

# **ANS/JCNRM Risk-Informed EP Workshop**

## **Graded approach to EPR and perspectives related to SMR deployment**

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**Division of Preparedness and Response**

**Office of Nuclear Security and Incident Response**

**U.S. Nuclear Regulatory Commission**

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**Reactor technology is advancing,  
EP is evolving,  
but the NRC's mission to protect the  
health and safety of the public  
remains unchanged**

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# Commission Policy Statement on Advanced Reactors

“the Commission expects, as a minimum, at least the same degree of protection of the environment and public health and safety and the common defense and security that is required for current generation light-water reactors (LWRs)...  
the Commission expects that advanced reactors will provide **enhanced** margins of safety and/or use **simplified, inherent, passive, or other innovative means** to accomplish their safety and security functions.” (emphasis added)<sup>1</sup>

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1 [73 FR 60612; October 14, 2008](#)

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# NRC Safety Policy and Reasonable Assurance

- NRC safety policy expresses the Commission's views on acceptable level of risks to public health and safety and on safety-cost tradeoffs in regulatory decision making
- Reasonable assurance of adequate protection of public health and safety is defined by the totality of Commission's health and safety regulations
  - "Adequate protection does not mean absolute protection...Safe is not the equivalent of risk-free"<sup>2</sup>
- When applicant/licensee demonstrates compliance with NRC regulations, it follows that there is reasonable assurance of adequate protection of public health and safety
- Once adequate protection is achieved, NRC is not empowered to drive risk even lower – that would be unnecessary regulatory burden
- NRC has the sole authority to make determinations regarding requirements for emergency preparedness, both onsite and offsite

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2 Union of Concerned Scientists vs NRC 824F.2.d 114, 118 D.C. Cir 1987

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# Modernizing Advanced Reactor Licensing

- **Nuclear Energy Innovation and Modernization Act (NEIMA)**
  - Defined an *advanced nuclear reactor* to mean a nuclear fission or fusion reactor with significant improvements compared to commercial nuclear reactors that include improvements such as additional inherent safety features, greater fuel utilization, enhanced reliability, increased thermal efficiency, and ability to integrate into electric and nonelectric applications.
- **NRC'S Vision and Strategy (ML16356A670) Outcomes**
  - Readiness for non-light water reactors to include policy issue resolution on EP requirements for high-safety, low-consequence designs.
  - Licensing Modernization Project provides endorsed guidance (RG-1.233) that focuses on evaluating defense in depth for *advanced reactor* designs.
- **NRC is modernizing its approach to licensing advanced reactors**
  - transparent manner with participation of all stakeholders as outlined in its webpage at <https://www.nrc.gov/reactors/new-reactors/advanced.html>

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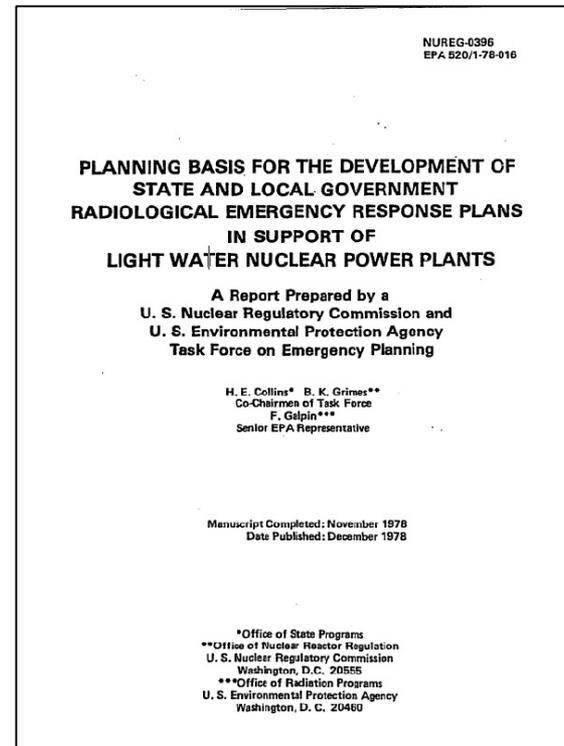
# Objective of Radiological Emergency Preparedness and Response

