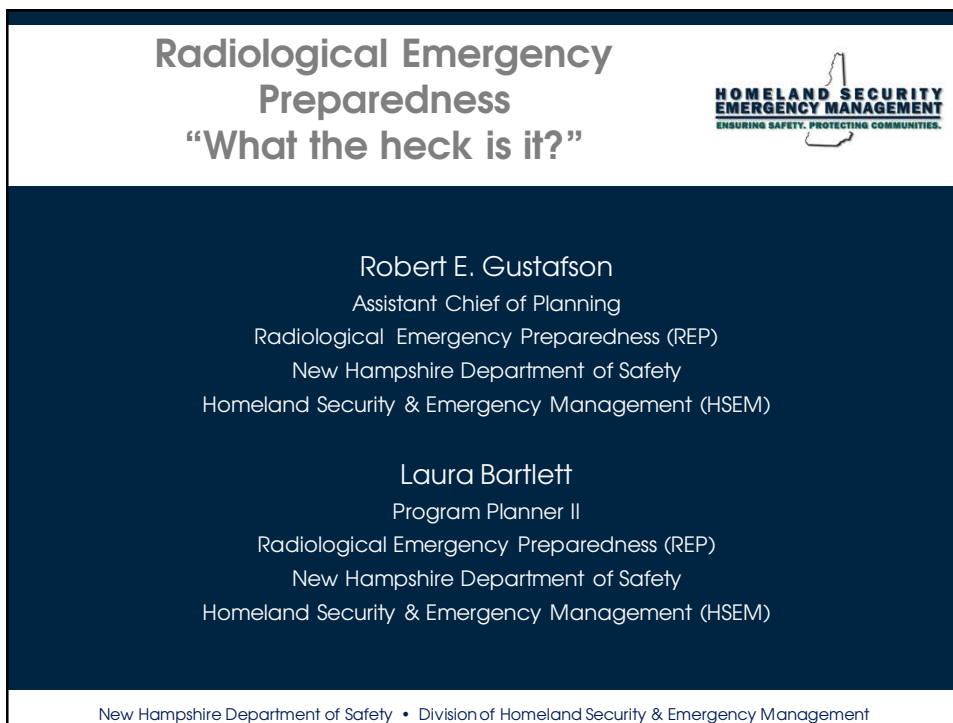




The image is a promotional banner for a conference. At the top left is the New Hampshire Department of Safety logo. The main background features a photograph of a nuclear power plant with a large containment dome, situated near a body of water. Below this are four smaller images: a map of New Hampshire with a red arrow pointing to the location, another view of the power plant, a map of the state with colored regions, and a sign for 'The Science & Nature Center'. The text is centered in white on a dark blue background.


**NH HSEM Emergency Preparedness Conference
Radiological Emergency Preparedness
What the Heck Is It?
June 5, 2018**

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This slide features a white header with the title and a logo on the right. The main content is on a dark blue background with white text. The footer is a white bar with black text.

**Radiological Emergency Preparedness
"What the heck is it?"**




**HOMELAND SECURITY
EMERGENCY MANAGEMENT**
ENSURING SAFETY. PROTECTING COMMUNITIES.

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Radiological Emergency Preparedness
“What the heck is it?”



Radiological Emergency Preparedness – REP

What Is It ?


Why Do We Need It ?

How Does a Community Benefit ?

What Does the Future Hold ?

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Radiological Emergency Preparedness
“What is it?”




FEMA Program Manual
Radiological Emergency Preparedness

“The REP Program coordinates the National effort to provide State, local, and Tribal governments with relevant and executable planning, training, and exercise guidance and practices to ensure that adequate capabilities exist to prevent, protect against, mitigate the effects of, respond to, and recover from incidents involving commercial nuclear power plants (NPPs).”

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Radiological Emergency Preparedness
“What is it?”




FEMA Program Manual
Radiological Emergency Preparedness

“The REP Program assists State, local, and Tribal governments in the development and conduct of off-site radiological emergency preparedness activities within the emergency planning zones (EPZs) of Nuclear Regulatory Commission (NRC) licensed commercial nuclear power facilities.”

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REP – Why Do We Need It?



