "Criteria for and Identification of Licensing and Regulatory Actions Requiring Environmental Impact Statements," require the preparation of an environmental impact statement (EIS) or a supplement documenting the NRC staff's environmental findings for issuance of an early site permit (ESP) or a combined license (COL) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," or for issuance of a construction permit (CP) and operating license (OL) for a nuclear power reactor under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." Applicants for micro-reactors will most likely file applications for COLs or ESPs under Part 52 or for CPs or OLs under Part 50. As such, 10 CFR 51.20 applies and requires that the staff prepare an EIS for those licensing actions.

EISs. A micro-reactor may have a limited impact during the construction and operation phases of the facility, and this fact could support streamlined documentation and reduce review times.

This ISG focuses on identifying considerations and approaches to better align the environmental reviews to the unique aspects of micro-reactors relative to the environmental reviews that the NRC has previously performed for other nuclear facilities, such as large light-water reactors (LWRs). This ISG outlines what the NRC staff considers to be an appropriate scope and level of detail for the specific aspects of an environmental review needed to document a micro-reactor licensing action. A micro-reactor may have some, but not necessarily all, of the following characteristics:

- occupies only a small area of land, disturbs only previously disturbed lands, or both
- uses zero or only small quantities of resources, such as water or fuel
- releases zero or only small quantities of emissions to the environment
- avoids environmentally sensitive areas such as wetlands and floodplains
- avoids areas with cultural, historic, or environmental justice significance
- avoids habitat for threatened or endangered species
- uses mitigation to reduce impacts
- involves only low levels of employment for both construction and operation
- uses simpler designs than those for large LWRs, with limited interfaces with the exterior environment

While this ISG is designed to aid the NRC staff in developing a micro-reactor EIS, the staff recognizes the value of this guidance as a supplemental source of insight into the NRC's environmental review process that can inform the development of an applicant's ER. Applicants should scale their level of effort appropriately when preparing ERs, commensurate with the significance of the impact on the resource area being addressed.

The scope of this ISG is limited to environmental review considerations specific to micro-reactors, such as the following:

- preapplication interactions
- purpose and need for the proposed project
- size of the proposed project and resources used
- mitigation
- land use
- water resources
- terrestrial ecology
- aquatic ecology
- socioeconomics and environmental justice
- historic and cultural resources
- need for power and alternatives

- meteorology and air quality
- nonradiological health
- radiological health
- postulated accidents
- severe accident mitigation alternatives (SAMAs);
- acts of terrorism
- fuel cycle impacts, transportation of fuel and waste, and continued storage of spent fuel
- cumulative impact analysis
- consistency with safety licensing documents
- incorporation by reference

The NRC staff will continue to look for other opportunities to effectively streamline environmental reviews and work with prospective applicants to identify opportunities to streamline ERs and still meet the NRC's regulations.

II. BACKGROUND

The NRC issued COL-ISG-029 in the *Federal Register* (FR) as a draft for public comment on February 26, 2020 (Volume 85 of the *Federal Register*, page 11127 (85 FR 11127)). The comment period closed on May 11, 2020. The NRC addressed the comments and appropriately modified this final ISG. The comment response document is available in the Agencywide Documents Access and Management System (ADAMS at Accession No. ML20252A077). Historically, the NRC has licensed nuclear facilities, including large LWRs, that involved the construction of dozens of buildings and other structures comprising the use of hundreds of acres. Large LWR projects had the potential to fundamentally transform surrounding landscapes, stream and river systems, and rural communities. The NRC staff anticipates that the construction footprints for micro-reactors will be small, that water consumption may be zero or limited to a small amount per day for potable purposes, and that construction and operation may involve a limited number of workers. Furthermore, many of these micro-reactors may be sited within existing developed areas that lack sensitive environmental resources. As such, when compared to a large LWR, a micro-reactor is likely to require a smaller amount of data and analysis for most environmental issues.

III. APPLICABILITY

This ISG is applicable to the environmental reviews for micro-reactor licensing actions. Specifically, this ISG applies to environmental reviews for micro-reactors associated with limited work authorization, construction permit, and operating license applications submitted under 10 CFR Part 50, and with ESP and COL applications under 10 CFR Part 52. Elements of this ISG may also be applicable to other advanced reactor projects. Applicants are encouraged to discuss this applicability during the preapplication phase.