- The overall objective of emergency preparedness (EP) at NRC is to ensure that there is reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency
  - Reasonable Assurance finding is made before a nuclear facility is licensed
  - Inspected over the lifetime of that facility
- EP provides for dose savings for a spectrum of accidents that could produce doses in excess of the Environment Protection Agency (EPA) protective action guides (PAG)

# NUREG-0396 Planning Basis Rationales

NUREG-0396 Task Force  
Considered Various  
Planning Basis Rationales:

- Risk
- Probability
- Cost Effectiveness
- Consequence Spectrum
  - Principal rationale behind planning basis



***The Task Force based the rationale on a full spectrum of accidents and corresponding consequences, tempered by probability considerations.***

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# NUREG-0396 EP Planning Basis

A spectrum of accidents should be considered to scope the planning efforts for:

- *The **distance** to which planning for predetermined protective actions is warranted*
- *The **time** dependent characteristics of a potential release*
- *The type of radioactive **materials***

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# NUREG-0396 Emergency Planning Zones (EPZ)

“The EPZ guidance does not change the requirements for emergency planning, it only sets bounds on the planning problem. The Task Force does not recommend that massive emergency preparedness programs be established around all nuclear power stations.”

***So how do you set the boundary?***

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# Scalable EPZ

- EPZ size based on the consequences from a spectrum of accidents, tempered by probability considerations.
- NRC regulations provide for scalable EPZs.
- Reactors have been approved for a 5 mile EPZ in the past.
- Depending on facility type, the EPZ may be the site-boundary.
- Considerable amount of studies since the 1980s on sizing EPZs for passive and advanced reactor designs all based on NUREG-0396 methodology.

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# Graded Approach to EP

- A risk-informed process in which the safety requirements and criteria are set commensurate to the risk of the facility
- Existing NRC regulations employ EP graded approach
  - Power reactors
    - (low-power testing, power operations, decommissioning)
  - Research and test reactors
  - Fuel Fabrication Facilities
  - Independent Spent Fuel Storage Installations
  - Monitored Retrievable Storage

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# Graded Approach to EP and Scalable EPZ

- NRC proposed rule provides a graded approach to EP that would base EPZ sizing for small modular reactors (SMRs) and other new technologies (ONT) on the risk of the facility involved
- Could result in a site containing a very low-risk power reactor with EPZ not greater than the site boundary, or smaller than for current large reactors
- Once adequate protection is achieved, NRC is not empowered to drive risk even lower – that would be unnecessary regulatory burden

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# Graded Approach to EP and Scalable EPZ

- NRC has the sole authority to make determinations regarding EPZ size and the requirements for both onsite and offsite EP and the overall determination of reasonable assurance
  - If NRC determines an EPZ size is greater than the site boundary, then formal offsite radiological emergency preparedness is a requirement
    - NRC will consult with FEMA for review of the adequacy of offsite preparedness
  - If NRC determines an EPZ size is not greater than the site boundary, then formal offsite radiological preparedness is not a requirement
    - Consultation with FEMA is not necessary
  - In either case, the NRC makes the final determination of reasonable assurance

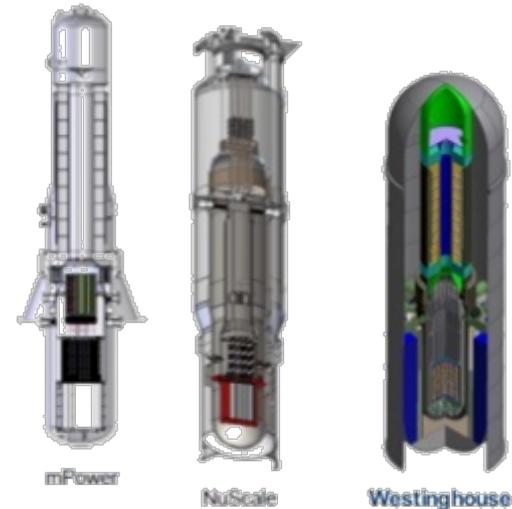
# EP for SMRs & ONT

- Rulemaking to develop a clear set of rules and guidance for small modular reactors (SMRs) and other new technologies (ONT)