FEMA Program Manual
Radiological Emergency Preparedness

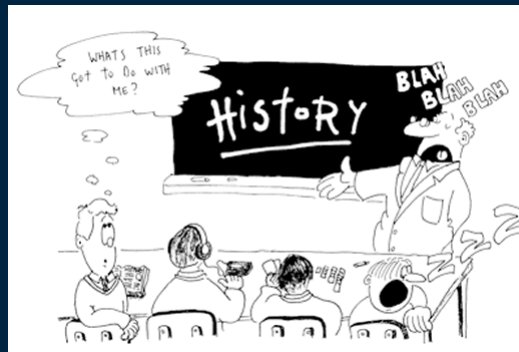
“REP’s historical success lies in the ability to integrate and enhance Federal, State, local, and Tribal governments’ preparedness planning and response capabilities for all types of radiological emergencies.”

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REP – Why Do We Need It? “Back to the future”



- Whoever wishes to foresee the future must consult the past;
 - Machiavelli
- Those who cannot learn from history are doomed to repeat it.
 - Santayana



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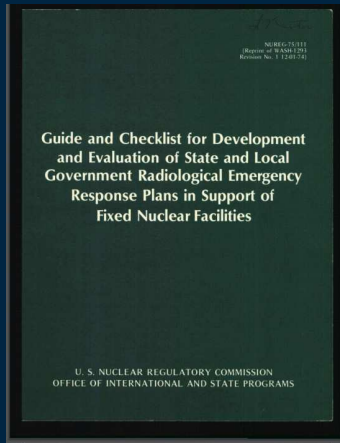
REP – Why Do We Need It? “Looking Back”



- Emergency planning not important consideration in early years of NPP development.
- Up to mid-1960s, experts thought most severe accidents would not breach containment.
- Atomic Energy Commission (AEC) required plans for dealing with radiological emergencies; plans were vague and low priority.
- Increasing size of NPPs focused attention on EP.
- December 1974 NRC published NUREG-75/111 “Guide and Checklist for Development... of Radiological Emergency Plans (REP)...”
- EPA published Protective Action Guides (PAG) manual in 1975 but did not specify bounds on planning.

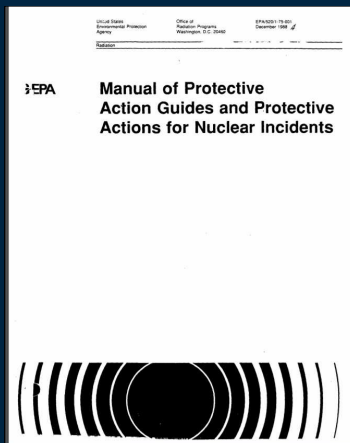
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REP – Why Do We Need It? “Looking Back”



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REP – Why Do We Need It? “Looking Back”



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REP – Why Do We Need It? “Looking Back”



- 1976 - Conference of (State) Radiation Control Program Directors asked NRC “to make a determination of the most severe accident basis for which radiological emergency response plans should be developed by offsite agencies.”
- NRC and EPA established a task force.
- NRC-EPA task force report - 1978, NUREG-0396, “Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants.”
 - a “spectrum of accidents ... (not based on a single accident sequence) should be considered in developing a basis for EP”
 - “most important guidance for planning officials is the distance... which defines the area over which planning... should be carried out”
 - Emergency planning zones sizes introduced
 - **NRC was 3 years old, EPA 8 Years old**

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REP – Why Do We Need It? “Looking Back”



- The overall objective of EP is to provide dose savings for a **spectrum of accidents** that could produce **offsite doses in excess of PAGs**
 - EPA PAGs are based on stochastic risk, not deterministic threat
- Planning basis elements consider **distance, timing, materials**
- **EPZs** are areas for which planning is needed to assure that **prompt** and effective actions can be taken to protect the public in the event of an accident
 - 10 mile plume exposure pathway
 - 50 mile ingestion exposure pathway
- Developed for Prompt Corrective Action, not the Prolonged Action.