IV. GUIDANCE

Preapplication Interactions

Preapplication interactions could assist the applicant in determining the appropriate scope and scale of an ER. Early interactions among the applicant and staff and their respective contractors should be used to establish clear communications and mutual understanding of the review scope and to identify key areas of significance in the application. Preapplication interactions between prospective applicants and the NRC staff conducted in accordance with

Title 10 of the Code of Federal Regulations (10 CFR) Part 51.40, "Consultation with NRC staff," can help set the scale of environmental field surveys before making substantive commitments of time and resources. Preapplication meetings and interactions need to be well focused and cover specific features, topics, and issues that are expected to be technically complex, unique, novel, or challenging from a policy perspective.

Early preapplication engagement may provide the NRC staff insight on how to best prepare to efficiently and effectively review a submittal. For example, the detailed characterization of terrestrial and aquatic habitats and seasonal observations of flora and fauna described in RG 4.11, "Terrestrial Environmental Studies for Nuclear Power Stations," and RG 4.24, "Aquatic Environmental Studies for Nuclear Power Stations," may not be necessary for projects that disturb only a few acres. Purely reconnaissance-level evaluations using published and online data sources and perhaps a single site visit may be adequate for certain resource areas, depending on the characteristics of the proposed new micro-reactor and site. The scope of site characterization and environmental baseline surveys should be tailored to what is essential to take a meaningful, hard look at licensing alternatives. Preapplication interactions among prospective applicants, their consultants, and NRC staff subject matter experts provide an opportunity to appropriately scale an environmental review and accurately estimate needed review time and resource allocations. ERs comprising concise or qualitative reconnaissance level evaluations by qualified subject matter experts for most environmental resource areas may be adequate for micro reactors with minimal potential for impacts.

Purpose and Need for the Proposed Project

The NRC staff develops the purpose and need statement, informed by the applicant's objectives[2] as stated in the applicant's ER, and this statement is the basis for the evaluation of the need for the project and for establishing a reasonable set of alternatives to the proposed action. Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint using common sense. A reasonable alternative may be outside an agency's regulatory authority, such as energy alternatives (e.g., coal, wind, solar, natural gas) and would need to be evaluated to determine if it meets the purpose and need statement for the project. However, if the purpose and need statement was to demonstrate a certain advanced reactor technology to generate electricity, alternative energy such as coal, wind, solar or natural gas would not be a reasonable alternative because it does not meet the purpose and need statement. Alternatives that do not meet the purpose and need statement are not considered reasonable alternatives and are not analyzed in detail.

For micro-reactors, the applicant may request licensing for purposes other than or in addition to electric power production, and the NRC staff considers the purpose of the project as identified by the applicant's ER in developing the purpose and need statement in the NRC's EIS.

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[2] The Council on Environmental Quality's (CEQ's) regulation at 40 CFR 1502.13, "Purpose and Need," 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." A recent change to the CEQ regulations, to become effective September 14, 2020 (85 FR 43304), modifies this definition as follows: "The statement shall briefly specify the underlying purpose and need for the proposed action. When an agency's statutory duty is to review an application for authorization, the agency shall base the purpose and need on the goals of the applicant and the agency's authority." The NRC is currently reviewing the applicability of the changes to the CEQ regulations to agency environmental reviews. However, the NRC will follow 10 CFR 51 regulations until rulemaking changes 10 CFR 51.

Size of the Proposed Project and Resources Used

The NRC staff anticipates that a micro-reactor will have a small footprint and use limited resources. If the micro-reactor site disturbs (either permanently or temporarily) no more than a few acres, then the amount of information and level of data collection needed to characterize the affected resources and the impacts resulting from the footprint of disturbance may be limited. In addition, because of the small facility size, the applicant can potentially select a site that avoids impacts to some resources, such as wetlands, floodplains, sensitive habitats, or historic and cultural resources. The following sections discuss the analysis of specific environmental resources for a micro-reactor.