Technology Neutral

Risk-Informed, Performance Based

Principle of dose-at-distance and consequence-oriented approach to determine EPZ size



- New designs/technologies are including features to enhance the margin of safety through use of simple, inherent, or passive means to accomplish their safety and security functions.

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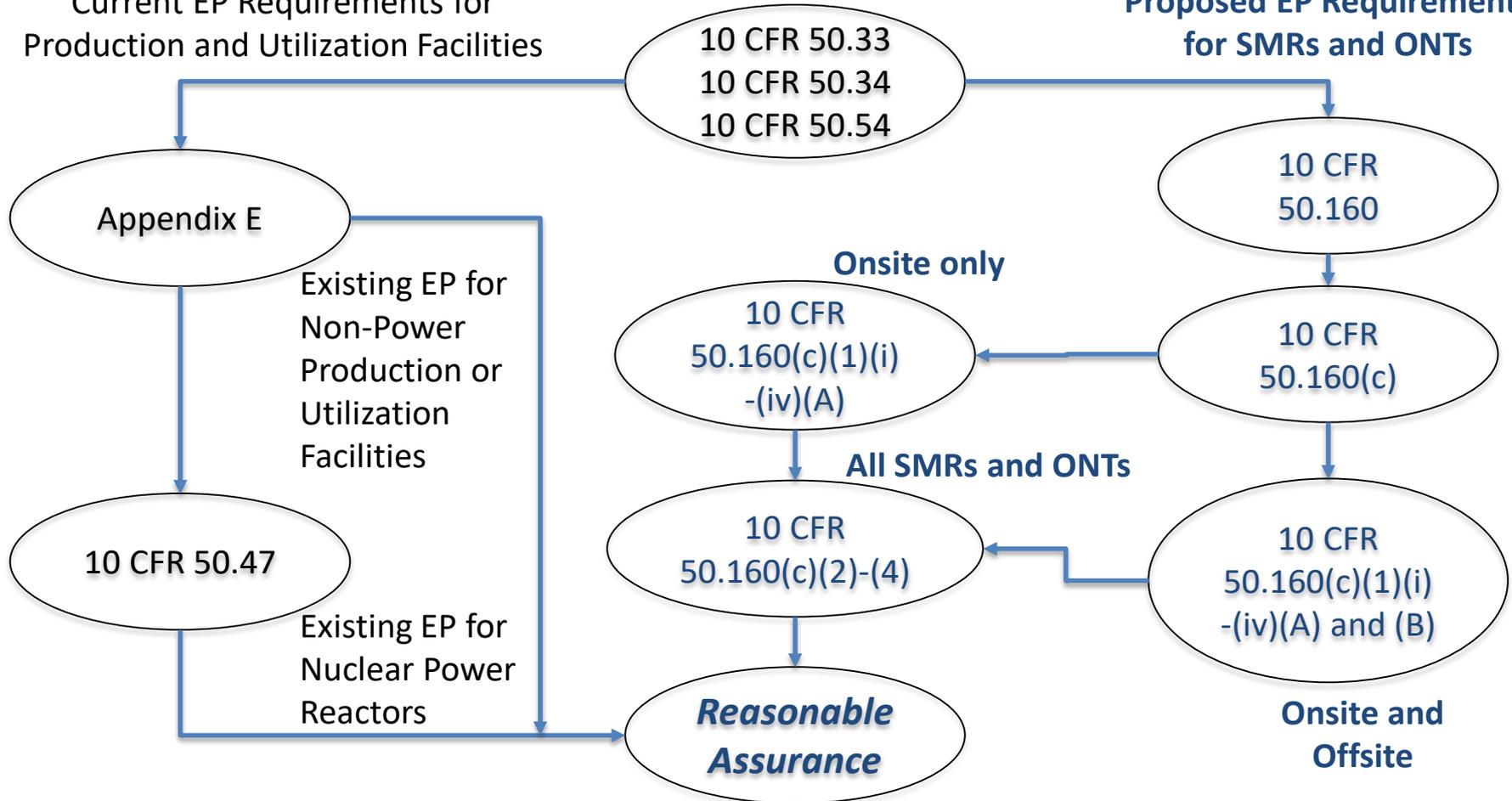
# Purposes of the Rule

