Risk-Informed, Performance-Based Radiological Emergency Response Program Oversight

Letter Report #2 for Task 2 (Deliverable 4.2g)

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1 INTRODUCTION

The Nuclear Regulatory Commission (NRC) relies upon a "defense-in-depth" approach to ensure adequate protection of public health and safety against risks from licensed nuclear power plant (NPP) operations. The 2011 incident in Fukushima, Japan, is a reminder that while the likelihood that high-quality designed components, safety systems, highly-trained operators, and containment systems all will fail is low, it is not zero. The ability of both licensees and State and local offsite response organizations (OROs) to respond to an emergency is the critical final link in the "defense-in-depth" concept.

The NRC must find there is "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency" or it can take enforcement action to include shutting down a reactor.[1] Inputs to that determination come from NRC's own assessment of licensee emergency preparedness and FEMA's assessments regarding whether State and local emergency plans are adequate and capable of being implemented.

The NRC's reasonable assurance determinations and FEMA's Radiological Emergency Preparedness Program (REPP) rely on 16 planning standards in regulation[2] and criteria in NUREG-0654/FEMA-REP-1, Revision 1, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants*. While there has been additional guidance including a 2012 update to FEMA's REPP Manual, these foundational standards and criteria date from 1980. They focus on review of emergency plans for adequacy, and on demonstrating the ability to implement plans, mainly through exercises.

However, in 2007 NRC endorsed exploration of a more "risk-informed, performance-based" (RIPB) regulatory approach for its reasonable assurance determinations regarding emergency preparedness, to include offsite preparedness.[3] For the NRC, risk-informed oversight involves focusing on the elements most significant to protecting public health and safety. Performance-based oversight involves demonstrating achievement of successful outcomes rather than compliance with procedural requirements.[4]

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[1] 10 CFR 50.54(s)(2)(ii).
[2] 10 CFR 50.47(b) and 44 CFR 350.5.
[3] NRC, SECY-06-200, "Results of the Review of Emergency Preparedness Regulations and Guidance," Commission Voting Record (January 8, 2007). Available at: http://www.nrc.gov/reading-rm/doc-collections/commission/cvr/2006/2006-0200vtr.pdf.
[4] NRC, Request for Proposal (RFP) NRC-HQ-12-R-07-0051, "Risk-Informed and Performance-Based Oversight of Radiological Emergency Response Programs" (October 1, 2012). Available at: https://www.fbo.gov/index?s=opportunity&mode=form&id=34908dc0442e2d49a3e13f114ae7d8f0&tab=core&_cview=1.

This letter report offers an initial proposal for the development of an RIPB oversight regimen for offsite Radiological Emergency Response Programs (RERP). The remaining report sections address the topics shown in Figure 1, below.