Mitigation

The National Environmental Policy Act of 1969 (NEPA) document should be written to be clear when mitigation measures are or are not reasonably foreseeable. A mitigation measure can be considered reasonably foreseeable if, for example, it is 1) required by the NRC as a license condition (e.g., a requirement imposed pursuant to 10 CFR 50.54(aa)), 2) required or likely to be required by another regulatory agency (e.g., United States Army Corp of Engineers), or 3) mitigation that the applicant has stated to the NRC (e.g., in the Environmental Report) that it would perform. Where mitigation measures would be required by a license condition, that should be clearly stated in the NEPA document.

Where applicable, the NRC staff should specify what Federal, State, or local laws require the mitigation measures, or if there is (or is expected to be) a Federal, state, or local permit that requires the particular measures. The NRC staff should clearly explain the requirements that are being imposed by the regulatory agency with authority over the resource and state how the staff relied on the mitigation to determine the impact level by discussing how the mitigation will be accomplished and whether it is expected to lower the impact level. For example, for a project where a wetlands mitigation plan is required by a state permit issued to the applicant and/or by state laws and regulations, the NRC staff should consider this information in its NEPA evaluation.

If the applicant committed to mitigation measures in the environmental report or other documents submitted to the NRC under oath or affirmation, that may be sufficient for the NRC staff to rely on that mitigation to determine impact levels, provided the NRC staff documents in the NEPA evaluation why it concludes that the mitigation is reasonably foreseeable. For example, if the applicant states that it plans to use construction best management practices (BMPs) that are not required by a license condition or another State or Federal permit, then the staff should rely on this mitigation if it can document that these BMPs are standard industry construction practices. BMPs can also be relied on if they are integral parts of the project. Documentation may take the form of asking the applicant to provide additional information to help determine if these practices are reasonably foreseeable. NRC staff should ask, for example, whether these same practices have been used by the applicant on other large construction projects.

If mitigation would result in a change in impact level for one or more resource areas, it is particularly important that the staff document the basis for concluding that this mitigation is reasonably foreseeable. NEPA instructs agencies to discuss environmental issues in accordance with their significance. If a mitigation measure is particularly important to an impact determination, it may be appropriate to request more specific additional information from an applicant to obtain more details on the proposed mitigation plan. If the available information

does not clearly demonstrate whether the mitigation measure is reasonably foreseeable and the non-implementation of that mitigation would result in a change in an impact level, then the staff should provide two impact levels; one with and one without mitigation (Example: The impact from traffic would be MODERATE without the traffic mitigation and SMALL with the mitigation). Because NEPA allows agencies to account for uncertainty, it may be appropriate to discuss why there is uncertainty in a particular analysis or state which impact is more likely to occur. If the non-implementation of mitigation would not alter the impact level, then the staff should provide the impact level without the mitigation and state that the mitigation, if enacted, would further reduce/minimize impacts (Example: The impact from traffic would be SMALL without mitigation, but implementation of a traffic management plan would further reduce impacts within the SMALL category.

Land Use

Micro-reactors might have a small land use footprint, consisting of only a few acres, thus affecting minimal land and land-based resources, such as farmland, forests, and minerals. As such, micro-reactors may be sited to avoid floodplains, wetlands, park land, and prime or unique farmland. The application should scale the methodologies in these guidance documents, as appropriate, for micro-reactors to reflect the anticipated land area affected and land-based resources used. The applicant may need to use certain guidance for a consistency determination under the Coastal Zone Management Act if a micro-reactor is sited in a State-designated Coastal Zone. The ER will need to evaluate whether building and operation of the micro-reactor is consistent with applicable zoning and land use plans. If the applicant proposes to locate a micro-reactor on a site containing, or adjacent to, sensitive land resources, such as wetlands or prime or unique farmland, then the applicant should perform the appropriate analyses, commensurate with the potential impacts of the micro-reactor, following existing guidance for considering possible impacts to those resources. Analysis of impacts to sensitive land resources adjacent to the micro-reactor site should continue to consider the limited off-site impacts anticipated for most micro-reactor designs, and scale the methodologies used in the existing guidance accordingly.

Because micro-reactors may require only a small area of land, it may be possible to site them entirely within existing or former industrial areas without requiring the dedication of land otherwise available for non-industrial uses or the disturbance of natural habitats or cultural resources. The discussions of impacts to land use, terrestrial and aquatic ecology, and cultural resources may be simplified for those micro-reactors. There may however have to be a consideration of the possible presence of contaminated soils, groundwater, and other environmental media resulting from former industrial operations at those sites.