- Provide an alternative performance-based, regulatory framework for SMRs and ONTs
- Address policy, licensing, and technical issues associated with SMR emergency planning
- Does not address: source terms, security, and siting criteria for SMRs or ONTs

# Framework

Current EP Requirements for  
Production and Utilization Facilities

Proposed EP Requirements  
for SMRs and ONTs



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# Major Provisions of Proposed NRC Rule

- Technology-inclusive for future SMRs and ONTs, including medical radioisotope facilities and non-light-water reactors
- Scalable performance based EP regulatory framework is proportional to the risk without unwarranted regulatory burden
- Scalable EPZ size based on the consequences (*1 rem / 96 hours*) from a spectrum of credible accidents, tempered by probability considerations.
- Ingestion planning *capabilities* rather than defined ingestion planning *zone*
- Hazard analysis for contiguous facilities
- New designs/technologies are including additional features to meet the expectations of the Commission Policy Statement on Advanced Reactors, issued in 2008
- NRC as a matter of long standing principle has licensed facilities such as research and test reactors, reactors at low power operation, and fuel facilities with EPZs that do not require a formal off-site EP program

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# Scalable EPZ

- Scalable approach for plume exposure pathway EPZ
  - Consistent with the analyses documented in NUREG-0396
  - Environmental Protection Agency (EPA) Protective Action Guides (PAG) manual supports the EPZ-PAG and planning relationship
  - Consistent with the existing graded-approach afforded to:
    - Research and test reactors
    - Fuel cycle facilities
    - Independent spent fuel storage installations
- Same level of protection afforded to public health and safety

*“The proposed rule simply allows the nuclear industry to be credited for recent and continuing design innovations and to deploy new designs employing these innovations in a way that enhances safety.”*

*Department of Energy (DOE) Comment letter on the proposed Emergency Preparedness for SMR and ONT rulemaking.*

- Proposed rule federal register notice for public comment
  - <https://www.gpo.gov/fdsys/pkg/FR-2020-05-12/pdf/2020-09666.pdf>
  - Proposed rule public comment period ended September 25, 2020

## NUCLEAR REGULATORY COMMISSION

### 10 CFR Parts 50 and 52

[NRC–2015–0225]

RIN 3150-AJ68

#### Emergency Preparedness for Small Modular Reactors and Other New Technologies

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Proposed rule and guidance; request for comment.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to include new requirements for small modular reactors (SMRs) and other new technologies (ONTs), such as non-light-water reactors (non-LWRs) and certain non-power production or utilization facilities (NPUFs). The new EP requirements would acknowledge technological advancements and other differences from large LWRs that are inherent in SMRs and ONTs. Concurrently, the NRC is issuing for public comment draft Regulatory Guide (DG), DG–1350, “Performance-Based Emergency Preparedness for Small Modular Reactors, Non-Light-Water Reactors, and Non-power Production or Utilization Facilities.” The NRC plans to hold a public meeting to promote full understanding of the proposed rule and guidance and to facilitate public comment.

**DATES:** Submit comments by July 27, 2020. Comments received after this date will be considered if it is practical to do so, but the Commission is able to ensure consideration only for comments received before this date.