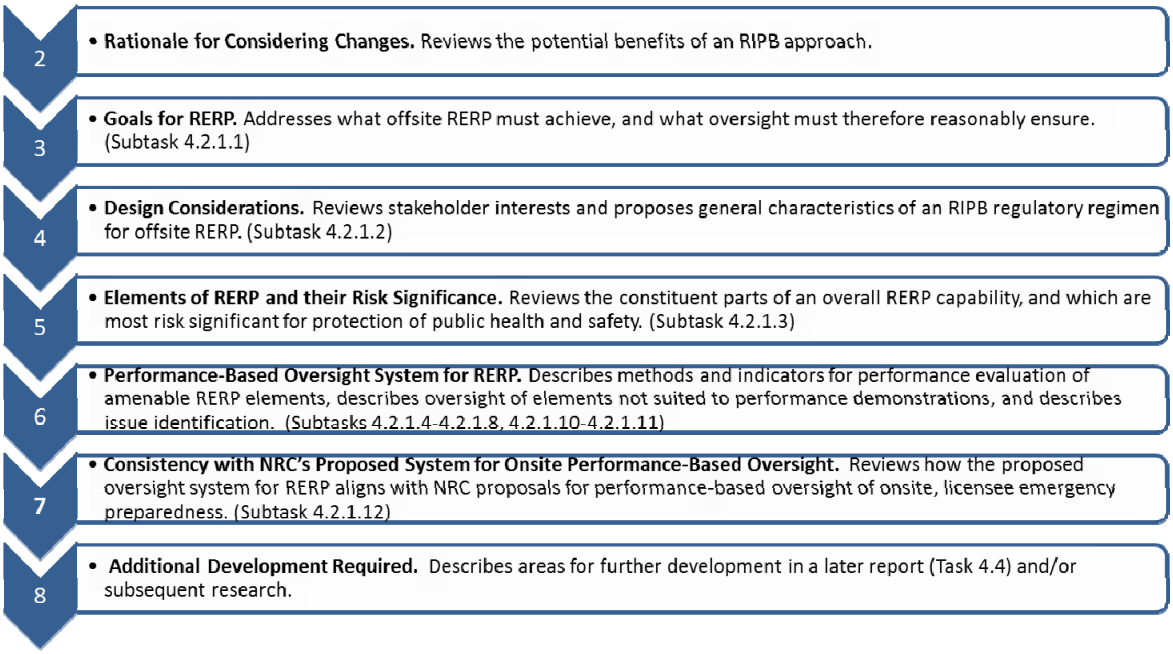

Figure 1. Organization of This Report.

2 RATIONALE FOR CONSIDERING CHANGES TO THE CURRENT REGULATORY REGIMEN

The current system for providing "reasonable assurance" of offsite radiological preparedness has served for over 30 years. However, a shift to outcome-oriented performance measures, linked to an overarching health and safety goal for assessing offsite radiological emergency response preparedness, could include the following benefits:

(1) Improved public understanding of how "reasonable assurance" relates to safety.
(2) Better fit with other elements of nuclear reactor safety oversight.
(3) More efficient use of personnel and equipment for both demonstration and oversight.

2.1 IMPROVED PUBLIC UNDERSTANDING

The current system of oversight involves a combination of plan reviews, exercises, and certifications to determine "adequacy of the plans and capabilities of State and local governments to effectively implement the plans."[5] Within this system:

[5] 44 CFR 350.1.

- *States submit plans for review.* For each site within the State, a State submits its radiological emergency plan and the plans of local jurisdictions in the 10-mile plume exposure pathway emergency planning zone (EPZ) and 50-mile ingestion pathway EPZ. The State must give its opinion that the plans are adequate to protect the public health and safety of its citizens in the EPZs and that the State and local governments can, and intend to, take appropriate protective actions in the event of a radiological emergency.
- *FEMA Regions review each plan in detail.* FEMA publishes a Federal Register notice that the plans are available for review, provides copies to an interagency Regional Assistance Council (RAC) for review and input, and completes an assessment of the adequacy of the State and local governments' capability to implement the plans. Reviews are keyed to the planning standards in regulation, NUREG-0654 and its supplements, and the REPP Manual.
- *FEMA evaluates an exercise of each plan.* The Licensee conducts an exercise with the State and local governments, allowing FEMA to evaluate the ORO plans and their implementation. The State and local governments within the 10-mile EPZ participate in such a joint exercise at least once every two years.
- *A public meeting is held regarding the plan and the exercise.* At or near the licensee facility, a public meeting must be held to describe the plan and the exercise, answer questions about the FEMA review, and receive suggestions on improvements.
- *The FEMA Regional Administrator forwards an evaluation of the plan to the FEMA Deputy Administrator.* Once an exercise and public meeting have been held, the FEMA Regional Administrator will forward to the Deputy Administrator an evaluation of the plan, results of the exercise (including deficiencies noted and corrections made, a summary of deficiencies identified during the public meeting, recommendations made to the State, and the State's commitments and actions to address the deficiencies and recommendations.
- *The FEMA Deputy Administrator approves the plan or indicates that it is inadequate.* The FEMA Deputy Administrator determines whether the plans are adequate and capable of being implemented. Approval is subject to appeal within 30 days by any interested person, but only on the grounds that the decision was unsupported by substantial evidence.
- *Determination that the plan is inadequate initiates a 120-day window to take action on deficiencies to FEMA's satisfaction or face withdrawal of approval.* If notified that the plan is not adequate, the State has 120 days to correct deficiencies or provide a plan and timeline for corrective the deficiencies. If after 120 days (or the agreed timeline) the deficiencies are not corrected, FEMA notifies the Governor, the NRC, other agencies, and the public that approval (i.e., that FEMA has "reasonable

assurance" that plans are adequate and capable of being implemented) is withdrawn.

- *FEMA's withdrawal of approval escalates to the NRC, which gives the licensee 120 days to correct the problem.* The NRC gives the licensee 120 days to ensure the problem is corrected or face enforcement action.