Water Resources

If a micro-reactors did not use cooling water it would not require constructing or operating cooling water intake or discharge structures or pipelines. If this is the case, the ER will not need to analyze the associated impacts. A brief evaluation may be sufficient to document that the water demands can be met without noticeably affecting surface and ground water resources. It

may also be necessary to briefly document the use of best management practices in accordance with State or local guidelines to minimize potential erosion and sedimentation.

Terrestrial Ecology

Micro-reactors might affect terrestrial habitat and important species and their habitats. Micro-reactors could be sited to avoid wetlands, riparian habitats, critical habitats, or habitats potentially containing threatened or endangered species. The ER will not have to address potential impacts to terrestrial features that are avoided. Micro-reactors also might not require transmission lines, pipelines, heavy haul roads, or other linear development features. If such linear development is not contemplated, then the ER will not have to consider possible effects on terrestrial habitats distant from the site. It will always be necessary for the NRC staff to consult with the U.S. Fish and Wildlife Service (FWS) to comply with Section 7, "Interagency Cooperation," of the Endangered Species Act. However, it may be possible to resolve potential concerns from a micro-reactor project affecting little or no terrestrial habitat through informal consultation.

Aquatic Ecology

If micro-reactors did not use cooling water it would not require constructing or operating cooling water intake or discharge structures or pipelines, the staff will not have to address such issues as entrainment, impingement, or entrapment of aquatic biota or thermal discharges. If a micro-reactor is sited away from surface waters and associated floodplains and stream valleys, the ER will not need to characterize potential impacts from sedimentation or erosion. Micro-reactors also may not require transmission lines, pipelines, heavy haul roads, or other linear development features. If such linear development is not contemplated, then the ER will not have to consider possible effects on surface water features distant from the site. It will always be necessary for NRC staff to consult with the FWS and National Marine Fisheries Service (NMFS) to comply with Section 7 of the Endangered Species Act. For projects sited in coastal areas or near large rivers, the staff may need to consult with the NMFS as well to comply with the Magnuson-Stevens Act. However, it may be possible to resolve potential concerns from a micro-reactor project affecting little or no aquatic habitat through informal consultation.

Socioeconomics and Environmental Justice

Micro-reactors may have limited numbers of construction workers and operational staff, and therefore may not require extensive demographic and employment analyses. The evaluation should be scaled as appropriate to reflect the employment levels and demand for regional services such as housing, schools, police, and fire. The scope will depend on the extent of project activities, and the focus of the analyses should consider only those areas affected by the project and the distances at which impacts of building and operating over the expected license term may occur.

Historic and Cultural Resources

Applicants for micro-reactors may propose to disturb only a small footprint of land, which may correspond to a small area of potential effects (APE) on historic and cultural resources. Based on the size of the APE, it may be possible to site a micro-reactor to avoid or minimize impacts to historic and cultural resources. However, the process for assessing effects to historic properties and historic and cultural resources, along with the associated consultation under Section 106 of

the National Historic Preservation Act of 1966, is the same as for other reactor projects. The implementing regulations at 36 CFR Part 800, "Protection of Historic Properties," serve as a guide for gathering information and assessing the effects to historic properties. A small APE may expedite the review process. The scope of the impact evaluation depends on the potential presence and significance of resources within the APE. For example, siting on previously disturbed land could potentially reduce the likelihood of discovering archaeological resources.

Need for Power and Alternatives

The applicant should base the discussion of the need for electrical power on the guidance in RG 4.2. However, a micro-reactor application might include additional purposes, such as generating power in a cogeneration arrangement or exclusively producing specific products (e.g., potable water, hydrogen gas). In each case, the NRC staff will determine the need for the proposed end-user products. RG 4.2 provides several options to demonstrate the need for power. For instance, if an applicant were to seek a license for the cogeneration of electricity and the desalination of saltwater for human consumption, the applicant would have to establish the need for the electricity in a manner similar to that currently discussed in RG 4.2. Similarly, the plan to produce potable water would trigger a second need analysis to determine whether the relevant service area needs the water that would be produced. This additional need would also trigger a second set of alternative analyses—in this case, for alternative ways to supply the societal need for potable water (e.g., drilling wells, creating reservoirs, or piping in water from where it is more abundant). Early in the preapplication process, the NRC staff should determine whether the applicant anticipates including purposes for the proposed facility beyond the commercial sale of electricity.