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REP – Why Do We Need It? “Looking Back”



- Nuclear Power Plant emergency preparedness programs are intended to *reduce* dose, not eliminate dose, to the public during a radiological emergency.
- NRC has overall responsibility for licensing decisions considering:
 - On-site emergency preparedness evaluated by NRC
 - Off-site emergency preparedness evaluated by FEMA
 - Final decision on licensing is responsibility of NRC
- EP has always been a licensing requirement for nuclear power plants.
 - Emergency planning zones
 - Requirements for plans

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Emergency Planning Zones (EPZ)

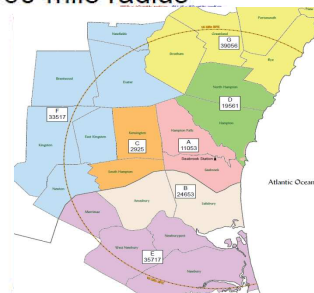
Plume Exposure Pathway

- Area requiring immediate protective action
 - Evacuation
 - Sheltering
 - Potassium Iodide
- 10-mile radius
- Monitoring of offsite radiological releases
- Public alerting and notification



Ingestion Exposure Pathway

- Protect from consumption of contaminated food
- Precautionary measures may be taken
- 50-mile radius



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REP – Why Do We Need It? “Looking Back”



Three Mile Island Unit 2 Accident



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REP – Why Do We Need It? “Looking Back”



Three Mile Island Unit 2

- March 28, 1979 an accident at TMI-2 melted approximately 1/2 of reactor core.
- 13 million curies of radioactive noble gases (primarily xenon isotopes) released.
- ~ 15 Ci of Iodine-131 released
- No health effects except for stress.
- Average dose to area residents ~1 millirem, maximum dose to a person at the site boundary ~ 75-85 millirem.

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REP – Why Do We Need It? “Looking Back”



Three Mile Island Unit 2

- NRC Only, No FEMA
- FEMA Still Being Developed
- GAO evaluated radiological emergency preparedness;
 - published report calling for improvements to offsite EP;
 - recommended that the NRC issue operating licenses only in locations where State/ local governments' emergency plans met the NRC'S guidelines.
- Report was published on **March 30, 1979, during the midst of the TMI accident**

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REP – Why Do We Need It? “Looking Back”



Three Mile Island Unit 2

- August 1979 FEMA became a Cabinet Level Agency
- NRC is a Private Agency, not Cabinet Level
- December 1979 President Carter announced that he was transferring to FEMA responsibility for evaluating the adequacy of offsite EP
 - FEMA to submit findings to NRC as part of overall reasonable assurance determination by NRC

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REP – Why Do We Need It? “Looking Back”



Current NRC Emergency Planning Regulations

- First published in 1980
 - Developed as a result of the accident at TMI U-2
- Strong EP framework was important to rebuild trust after the accident
- EP regulatory framework was built to fit the **existing large light water reactors**
 - based on source term, spectrum of accidents, offsite consequences

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REP – How Does a Community Benefit ?



- REP Plans/Procedures Describe what a Jurisdiction will do in case of a radiological emergency
 - Part of the organization’s emergency operations plan **for all types of hazards**
 - May be documented as a hazard-specific appendix to the emergency operations plan
- Most of the Plan/Procedure is devoted to describing:
 - The emergency response activities and functions that must be performed
 - The designated OROs that perform them

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REP – How Does a Community Benefit ?



- Most Plans/Procedures describe emergency functions at three levels of detail
 - Concept of Operations – overview of jurisdiction’s response organization with functional description of each
 - Agency-specific chapters with detail of agency roles and responsibilities
 - Step-by-step procedures outlining the tasks to be performed by response staff – incorporated into plan or attached as separate volumes
- A REP Plan generally describes response efforts related to other jurisdictions, such as;
 - Licensee
 - Neighboring OROs
 - Federal Government

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REP – How Does a Community Benefit ?



- A REP Plan generally describes response efforts related to other jurisdictions, such as;
 - Specific Job Aids per Function
 - Detailed Evacuation Routes
 - Dedicated Bus Routes for Evacuations

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REP – How Does a Community Benefit ?



- A REP Plan should become an integral part of the LEOP
 - Specific Job Aids per Function
 - Detailed Evacuation Routes
 - Dedicated Bus Routes for Evacuations
 - A REP plan can function as an LEOP
 - A LEOP cannot function as a REP plan

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REP – What Does the Future Hold?



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REP – What Does the Future Hold?



- Small Modular Reactor (SMR)
- NuScale Power Module
 - Small Size – Factory Built & Shipped by Truck
 - NRC review progressing on track
 - Completed Phase 1 review of Design Cert. App. (DCA)
 - Began March 2017
 - Final Report Completion expected by September 2020
 - First Customer – Utah Associated Municipal Power Systems (UAMPS)
 - 12-module plant configuration
 - Placed at Idaho National Laboratory
 - Operated by Energy Northwest
 - Cost predicted to be under \$3 Billion to build

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REP – What Does the Future Hold?