FEMA supplements the plan reviews and exercises with an Annual Letter of Certification (ALC) from each REPP State and Staff Assistance Visits (SAVs).[6]

This approach is well institutionalized among licensees, State and local governments, FEMA, and the NRC. The 16 planning standards defined in regulation (10 CFR 50.47(b) and 44 CFR 350.5) have served as a stable foundation for plan reviews and exercise evaluation for over 30 years.

The planning standards also rely on two additional layers of interpretation. (See Figure 2, below.) NUREG-0654/FEMA-REP-1, Revision 1, offers over 100 criteria for review of plans. FEMA's April 2012 REPP Manual additionally offers six "assessment areas" with 25 subelements and 31 demonstration criteria, mapped to the NUREG-0654 plan review criteria.

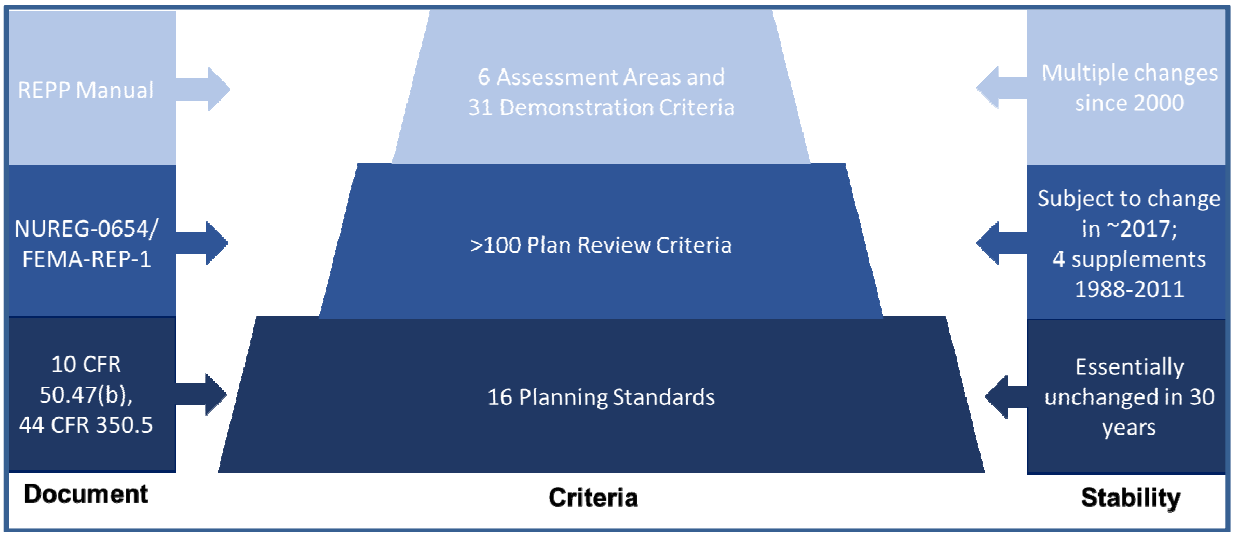

Figure 2. Layers of Interpretation for "Reasonable Assurance" of Offsite Preparedness

[6] The process description is drawn from the summary of 4 CFR 350 given in FEMA, *Radiological Emergency Preparedness Program Manual* (April 2012), pp. IV-2 to IV-9. See also pp. IV-36 to IV-37 and IV-49 to IV-57 regarding SAVs and ALCs, respectively. The document is available at: http://www.fema.gov/library/viewRecord.do?id=5865.

The benefit of this structure is that it allows the flexibility to make incremental changes without the time-consuming effort of revising the underlying regulations. For example, FEMA and NRC have jointly issued four supplements to NUREG-0654. In 2012 FEMA and NRC announced plans to begin revising NUREG-0654, with the new document to be issued in 2017.[7] Also, in response to a multi-year REPP strategic review, FEMA streamlined and reorganized exercise evaluation criteria in 2001.[8] Two of those criteria were dropped by the time a consolidated REPP Manual was published in October 2011 and revised in April 2012.

The drawback of the existing layered approach is that it is not transparent. While all of the documents are made publicly available, identifying how compliance or non-compliance with over 100 separate criteria translates to a single FEMA "reasonable assurance" determination is difficult to communicate. Further, it is unclear what degree of safety the public can expect based on a FEMA determination that a plan and its supporting capability are "adequate."

