Advanced Nuclear Reactors Justify Modernized Emergency Preparedness Requirements

U.S. Nuclear Industry Council, ClearPath, and Third Way

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Findings

A viable future U.S. advanced nuclear industry needs Emergency Planning Zones (EPZs) based on the specific safety characteristics of a reactor design. EPZs for advanced reactors should be appropriately based on the new generation of advanced reactor technologies. For example, advanced reactors should be regulated like industrial facilities that have similar levels of risk. The Tennessee Valley Authority (TVA) correctly recognized the contradiction between the existing Nuclear Regulatory Commission (NRC) EPZ regulations and the improved risk profiles of advanced reactors. TVA proposed an approach in their recent Early Site Permit (ESP) Application that is informed by enhanced design features and safety margins of light-water cooled small modular reactors (SMRs). This proposal establishes an important precedent for future advanced reactor emergency planning activities.

The U.S. Nuclear Industry Council (USNIC), ClearPath, and Third Way strongly support the NRC approval of the TVA plume exposure pathway EPZ sizing methodology for both the Clinch River ESP and for future advanced non-light water cooled advanced reactors. This methodology was initially presented in the TVA Clinch River ESP Application, which was reviewed and approved by the NRC staff. The TVA approach can result in an EPZ at the site boundary or at two miles, depending on the specific safety and design characteristics of the reactor selected within the envelope of the ESP.

Background

Historically, as a part of the licensing of a new nuclear reactor, the NRC has defined an EPZ surrounding the plant. The exact size and configuration of the EPZ can vary from plant to plant due to local emergency response needs and capabilities, the population surrounding the site, the topographic characteristics, access routes in the specific area, and the jurisdictional boundaries of the region. However, the regulation stipulates a plume exposure pathway EPZ of “about 10 miles” in a radius around the plant.

In the U.S., each commercial nuclear power reactor has both onsite and offsite emergency plans to assure that adequate protective measures can be taken to protect the public in the event of a radiological emergency. Federal oversight of emergency preparedness for nuclear power plants is shared by the NRC and Federal Emergency Management Agency (FEMA). The NRC has statutory responsibility for the radiological health and safety of the public by overseeing onsite preparedness and the overall authority for both onsite and offsite emergency preparedness.

Before a plant is licensed to operate, the NRC must have "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The NRC's decision of reasonable assurance is based on licensees meeting NRC regulations and guidance which demonstrate compliance with appropriate safety requirements. In addition, licensees and area response organizations must demonstrate that they can effectively implement emergency plans and procedures during periodic evaluated exercises. As part of the Reactor Oversight Process, the NRC reviews licensees' emergency planning procedures and training. These reviews include regular drills and exercises that assist licensees in identifying areas for improvement, such as in the interface of security operations and emergency preparedness. Each plant operator is required to exercise its emergency plan with offsite authorities at least once every two years to ensure state and local officials remain proficient in implementing their emergency plans. Those biennial exercises are inspected by the NRC and evaluated by FEMA. Licensees also self-test their emergency plans regularly by conducting drills.[i]

Discussion

The licensing of reactors depends on their facilities meeting NRC's regulations for construction and operation. However, many regulations including those for EPZs, were developed and implemented based on the currently licensed fleet of large light water reactors (LWRs) which have characteristics that differ from advanced reactors (including light-water SMRs)[1]. Regulations should be appropriately tailored to meet the potential safety risk of the facility, and should recognize the significant value that passive and inherent safety systems can provide. An approach that requires advanced reactors to meet standards and practices consistent with their safety characteristics and risk, such as a reduced EPZ, should apply for all advanced reactors, consistent with the approach set forth in TVA's Clinch River ESP Application, and independent of location. The NRC is in the process of a rulemaking that would allow multiple advanced nuclear reactors (including SMRs and non-LWRs) to use a similar methodology to determine appropriate EPZs. Such an approach would provide the same level of public health and safety as is provided by the current operating fleet of large LWRs.

If the NRC determines that the appropriate EPZ should be located at the reactor's site boundary, no formal off-site response plans would be required because the likelihood of accidents that have a significant public health and safety impact outside of the facility are extremely low. Any such hypothetical accident would have a risk commensurate with many other industrial hazards such that they would be covered by "all hazard plans" that are routinely developed and used by local and regional responders to respond to events such as natural disasters, industrial accidents, and transportation

[1] Small modular reactors (SMRs) are generally considered to be 300 MWe or less. "Advanced reactors" typically refers to non-LWRs, i.e., using different fuel, coolant, and/or moderator types. Many non-LWRs currently under development are also SMRs. In the context of EPZ sizing, SMRs and non-LWRs share similar attributes of smaller source terms, increased accident progression times, and passive/inherent safety features.