**ADDRESSES:** You may submit comments by any of the following methods (unless this document describes a different method for submitting comments on a specific subject):

- **Federal Rulemaking Website:** Go to <https://www.regulations.gov> and search for Docket ID NRC–2015–0225. Address questions about NRC dockets to Carol Gallagher; telephone: 301–415–3463; email: [Carol.Gallagher@nrc.gov](mailto:Carol.Gallagher@nrc.gov). For technical questions contact the individuals listed in the **FOR FURTHER INFORMATION CONTACT** section of this document.

- **Email comments to:** [Rulemaking.Comments@nrc.gov](mailto:Rulemaking.Comments@nrc.gov). If you do not receive an automatic email reply confirming receipt, then contact us at 301–415–1677.

- **Mail comments to:** Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001, ATTN: Rulemakings and Adjudications Staff.

For additional direction on obtaining information and submitting comments, see “Obtaining Information and Submitting Comments” in the **SUPPLEMENTARY INFORMATION** section of this document.

**FOR FURTHER INFORMATION CONTACT:** Robert Beall, Office of Nuclear Material Safety and Safeguards; telephone: (301) 415–3874, email: [Robert.Beall@nrc.gov](mailto:Robert.Beall@nrc.gov); or Eric Schrader, Office of Nuclear Security and Incident Response; telephone: 301–287–3789; email: [Eric.Schrader@nrc.gov](mailto:Eric.Schrader@nrc.gov); both are staff of the U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001.

#### SUPPLEMENTARY INFORMATION:

##### Executive Summary

##### A. Need for the Regulatory Action

The current EP requirements and guidance, initially developed for large light-water reactors (LWRs) and for non-power reactors, also referred to as research and test reactors (RTRs), as defined in part 50 of title 10 of the *Code of Federal Regulations* (10 CFR), “Domestic Licensing of Production and Utilization Facilities,” do not consider the advances in designs and safety research and their application to future operation of SMRs and ONTs. Through this proposed rule, the NRC is proposing to amend its regulations to create an alternative EP framework for SMRs and ONTs. The new alternative EP requirements and implementing guidance in DG–1350 would adopt a performance-based, technology-inclusive, risk-informed, and consequence-oriented approach. The new alternative EP requirements and guidance would adopt a scalable plume exposure pathway emergency planning zone (EPZ) approach and address ingestion response planning. The new alternative EP requirements and guidance would: (1) Continue to provide reasonable assurance that adequate protective measures can and will be implemented by an SMR or ONT licensee; (2) promote regulatory stability, predictability, and clarity; (3) reduce requests for exemptions from EP requirements; (4) recognize advances in design and technological advancements embedded in design features; (5) credit safety enhancements in evolutionary and passive systems; and (6) credit smaller sized reactors’ and non-LWRs’ potential benefits associated with postulated accidents, including slower transient response times, and relatively

small and slow release of fission products. This proposed rule and guidance could affect existing SMR and non-LWR applicants and licensees as well as SMRs, non-LWRs, and NPUFs that would be licensed after the effective date of the final rule. Those applicants and licensees would have the option to develop a performance-based EP program as an alternative to using the existing, deterministic EP requirements in 10 CFR part 50. This proposed rule does not include within its scope emergency planning, preparation, or response for large LWRs, fuel cycle facilities,<sup>1</sup> or currently operating non-power reactors. For the purposes of this rule, large LWRs are reactors that are licensed to produce greater than 1,000 megawatts thermal (MWt) power.

##### B. Major Provisions

Major provisions of this proposed rule and guidance would include the addition of:

- A new alternative performance-based EP framework, including requirements for demonstrating effective response in drills and exercises for emergency and accident conditions;
- A hazard analysis of any NRC-licensed or non-licensed facility contiguous or nearby to an SMR or ONT, that considers any hazard that would adversely impact the implementation of emergency plans;
- A scalable approach for determining the size of the plume exposure pathway EPZ; and
- A requirement to describe ingestion response planning in the emergency plan, including the capabilities and resources available to prevent contaminated food and water from entering the ingestion pathway.