A potential improvement for oversight of offsite radiological emergency preparedness would be to define objective performance measures and describe their contribution to an overall safety outcome or consequence metric. That metric could involve target values for an averted dose of radiation, a maximum dose and the probability of exceeding it, or (as developed further in this report) a maximum amount of time available to implement a protective action, among other possibilities. While there could be debate on whether the target values provide the degree of safety desired, refocusing that debate on health and safety outcomes rather than inputs could enhance public understanding of what is meant by "reasonable assurance."

2.2 BETTER FIT WITH OTHER ELEMENTS OF NUCLEAR REACTOR OVERSIGHT

FEMA's adoption of more outcome-based metrics supporting a defined health and safety outcome could improve the linkage between FEMA's offsite preparedness determinations and NRC's overall "reasonable assurance" determinations.

First, NRC could judge the contributions of onsite emergency preparedness to meeting the same health and safety outcome. For example, if the overarching metric involved

[7] FEMA, "Notice of Request for Comments on the Scope of Future Revisions to 'Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants' (NUREG-0654/FEMA-REP-1, Rev.1)" (October 30, 2012), 77 FR 65700. Available at: http://www.gpo.gov/fdsys/pkg/FR-2012-10-30/pdf/2012-26578.pdf.

[8] FEMA, "Radiological Emergency Preparedness: Exercise Evaluation Methodology" (June 11, 2001), 66 FR 31342. Available at: http://www.gpo.gov/fdsys/pkg/FR-2001-06-11/pdf/01-14637.pdf.

timeliness for completing protective actions from awareness of an event to evacuation (if appropriate) of the EPZ, time taken by licensees to complete their sequence of actions could reduce time available for OROs to complete their actions. NRC and FEMA would be able to coordinate any needed emergency preparedness improvements holistically for both sides of the facility boundary in order to achieve the target outcome.

Second, NRC could more easily incorporate outcome-oriented or quantitative FEMA findings and determinations into the RIPB scheme NRC has been developing for oversight of all elements of its defense-in-depth approach. (See Figure 3 next page.) While NRC has had quantitative objectives to inform regulation since its Safety Policy Goal of 1986, NRC's Fukushima Near-Term Task Force has recommended establishing a "logical, systematic, and coherent regulatory framework for adequate protection that appropriately balances defense in depth and risk considerations."[9,10] To the extent NRC can estimate probability of success or failure for each defense-in-depth element (including emergency preparedness), along with the range of potential consequences from accident sequences, NRC may be able to offer a more transparent basis for its overall "reasonable assurance" determinations.

2.3 MORE EFFICIENT RESOURCE ALLOCATION

Finally, if FEMA focuses oversight on outcome-oriented performance measures linked to an overarching health and safety goal (such as minimizing risk of exposure), it may be able to focus oversight resources on those activities most significant to achieving that goal. If FEMA assesses offsite performance based on outcomes rather than procedural compliance, the flexibility available to State and local governments may also lead to more efficient use of personnel and equipment.

[9] The 1986 Safety Policy Goals statement included the quantitative health objective that "the risk to the population in the area near a nuclear power plant of cancer fatalities that might result from nuclear power plant operation should not exceed one-tenth of one percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes." Targets also exist for core damage frequency (reflecting effectiveness in controlling and mitigating initiating events) and "large early release" frequency (reflecting effectiveness of containment barriers). See NRC, SECY-00-0077, "Modifications to the Reactor Safety Goal Policy Statement" (March 30, 2000). Available at: http://pbadupws.nrc.gov/docs/ML0036/ML003694247.html.

[10] Commissioner George Apostolakis, "Application of Risk Assessment and Management to Nuclear Safety" (September 20, 2012). Available at: http://www.nrc.gov/about-nrc/organization/commission/comm-george-apostolakis/apostolakis-09-20-2012-appl-of-risk-assessment.pdf.