Meteorology and Air Quality

Micro-reactors may have limited potential air emissions and if the project is replacing a carbon dioxide (CO_2) emitting generator or is built instead of CO_2 emitting generator, then it is expected to have a net positive potential contribution to mitigating global climate change. For specific data requirements, the environmental review of potential meteorology and air quality impacts from micro-reactors will likely rely on the same information provided for the safety review and not require additional monitoring data or dispersion modeling. If a micro-reactor operates without cooling towers, then analyses of cooling tower drift, shadowing, fogging, and icing will not be necessary. The applicant should scale, as appropriate, any analysis of atmospheric emissions from construction and operations based on the review procedures in NUREG-1555 to the expected level of emissions. However, the staff may rely on other documents as appropriate for its global climate change review and findings.

If the project will avoid CO_2 emissions by replacing a source of power that emits CO_2 compared to alternatives, then the staff should estimate the CO_2 avoided by generating the electricity from a micro-reactor. The staff should calculate the operational CO_2 emissions from the micro-reactor including emissions from associated auxiliary boilers or emergency generators, if any. The operational CO_2 emissions from an alternate generator of the same size as the micro-reactor should be calculated and compared to the operational emissions from the micro-reactor.

State the effects of replacing the alternate generator with a micro-reactor on global climate change.

Nonradiological Health

If a micro-reactor has a small size, simple design, minimal staffing, and limited resource use, it may pose a limited nonradiological risk to human health and safety. As such, simple analyses of potential nonradiological impacts may be sufficient. A small footprint, limited workforce, and design considerations may result in a streamlined health analysis. If a micro-reactor can operate without cooling water discharges, it would have a limited potential to elevate surface-water temperatures conducive to pathogens. If limited vehicular use is necessary to build and operate a micro-reactor, transportation safety considerations may be minimal. Additionally, micro-reactors may not require transmission lines; thus, the ER may not need to consider the effects of electromagnetic fields over distant landscapes.

Radiological Health

Micro-reactors may have limited, or zero, radiological releases during normal operations from liquid, gaseous, and solid radioactive waste systems, as driven by the design. Current guidance and procedures for assessing radiological health still apply if the applicant anticipates radiological releases. The staff should also consider incorporation by reference of the safety findings since the micro-reactor applicant would still have to demonstrate that plant operations are within the dose limits of 10 CFR Part 20, "Standards for Protection Against Radiation." The environmental findings must also address the area's cumulative population exposure for comparison with the natural background radiation level and consider doses to nonhuman biota. The staff should complete this part of the environmental assessment using the same analytical tools as applied to the radiological health safety findings.

Postulated Accidents

The risks from micro-reactor accidents may be limited. As with radiological health, the micro-reactor's design will drive the staff's environmental evaluation of postulated accidents for the micro-reactor. In evaluating the radiological releases from postulated accidents, the staff will consider the design's safety features and analyses, including the results of a probabilistic risk assessment, as appropriate, and as presented in the applicant's safety analysis report. The NRC environmental reviewers will coordinate the review of such postulated accidents with the NRC safety reviewers.

Severe Accident Mitigation Alternatives

A particular micro-reactor design may not have credible severe accidents associated with it.[3] In such a case, the NRC staff will not need to assess the offsite environmental impacts from severe accidents or evaluate the benefits and costs of SAMAs. The ER should provide information, including appropriate references to the accident analysis contained in the safety analysis report, to support the assertion that a SAMA evaluation is not needed. The NRC staff's EIS must document whether or not the conclusions reached in the safety evaluation report support the applicant's severe accident analysis. However, if the micro-reactor design has credible severe accidents, a SAMA evaluation will be necessary. The current guidance for

[3] The NRC staff will determine whether credible severe accidents are associated with a particular micro-reactor design based on the staff's review of information presented in an applicant's safety analysis report.