accidents. Importantly, licensees of advanced nuclear facilities would still be required to have appropriate onsite response plans.[ii]

TVA's Clinch River Proposal Leads the Way

Right-sizing regulations for future advanced reactor designs (including light-water SMRs), which utilize passive and inherent safety features, is essential to affordably facilitating the next generation of nuclear technologies while maintaining the safety of people living and working near advanced reactors. Approval of the TVA ESP will be the first formal regulatory action to recognize that future advanced reactor designs should have regulations that both credit their improved safety characteristics and are representative of a facility's overall reduced risk. The TVA ESP Application uses a plume exposure pathway EPZ methodology that is a risk-informed, dose-based, and consequence-oriented approach that is appropriate for such a technology.[iii]

The TVA ESP Application requested: (a) approval for plume exposure pathway EPZ sizing methodology, (b) exemptions for a site boundary EPZ or a 2-mile EPZ, and (c) approval for two major features emergency plans. The TVA ESP Application does not establish the final plume exposure pathway EPZ size for the Clinch River site. The final EPZ size for the Clinch River site would be determined in a future application based on a specific reactor's safety and design characteristics. Ultimately, the NRC staff supported the plume exposure pathway EPZ sizing methodology to be used in a future combined license or construction permit application.

The approach TVA used has broader applicability than just for a reactor built at the Clinch River site. The TVA ESP Application described the characteristics of a nuclear plant using a composite of reactor and engineering parameters based on four U.S. light water SMR designs. Other advanced reactor designs, including non-LWRs, may fit into the same set of parameters if they have the appropriate accident source terms, risks, and other similar safety characteristics. Thus, other advanced reactors also may be able to use this risk-informed methodology and justify having either a site boundary EPZ or a less than 10-mile EPZ.

The NRC issued a Final Environmental Impact Statement for the TVA ESP Application in April 2019,[iv] and the Final Safety Evaluation Report in June 2019[v]. The NRC staff has recommended, based upon the environmental and safety reviews, issuing an ESP for the Clinch River Nuclear site in Oak Ridge, TN.

The NRC held a mandatory public hearing on August 14, 2019. Based on a statement made at the August 14, 2019 NRC public hearing, the NRC Commissioners intend to decide on an appropriate methodology for determining EPZs in general after receiving any post-hearing input. FEMA submitted a post-hearing letter detailing their concerns with the scalable emergency planning approach on August 24, 2019. The NRC staff responded point by point to the FEMA post-hearing letter on September 5, 2019 substantiating that the basis for the NRC analysis, based in part on Environmental Protection Agency (EPA) policies, was appropriate for regulating future SMRs and non-LWRs.

In order to enable viable future U.S. advanced nuclear technologies, the NRC should approve the use of EPZs that are based on the specific safety characteristics of a reactor design. The TVA plume exposure

pathway methodology that is supported by the NRC staff is an appropriate methodology for the NRC to use not only for the Clinch River site, but also to apply to future advanced reactor designs.

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About USNIC
The United States Nuclear Industry Council (USNIC) is the leading U.S. business consortium advocate for new nuclear and promotion of the American supply chain globally. Composed of over 80 companies USNIC represents the "Who's Who" of the nuclear supply chain community, including key utility movers, technology developers, construction engineers, manufacturers and service providers. USNIC encompasses eight working groups and select task forces including an Advanced Reactors Task Force. For more information visit www.usnic.org.

About ThirdWay
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Our agenda is ambitious, aspirational, and actionable. It is built on the bedrock belief that for political movements to succeed in our political system, they must relentlessly re-imagine their policies, strategies, and coalitions.

We are fighting for opportunity, so everyone has the chance to earn a good life; progress on social issues, so all have the freedom to live the lives they choose; and security, so we are protected from 21st century global threats. For more information visit www.thirdway.org.

Contact Information:
Nicholas McMurray
Nuclear Program Director
ClearPath
Phone: 216.407.2387
Email: mcmurray@clearpath.org

Cyril Draffin
Senior Fellow, Advanced Nuclear
United States Nuclear Industry Council
Phone: 301.233.4643
Email: Cyril.Draffin@usnic.org

Ryan Fitzpatrick
Director of the Clean Energy Program
Third Way
Phone: 202.384.1734
Email: rfitzpatrick@thirdway.org

[i] https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/emerg-plan-prep-nuc-power.html#targetText=For%20planning%20purposes%2C%20the%20NRC,access%20routes%2C%20and%20jurisdictional%20boundaries
[ii] https://www.nrc.gov/about-nrc/emerg-preparedness/respond-to-emerg/nuclear-facility-response.html
[iii] https://www.nrc.gov/reactors/new-reactors/esp/clinch-river.html
[iv] https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2226/
[v] https://www.nrc.gov/reading-rm/doc-collections/news/2019/19-026.pdf