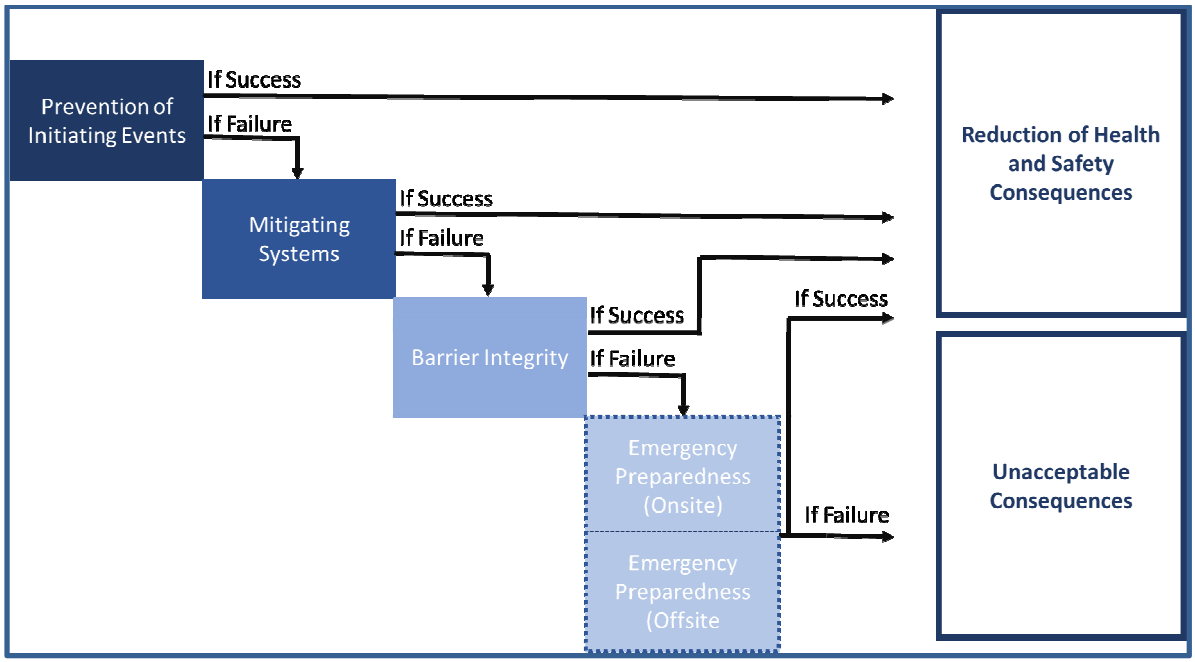

Figure 3. NRC Overall "Reasonable Assurance" of Public Health and Safety.

3 PERFORMANCE GOALS FOR OFFSITE RESPONSE

The goals for offsite radiological emergency response remain the same regardless of the oversight mechanisms involved. An RIPB oversight regimen should seek to ensure that:

- State and local officials can immediately receive licensee notification of emergency conditions, understand the potential hazard, and alert or activate necessary response capabilities.
- State and local officials can make timely protective action decisions (PADs) appropriate to the emergency conditions.
- State and local officials can rapidly alert and inform the public regarding emergency conditions and appropriate protective measures in a way that supports State and local implementation of those measures.
- State and local officials can timely implement PADs to eliminate or substantially reduce public radiation exposure.
- All persons in the EPZ are accounted for in PADs, including emergency workers, the non-English speaking populations, persons with access and functional needs, and persons under the care of others in facilities (e.g., schools, prisons, health care facilities, etc.).

4 DESIGN CONSIDERATIONS FOR A REVISED REGULATORY REGIMEN

4.1 STAKEHOLDER ANALYSIS

Successfully implementing any change will require satisfying the needs of the community of stakeholders and giving the stakeholders the opportunity to participate in the development of the change. The NRC's interests in exploring change are reflected in section 2, above. The discussion below reviews some potential interests of the community of stakeholders beyond the NRC – NRC licensees, State and local governments, the general public, and FEMA – in the current system, along with how those interests may translate to design considerations. All stakeholders are assumed to share an interest in safety.

NRC Licensees

NRC licensees' stake in ORO oversight is: (a) to maintain their operating license, and (b) to maintain the confidence of surrounding communities in the ability of the licensee and the ORO together to ensure safety in the event of an accident. Licensees also pay fees to fund Federal and, typically, State and local efforts to maintain offsite radiological emergency response preparedness. For NRC licensees, design considerations may be:

- *Stability of Requirements.* Industry prefers stable requirements. The Nuclear Energy Institute's (NEI) initial 2008 reaction to a developing a performance-based oversight regimen was that the current approach had been "successfully implemented for many years." NEI noted that other regulatory changes were underway, and asked that a new approach be considered only after those changes had been implemented.[11]
- *Stability of Results*. NEI also noted that for onsite emergency preparedness programs there were "relatively few issues noted" and these could be addressed in a timely manner.[12] Similarly, few offsite deficiencies identified by FEMA lead to enforcement actions by the NRC against licensees. While industry has a strong interest in demonstrating the safety of its operations, industry has no direct control over offsite response. Industry likely will not want outcome-oriented performance standards that prove overly stringent, leading to an uptick in deficiencies. While transparency is a benefit of objective performance metrics, it also poses a risk.
- *Avoidance of Cost Increases.* The nuclear industry faces strong competition from other power generation sources, such as natural gas, and faces pressure to contain costs. Industry is unlikely to embrace a new oversight regimen for offsite radiological emergency preparedness if additional fees are required to support it.

[11] Nuclear Energy Institute, letter from Alan P. Nelson to Christopher G. Miller, "Performance Based Emergency Preparedness Regulatory Regimen" (May 9, 2008). Available at: http://pbadupws.nrc.gov/docs/ML0813/ML081340523.pdf.
[12] *Idem*.

Providing reasonable assurance based solely on performance demonstrations could require an increase in the number of such demonstrations, and it is as yet undetermined whether the reduction in costs for compliance monitoring (plan reviews, etc.) would offset any increase in demonstration costs.

- *Flexibility and Performance Focus.* Related to stability of requirements, industry has suggested that the requirements be made less prescriptive and more results-focused. "The NUREG [NUREG-0654] is prescriptive in that it defines elements – and in some cases exact methods – for implementation of the Planning Standards. […] In order to safeguard document longevity, the [revised] NUREG guidance should be flexible and not overly prescriptive. This flexibility should allow for alternative approaches to achieve the same result and enable the use of evolving technology."[13]

State and Local Governments

State and local governments influence safety oversight by: (a) providing input into planning and design and (b) complying with the requirements using available resources.[14] Given budget pressures on State and local governments, States have an interest in ensuring the level of funding provided by licensees for radiological emergency preparedness is not reduced due to any savings from efficiency, where needs still remain. State and local governments also must balance requirements for radiological emergency preparedness with preparedness requirements for other hazards. For State and local governments, design considerations may be:

- *Continuity.* Most State and local commenters on possible revision of NUREG-0654 did not call for wholesale change. One commenters, echoed by two others, noted that the "16 planning standards as they currently exist in NUREG-0654 are still applicable."[15]
- *Streamlined, Rationalized Requirements.* Some comments noted duplicative requirements (e.g., providing information or demonstrations for plan reviews,

[13] Nuclear Energy Institute, "Comments on Scope of Future Revisions to 'Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants' (NUREG-0654/FEMA-REP-1, Rev. 1)" (January 23, 2013), Attachment 2. Available at: http://www.regulations.gov/#!documentDetail;D=FEMA-2012-0026-0016.

[14] States are preempted from regulating radiological safety aspects of nuclear power plants (as opposed to need, reliability, or cost of nuclear power). See Congressional Research Service, *State Authority to Regulate Nuclear Power: Federal Preemption Under the Atomic Energy Act*, R41984 (September 6, 2011). Available at: https://www.hsdl.org/?view&did=718958. Also, State and local governments also cannot preclude "reasonable assurance" determinations by opting not to participate in the oversight process per 10 CFR 50.47(c)(1).

[15] Patrick A. Mulligan, New Jersey Department of Environmental Protection, Comments on Scope of Future Revisions to NUREG-0654 (January 30, 2013). Available at: http://www.regulations.gov/#!docketBrowser;rpp=25;po=0;dct=PS;D=FEMA-2012-0026. Commenters from Kansas and Michigan provided the same comment.

exercises, and ALCs) or lack of clarity on requirements (e.g., having to provide lists of trainings conducted without an approved training curriculum to evaluate against).[16]