- Traditional nuclear reactors are between about 600 and 1,200 MW
 - SMR about 50 MW Each
 - 12 – Pack creates about 600 MW
- Use standard 17x17 PWR Fuel Assemblies
- Single NuScale Power module
 - 76 feet long, 15 feet in diameter
 - Plant requirement about 60 acres
- Forbes Magazine Article
 - <https://www.forbes.com/sites/jamesconca/2018/05/15/nuscales-small-modular-nuclear-reactor-passes-biggest-hurdle-yet/#77e245ba5bb5>


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REP – What Does the Future Hold?



The Future is Now- US

16 January 2017
 The Tennessee Valley Authority (TVA) has welcomed the acceptance for regulatory review of its early site permit application for the Clinch River site in Tennessee as a milestone towards the potential use of small modular reactors (SMRs) in its operating fleet.



Related Stories

- NuScale makes history with SMR design application
- NRC receives first SMR site application

WNA Links

- Small Nuclear Power Reactors
- Nuclear Power in the USA


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- Nuclear Regulatory Commission
- Tennessee Valley Authority
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Five reasons nuclear energy will rebound in 2018

- Five reasons nuclear energy will rebound in 2018
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- Canada begins SMR strategy roadmap
- China to start building up to eight reactors in 2018
- China to start building up to eight reactors in 2018

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REP – Small Modular Reactors/Other New Technologies



- Small Modular Reactors
 - NUSCALE
 - Holtec SMR-160
 - Westinghouse
 - Babcock & Wilcox Generation mPower
- Advanced, non-light water reactors
 - Sodium-cooled Fast Reactor (SFR) and Liquid metal fast reactors (LMFR)
 - Molten-salt Reactor (MSR)
 - High-temperature, Gas-cooled Reactor (HTGR) and Very-high-temperature reactor (VHTR)
 - Traveling Wave Reactor (TWR)
 - Canadian Heavy-water Reactor (Candu)

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The Future is Now Molten Salt Reactor -Canada



LEARN MORE

Terrestrial Energy on track to commercial molten salt reactor competitive with natural gas prices

Terrestrial Energy March 18, 2018 6 comments

Pin It

Terrestrial Energy is developing a 190 megawatt small modular molten salt reactor that will cost less than \$1 billion to build. This will result in kilowatt-per-hour costs of less than 3 cents, a price competitive with power from natural gas.

Terrestrial Energy of Canada has signed a contract for technical services with the European Commission's Joint Research Centre (JRC) in Karlsruhe, Germany. JRC will perform confirmatory studies of the fuel and primary coolant salt mixture for Terrestrial's Integrated Molten Salt Reactor (IMSR).

IMSR: Fly By

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The Future is Now High Temperature Gas Cooled Reactor-Indonesia



Energy & Environment | **New Nuclear** | Regulation & Safety | Nuclear Policies | Corporate | Uranium & Fuel | Waste & Recycling | Viewpoint

Progress with Indonesian SMR project

16 March 2018

Indonesia's National Atomic Energy Agency (Batan) has launched a roadmap for developing a detailed engineering design for its Experimental Power Reactor (Reaktor Daya Eksperimental, RDE). The design of the country's indigenous small modular reactor is expected to be finalised later this year.

The design concept for an RDE plant (Image: Batan)

The detailed engineering design roadmap - part of Batan's RDE pre-project phase - was announced on 7 March by Geni Rina Sunaryo, Batan's director of nuclear reactor safety and technology. The roadmap is a continuation of the RDE basic engineering design, which was completed in 2017.

Batan said the detailed engineering design document, together with the safety analysis report, will be an important requirement for it to achieve approval for the RDE design from the Indonesia's Nuclear Energy Regulatory Agency (Bapeten).

Batan said it aims to complete the RDE detailed engineering design this year by involving a consortium of Indonesian universities and private companies. It plans to have the first draft of the detailed engineering design ready for review in June by an expert mission from the International Atomic Energy Agency (IAEA). It will follow up recommendations from that review by September. The Indonesian government aims to announce the design to the global community during this year's IAEA General Conference, Batan said.

"The detailed design means that the design is close to construction, and the ultimate goal is to determine how much the RDE will cost," Sunaryo said.