SAMAs is based on several documents, including NUREG/BR-0058, “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,” and NUREG/BR-0184, “Regulatory Analysis Technical Evaluation Handbook,” issued January 1997, with industry guidance for license renewals provided in Nuclear Energy Institute (NEI) 05-01, “Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document,” Revision A, issued November 2005.

If the design includes credible severe accidents, the applicant should perform a SAMA screening, and the NRC staff will determine whether a SAMA evaluation is necessary. In considering the results of the screening, the NRC staff should determine the cost benefit of performing a SAMA evaluation. This screening process should be based on the available risk information from the safety analysis report and apply the cost formulas as a first step rather than a last step, as prescribed under current review practices. If the resulting maximum benefit cost will clearly not exceed the implementation cost of any design alternatives, then the environmental finding of no potentially cost-beneficial SAMAs is reasonable.

Acts of Terrorism

Previous Circuit Court decisions addressed the circumstances under which the NRC must assess the environmental impacts from potential acts of terrorism and sabotage. The United States Court of Appeals for the Ninth Circuit held that the NRC could not categorically refuse to consider the consequences of a terrorist attack in an analysis under the NEPA. The Commission thereafter stated it will adhere to the court’s decision for licensing actions for facilities subject to the jurisdiction of that Circuit. The court decisions related to NEPA evaluations of terrorist attacks and the NRC staff’s subsequent evaluations to address them are discussed in Section E.3, “Accident Risk and Impact Assessment,” of Appendix E, “Environmental Impact of Postulated Accidents,” to NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants,” Revision 1, issued June 2013, and in Section 4.19, “Potential Acts of Sabotage or Terrorism,” of NUREG2157, “Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel,” issued September 2014. In circumstances under which the NRC is required to address acts of terrorism and sabotage (i.e., for proposed nuclear facilities located within the territorial jurisdiction of the Ninth Circuit Court of Appeals), the staff evaluation will apply a process for reaching an environmental finding for this impact unless the microreactor applicant can demonstrate that the design features that provide physical protection of the reactor make acts of terrorism remote and speculative. This section presents two options for the staff to consider for the environmental review.

The first method is to determine whether an act of terrorism would have a similar result as a bounding licensing basis event evaluated under the safety review. NUREG-1437 and NUREG-2157 state that the staff should assess whether a postulated accident evaluated under the safety analysis from internally initiated events or external hazard events would be bounding for a potential act of terrorism.

A second method could be applied if the postulated accidents evaluated as part of the safety review cannot provide the bounding scenario. In this case, the NRC environmental reviewer should coordinate with staff in the NRC Office of Nuclear Security and Incident Response to determine the impacts from acts of terrorism as is appropriate for the physical safety features of the micro-reactor design in accordance with 10 CFR Part 73, “Physical Protection of Plants and Materials.” If the staff determines that acts of terrorism or sabotage are not credible, then this would be so noted in the environmental findings. If such a determination cannot be reached, then the environmental impacts from acts of terrorism should be evaluated with the resulting

hypothetical radiation dose to be determined for an individual at the site boundary and at any other desired offsite locations. A calculated dose to an individual at the nearest site boundary could be applied for comparison to be consistent with the regulatory dose requirements at the time of the application.

As part of either assessment option, the NRC staff should discuss how such acts could be mitigated by the applicant's plans for complying with the physical protection requirements under 10 CFR Part 73, "Physical Protection of Plants and Materials," that provide reasonable assurance that the risk from sabotage is small. The resulting environmental finding should then be based on a combination of the applicant's plans for satisfying the security requirements and the assessed environmental impacts.

Fuel Cycle Impacts, Transportation of Fuel and Waste, and Continued Storage of Spent Fuel

The NRC staff has evaluated fuel cycle impacts for LWRs, as documented in 10 CFR 51.51, "Uranium Fuel Cycle Environmental Data—Table S-3," Table S-3, "Table of Uranium Fuel Cycle Environmental Data." However, in accordance with 10 CFR 51.51, only an ER for LWRs can include Table S-3. For reactors other than LWRs, the application must contain the basis for evaluating the contribution of the environmental effects of fuel cycle activities for the reactor (10 CFR 51.50(b)(3) and 10 CFR 51.50(c)). The staff should discuss during preapplication interactions how the applicant will address the fuel cycle impacts for the specific project.