- *Cost Concern.* A new oversight regimen should attempt not to place significantly more burden (financial, time, or opportunity cost) on State and local government responders, nor reduce the resources available to maintain radiological safety. "The States must prioritize their limited resources to ensure adequate focus on the required items."[17] It is unclear whether cost increases from conducting exercises and drills more frequently would be fully offset by a reduction in compliance costs and in the scope of the exercises (e.g., from large-scale exercises to task-focused drills and demonstrations, emphasizing the most risk-significant tasks).
- *Flexibility.* In commenting on possible revision of NUREG-0654, one State requested "an evaluation and approval process that is flexible enough to apply to future technologies, so that regulatory documents do not have to be revised to allow [their] usage." This State also noted that each site has unique circumstances.[18] Another State pointed out that FEMA's REPP Manual mentions "alternate forms of demonstration" to meet requirements, and requests that a revised NUREG-0654 provide for and discuss these acceptable alternatives.[19]
- *Input*. Many State commenters on possible revisions to NUREG-0654 stressed the importance of State involvement in defining the oversight requirements. An extension of this may be to expand State input into the determination of oversight assessments, such as allowing States themselves to highlight where potential deficiencies exist and propose corrective actions.

General Public

The general public has mixed views on the safety of nuclear power.[20] To the extent the public equates radiological emergency preparedness with being able to evacuate quickly, growing populations in EPZs and increased traffic congestion on road networks sow doubt. Advocacy groups and public commenters in the environmental impact study process for

[16] Teri Engelhart, Wisconsin Division of Emergency Management, Comments on Scope of Future Revisions to NUREG-0654 (January 31, 2013). Available at: http://www.regulations.gov/#!docketBrowser;rpp=25;po=0;dct=PS;D=FEMA-2012-0026.

[17] Joseph G. Klinger, Illinois Emergency Management Agency, Comments on Scope of Future Revisions to NUREG-0654 (April 12, 2013). Available at: http://www.regulations.gov/#!docketBrowser;rpp=25;po=0;dct=PS;D=FEMA-2012-0026.

[18] Engelhart.

[19] Michael L. Bear, Ohio Emergency Management Agency, Comments on Scope of Future Revisions to NUREG-0654 (January 23, 2013). Available at: http://www.regulations.gov/#!docketBrowser;rpp=25;po=0;dct=PS;D=FEMA-2012-0026.

[20] See contrasting poll results for regarding the U.S. public's safety perceptions at http://www.nei.org/CorporateSite/media/filefolder/COMM/Public%20Opinion%20Research/POPO_Nov2012_FINAL.pdf?ext=.pdf and http://environment.yale.edu/climate/the-climate-note/nuclear-power-in-the-american-mind/. NEI reports a September 2012 poll showing 17 percent find plants "unsafe" to some degree. Yale reports a May 2011 poll (shortly following the Fukushima incident) in which 53 percent think of nuclear power as a "disaster" or "bad," compared to 34 percent in 2005.

nuclear power plant license renewals often express these doubts in performance terms. They question whether the plan reviews and exercise demonstrations used for "reasonable assurance" determinations actually mean the licensee, ORO, and community could implement an evacuation in time for the EPZ population to be "safe." What the NRC and FEMA mean by "reasonable assurance" may not equate to "safe" in the public's mind and may need to be defined more explicitly. How determinations are made should also be understood, to aid in gaining trust and confidence in the process. Resulting considerations are:

- *No Loss of Useful Information.* Changes to the offsite regulatory regimen should not eliminate the ability to gain information on capability enablers (i.e., plans, organization, equipment, and training) in addition to performance, where performance does not create confidence. Such information may be useful for interpreting performance and developing corrective actions.
- *Transparency.* Any changes made should enhance transparency and the ability to understand the "reasonable assurance" determination.

FEMA

FEMA retains responsibility for oversight of State and local OROs' radiological emergency preparedness, in coordination with the NRC. FEMA has a decades-long investment in the current oversight regimen, even as FEMA has explored changes (e.g., the Strategic Review in the late 1990s) and adapted elements of the regimen to address all-hazards imperatives (e.g., adoption of elements of the Homeland Security Exercise and Evaluation Program [HSEEP]). FEMA has an interest in ensuring it can maintain effective RERP-specific oversight within other all-hazards requirements, and in seeing the results of its oversight efforts embraced within NRC's overall oversight process. Considerations include:

- *Balance and Linkage between Onsite and Offsite Emergency Preparedness Oversight.* FEMA has an interest in seeing that the oversight approaches and requirements for onsite and offsite emergency preparedness support, are consistent with, and do not undermine one another.
- *Integration with All Hazards Policy.* FEMA's RERP oversight must focus on the elements necessary to ensure preparedness specific to the radiological hazard to public health and safety from commercial nuclear power plants. However, FEMA as a whole needs to understand and report to Congress whether the Nation is prepared for all hazards under terms of Presidential Policy Directive 8 and its National Preparedness Goal. Where consistency is impractical, quantitative and objective results may be easier to translate from one construct to the other.
- *Stability.* Implementation of changes should not undermine confidence in current "reasonable assurance" determinations.
- *Cost Concern.* In a tight budget environment, FEMA shares an interest with State and local governments in not facing a significantly greater burden (financial, time, or

opportunity cost) under a new oversight regimen or a reduction in resources available to maintain radiological safety.