Batan launched a plan in 2014 to build an 10 MW RDE at its largest research centre site - the Brawijaya complex, in Semarang, South

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- White House report highlights nuclear achievements

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- China and Indonesia to jointly develop HTGR

WNA Links

- Nuclear Power in Indonesia
- Small Nuclear Power Reactors

Related Links

- Batan

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REP – What Does the Future Hold?



To the future and beyond

- Building on the lessons learned reactor designers developing new/innovative designs that focus on safety and security as an integral part of design
 - “EP by design”
 - Stronger reinforcement against aircraft impact
 - Most designs under consideration incorporate passive or inherent safety features which require no active controls or operational intervention to avoid accidents
 - Rely on gravity, natural convection or resistance to high temperatures
 - Limited to no penetrations below top of active fuel



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REP – To the Future and Beyond



- Technology neutral: “independent of reactor technology”
- Risk Informed, Performance Based: uses risk insights, engineering analysis/ judgment (including defense-in-depth and incorporation of safety margins), and performance history to:
 - focus attention on the most important activities,
 - establish objective criteria for evaluating performance,
 - develop measurable/calculable parameters for monitoring system and licensee performance,
 - provide flexibility to determine how to meet the established performance criteria in a way that will encourage and reward improved outcomes,
 - focus on the results as the primary basis for regulatory decision-making.

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REP – What Does the Future Hold?



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
 - **Scalable EPZ size; can be site boundary EPZ or larger**

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REP – What Does the Future Hold?



Rulemaking

- Regulatory basis ADAMS accession number ML17206A265
 - Rulemaking for Emergency Preparedness for Small Modular Reactors and Other New Technologies
 - Draft rule to be published for public comment Jan 2019
 - Final rule expected to be published mid 2020

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REP – What Does the Future Hold?



Reasonable Assurance Alignment Framework (RAAF) – Goal

Modernize the way FEMA assesses Reasonable Assurance in communities surrounding commercial nuclear power plants.

RAAF enhances collaboration and flexibility between FEMA and offsite response organizations (OROs) on the game plan for how capabilities will be demonstrated and validated during the biennial cycle.

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REP – What Does the Future Hold?



RAAF Considerations

Aligns the established REP Program guidance (that meet the intent of the planning standards found in 44 CFR 350) with the NPS

- Conceived and developed from a stakeholder point of view in partnership with;
 - State and local governments
 - Tribal
 - Industry
 - NRC and other Federal Partners
 - FEMA

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REP – What Does the Future Hold?



RAAF Considerations (contd.)

- Provides greater flexibility to Offsite Response Organizations (OROs) in meeting REP requirements while strengthening overall preparedness posture within their communities
- States have been following the components of the NPS and RAAF aligns those same principles into REP
- Supports FEMA's 2018-2022 Strategic Plan

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REP – What Does the Future Hold?



RAAF Considerations (contd.)

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REP – What Does the Future Hold?



RAAF Guidance

- Translate and integrates legacy REP concepts into the NPS model that States utilize for other threats and hazards
- Complements the REP Manual
- Contains “concepts and ideas” to assist Regions and OROs in development of State Game Plans
- Framework can accommodate integration of emerging threats (i.e. Cybersecurity, Nation State Threat)

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REP – What Does the Future Hold?



RAAF Notional Timeline

- PHASE I (October – December 2017)
 - RAAF Document Development, Vetting and Internal FEAM REP Training
- Phase II (January – December 2018)
 - External (State/Local/Tribal, federal, industry stakeholders) Communications and Engagement, Outreach, and Introductory Workshops
- Phase III (May 2018 – February 2019)
 - Retraining of REP Exercise Evaluators
- Phase IV (May 2018 – December 2019)
 - Development of State Specific Game Plans (with Site-Specific Annexes)

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REP – What Does the Future Hold?



RAAF Notional Timeline

Supports the Goal of a "...secure and resilient Nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover..."

Enhances integration for an already successful and proven preparedness program – Seen as the Gold Standard in States

16 REP Planning Standards in NUREG-0654 are being maintained

Highly Collaborative: Customizing the work plan by site for demonstrating capabilities and assessment of Reasonable Assurance

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REP – What Does the Future Hold?



RAAF Notional Timeline

Official kickoff was 1/1/18

Aligns with the start of Biennial Cycle for each site

Increased effectiveness using NPS, core capabilities

Potential efficiency resulting in neutral or cost savings to the utilities

2016 NPR: "... reaffirm the value of a capabilities-based approach to preparedness"

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REP – What Does the Future Hold?



Questions?