The NRC has generically evaluated the environmental impacts of the transportation of fuel and waste in 10 CFR 51.52, "Environmental Effects of Transportation of Fuel and Waste—Table S-4," Table S-4, "Environmental Impact of Transportation of Fuel and Waste To and From One Light-Water-Cooled Nuclear Power Reactor," for LWR fuel that meets certain entry conditions specified in 10 CFR 51.52(a). Additionally, in NUREG-2157, the NRC evaluates the environmental impacts of the continued storage of spent nuclear fuel beyond the licensed life for the operation of LWRs. In 10 CFR 51.23, "Environmental Impacts of Continued Storage of Spent Nuclear Fuel Beyond the Licensed Life for Operation of a Reactor," the NRC specifies that NUREG-2157 is deemed incorporated into the EIS for a new reactor. However, NUREG-2157 did not evaluate the storage of spent nuclear fuel from non-LWRs.

The NRC staff will address the transportation of fuel and wastes along with spent fuel storage for micro-reactors and other non-LWRs on a case by case basis and document its findings in the appropriate environmental review documentation. The general methodology for assessing transportation impacts, as discussed in NUREG-1555 Sections 5.7.2, "Transportation of Radioactive Material," and 7.4, "Transportation Accidents," along with RG 4.2, Section 6.2.1, "Components of a Full Description and a Detailed Analysis of Transportation Impacts," should be applied for assessing these environmental impacts assuming all appropriate information and data has been provided by the applicant. The staff should consider whether micro-reactor fuel cycle impacts can be bounded by current environmental impact analyses for existing fuel cycle facilities. Moreover, the staff should incorporate fuel cycle impact assessments from other environmental analyses—such as NEPA assessments by the U.S. Department of Energy (DOE) (if DOE is providing the fuel), or reviews by the NRC related to the licensing of future fuel cycle facilities that would fabricate micro-reactor nuclear fuel.

Cumulative Impact Analysis

Micro-reactors may have operational and physical characteristics (e.g., small footprints) that minimize the size of the area affected by the micro-reactor project, thereby more narrowly

focusing the scope of the cumulative impact analysis. If the micro-reactor project does not impact a resource, then the NRC's environmental review will not need to discuss or provide a cumulative impact analysis for that resource.

Consistency with Safety Licensing Documents

Micro-reactor designs must satisfy the applicable technical requirements of 10 CFR Part 50, 10 CFR Part 52, and 10 CFR Part 100, "Reactor Site Criteria," as well as the public and occupational health requirements of 10 CFR Part 20 and 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," as applicable. The NRC environmental reviewers for the radiological impact assessment should closely coordinate the review with the NRC safety reviewers. To the extent practicable, the radiological impacts presented in the applicant's ER should be consistent with the safety analysis report.

If a micro-reactor applicant also submits requests for exemption from any safety regulations, the ER and the EIS must assess the environmental impacts of the exemption requests. Additionally, confirmatory calculations in support of the NRC staff's safety review could be informative for assessing offsite impacts under the environmental review. The staff should review and coordinate any differences between the applicant's safety and environmental documents and document those differences in its findings.

Incorporation by Reference

Reviewers are encouraged to use incorporation by reference to reduce the length and amount of time needed for environmental reviews. Incorporation by reference may be especially useful in keeping environmental review documentation on a scale appropriate for micro-reactors. Appendix A to this ISG provides guidance on the use of incorporate by reference.

V. IMPLEMENTATION

The NRC staff will use the information discussed in this ISG to evaluate the potential environmental impacts of micro-reactors on the various resource areas in relation to their significance.

VI. FINAL RESOLUTION

This guidance will be incorporated into the next revision of NUREG -1555, "Environmental Standard Review Plans." Following the transition of this guidance to NUREG-1555 this ISG will be closed.

APPENDIX

A. Incorporation by Reference Guidance for an Environmental Impact Statement

REFERENCES

Code of Federal Regulations, Title 10, *Energy,* Part 20, "Standards for protection against radiation."

Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic licensing of production and utilization facilities."

Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions."