##### C. Costs and Benefits

The NRC prepared a draft regulatory analysis to determine the expected quantitative costs and benefits of this proposed rule and associated guidance as well as qualitative factors to be considered in the NRC’s rulemaking decision. The conclusion from the analysis is that this proposed rule and associated guidance would result in net averted costs to the industry and the NRC ranging from \$5.69 million using a 7-percent discount rate to \$9.71 million using a 3-percent discount rate.

The draft regulatory analysis also considered qualitative aspects, such as greater regulatory stability, predictability, and clarity to the licensing process. These benefits would

<sup>1</sup>Emergency planning requirements for facilities licensed under 10 CFR part 70, “Domestic Licensing of Special Nuclear Material,” are set forth in § 70.22(i).

- NRC Public Website for rule information
  - <https://www.nrc.gov/reading-rm/doc-collections/rulemaking-ruleforum/active/RuleDetails.html?id=18>

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## Planned Rulemaking Activities - Rule

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📄 Rule Information

Title	Emergency Preparedness Requirements for Small Modular Reactors and Other New Technologies								
Docket ID:	NRC-2015-0225	RIN:	3150-AJ68						
Affected CFR Parts:	50, 52								
Associated PRM Numbers:	-								
Rule Phase:	Proposed Rule	Rule Type:	Could Reduce Or Clarify Existing Requirements						
Area of Regulatory Responsibility	New Reactors								
NRC Office:	Office of Nuclear Reactor Regulation (NRR)								
Status:	Funded								
Signature Authority:	Commission Approval & SECY Signature	Associated Guidance Documents:	Yes						
Abstract:	<p>This rulemaking would amend the NRC's regulations to add new emergency preparedness requirements for small modular reactors and other new technologies such as non-light-water reactors and non-power production or utilization facilities. The rule would adopt a scalable plume exposure pathway emergency planning zone approach that is performance-based, consequence-oriented, and technology-inclusive. This rulemaking would affect applicants for new NRC licenses and reduce regulatory burden related to the exemption process.</p>								
NRC Contacts	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Name</th> <th style="width: 30%;">Phone</th> <th style="width: 40%;">Email</th> </tr> </thead> <tbody> <tr> <td>Beall, Robert</td> <td>301-415-3874</td> <td>Robert.Beall@nrc.gov</td> </tr> </tbody> </table>	Name	Phone	Email	Beall, Robert	301-415-3874	Robert.Beall@nrc.gov		
Name	Phone	Email							
Beall, Robert	301-415-3874	Robert.Beall@nrc.gov							

- <https://www.regulations.gov>
  - Search on Docket ID: NRC-2015-0225

The screenshot shows the homepage of regulations.gov. At the top, there is a navigation menu with links for Home, Help, Resources, and Contact Us. Below the navigation is a search bar with a magnifying glass icon and the text "Search". To the right of the search bar are buttons for "Browse" and "Learn". The main content area features a large banner with the text "Make a difference. Submit your comments and let your voice be heard." Below this banner is a search box with the text "SEARCH for: Rules, Comments, Adjudications or Supporting Documents:" and a search input field containing "NRC-2015-0225". To the right of the search input is a "Search" button and a link to "Advanced Search". Below the search box are three columns of content: "What's Trending" with a bar chart icon, "Comments Due Soon" with a list of comment counts for various time periods, and "Newly Posted" with a list of comment counts for various time periods. On the right side of the page, there is a sidebar with links for "Visit New Regulations.gov Site", "Unable to submit a comment?", "APIs for Developers", "Browse by Category", and "DOS Regulations Twitter Page".

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# Contact Information

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# Acronyms

**ANS** – Alert and Notification System

**CFR** – Code of Federal Regulations

**DOE** – Department of Energy

**EPA** – Environmental Protection Agency

**EPR** – Emergency Preparedness and Response

**EPZ** – Emergency Planning Zone

**FEMA** – Federal Emergency Management Agency

**LWR** – Light Water Reactor

**ONT** – Other New Technology(ies)

**PAG** – Protective Action Guides

**NRC** – Nuclear Regulatory Commission

**SMR** – Small Modular Reactor