Code of Federal Regulations, Title 10, *Energy,* Part 52, "Licenses, certifications, and approvals for nuclear power plants."

Code of Federal Regulations, Title 10, *Energy,* Part 73, "Physical protection of plants and materials."

Code of Federal Regulations, Title 10, *Energy,* Part 100, "Reactor site criteria."

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RG 4.24, “Aquatic Environmental Studies for Nuclear Power Stations,” Revision 0, Issued December 2016, (ADAMS Accession No. ML15309A219).

Appendix A

Incorporation by Reference Guidance for an Environmental Impact Statement

Purpose

The U.S. Nuclear Regulatory Commission (NRC) promotes measures to streamline internal processes to improve efficiency. Efficiency measures include those aimed at optimizing the environmental reviews performed by the NRC staff. One initiative to streamline the environmental review process and reduce unnecessary repetition of previous analyses is to incorporate by reference publicly available documents. This appendix provides methodologies for incorporating previous analyses by reference into environmental review documentation.

Background

Consistent with Title 10 of the *Code of Federal Regulations* (10 CFR) 51.95(a), the NRC staff may incorporate by reference any information contained in a final environmental document previously prepared by the NRC staff that relates to the same facility. Additionally, 10 CFR Part 51, "Environmental protection regulations for domestic licensing and related regulatory functions," Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," Appendix A, "Format for Presentation of Material in Environmental Impact Statements," states, in part, that the technique of incorporation by reference described in 40 CFR 1502.21, "Implementation," of the Council on Environmental Quality's regulations implementing the National Environmental Policy Act of 1969 (NEPA) may be used as appropriate to aid in the presentation of issues, eliminate repetition, or reduce the size of an environmental impact statement (EIS). The regulation at 40 CFR 1502.21, "Incorporation by reference," states the following[4]:

> Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. **The incorporated material shall be cited in the statement and its content briefly described.** No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference. [Emphasis added]

[4] A recent change to the CEQ regulations, to become effective September 14, 2020 (85 FR 43304), moves the "Incorporation by reference" section to 40 CFR 1501.12, and modifies the language to read the following: "Agencies shall incorporate material, such as planning studies, analyses, or other relevant information, into environmental documents by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. Agencies shall cite the incorporated material in the document and briefly describe its content. Agencies may not incorporate material by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Agencies shall not incorporate by reference material based on proprietary data that is not available for review and comment." However, the NRC will follow 10 CFR 51 regulations until rulemaking changes 10 CFR 51.

These regulations allow NRC technical reviewers to comply with the requirements of NEPA by referring to materials already published elsewhere.

General Staff Guidance

When incorporating by reference, technical reviewers should adhere to the following three principles to meet the criteria of 40 CFR 1502.21:

(1) Specificity: After ensuring that reference material is publicly available, identify the documents that are being incorporated by reference and specify the section or page range, or both, that is being incorporated.

(2) Summarize: Provide a summary of the information being incorporated by reference.

(3) Address new information: Identify and discuss any new information relevant to environmental concerns and bearing on the proposed action or its impacts that was not considered in the documents being incorporated by reference.

Environmental reviewers are encouraged to incorporate by reference any relevant information from other publicly available documents (from the NRC, applicant documents submitted for the record, or any other reputable source, such as other governmental entities or academic institutions). The staff must only incorporate by reference documents that are publicly available and properly cite them in the EIS reference list. Incorporating material from applicant documents (such as the environmental report and safety analysis report) may be appropriate. The staff should not, however, incorporate by reference conclusions from the applicant's environmental report.

The regulations at 10 CFR 51.41, "Requirement to submit environmental information," state that "[t]he Commission will independently evaluate and be responsible for the reliability of any information which it uses." As such, the staff is responsible for evaluating and verifying the reliability of the information that is incorporated by reference.

Generic Example

When NRC technical reviewers decide to use incorporation by reference for applicable documents, the staff's review document should contain a clear statement to that effect. For example, at first usage in an EIS, the staff can accomplish incorporation by reference by using language similar to the following:

> Where appropriate, the NRC staff has summarized and incorporated by reference material from the EIS for [XXX].

At the first appearance of each document incorporated by reference, the text should fully spell out the title, and the EIS reference list should properly cite each document mentioned.