4.2 PROPOSED CHARACTERISTICS OF A REVISED REGULATORY REGIMEN

Design considerations following from examination of potential stakeholder interests are provided below.

Transparency in Methodology for Determining Reasonable Assurance

- *Objective Measures of Performance.* To the extent feasible, assessment of offsite radiological emergency preparedness will involve objective measures of performance (and capability as necessary), to include both binary and quantitative measures of reliability and timeliness.
- *Overarching Safety Goal.* Measures will be designed to help gauge contribution to an overarching safety goal or goals. The primary goal presented in this document is to ensure that an offsite radiological emergency response is able to ensure public health and safety during a radiological emergency. Although that goal could be expressed in terms of dose averted or received, this paper focuses on accomplishing a sequence of actions in time to avoid exposure.

Flexibility

- *Focus on Performance.* Oversight will focus on performance demonstrated during drills and exercises, with specificity in the competencies to be demonstrated and standards to judge success.
- *Flexibility of Data Inputs: Use of Non-REP Responses or Exercises as Proxies.* Credit for demonstrated performance in a non-REP context may be given if it can be documented or otherwise validated that performance met or exceeded the relevant performance standard.

Streamlining and Rationalization

- *Focus on Risk-Significant Elements.* Oversight will focus on elements most critical to ensuring adequate protection of public health and safety during the plume release phase of a radiological event. While the ingestion pathway is likewise important to ensuring public health and safety, it is not considered for regulation in the scope of this report.
- *Differential Levels of Scrutiny Based on Performance.* Performance demonstrations may be supplemented with self-certified information including capability indicators (see below). However, reviews of the adequacy of capability elements (plans/procedures, organization/staffing, training, facilities/equipment) will occur only if adequate performance cannot be demonstrated. This is analogous to "trusted

traveler" programs operated by the Department of Homeland Security, in which those who meet requirements face reduced scrutiny and expedited passage.

Resource Neutrality

- *No Significant Net Change*. Where resource information is available, the oversight program will be designed to involve approximately the same level of effort as is currently required. The focus and allocation of that effort will shift from compliance reviews of plans and training to demonstrations of task performance, and from all elements of overall RERP capability to those most critical to public health and safety. This will require more frequent demonstration of capabilities within a performance cycle through tightly scoped functional exercises and drills, rather than reliance on a large-scale biennial exercise.

Adequacy of Available Information

- *Proxy Indicators*. While focus of oversight may shift to demonstrations of performance – what capabilities can actually *do* – it may not be feasible to perform some tasks in an exercise, or perform them fully. For example, the scope of an exercise will not allow for actually monitoring 20 percent of the plume exposure EPZ population over 12 hours. Where necessary, proxy quantitative indicators of capability may be substituted for performance indicators. Indicators of potential challenges, such as 511 information on number of days on which major evacuation routes experienced delays, may also be considered if obtaining the information can be streamlined.

Other Considerations

- *Diversity of Scenarios*. Performance demonstrations would continue to occur under a variety of scenarios, to avoid rote response and the possibility of "gaming" the oversight system. Performance demonstrations may include additional scenarios or variety in exercise design, including, but not limited to, exercising real weather conditions, exercising at different times of day, or reacting to a sudden radiological release without a gradual escalation of events.
- *Transition*. The new regimen would replace the existing regimen and its requirements.[21] Some transitional testing or pilot phase with selected licensees and State and local OROs likely would be required before adoption of the new regimen.

[21] This would be in contrast to the proposed approach for onsite oversight in the NRC's "Elements of a Performance Based Emergency Preparedness Regulatory Regimen" (2008), p. 3. Available at: http://pbadupws.nrc.gov/docs/ML0804/ML080440163.pdf. Maintaining two regimens in parallel permanently could be burdensome for FEMA to implement. It could be confusing for OROs seeking to comply. It could also undermine public confidence in "reasonable assurance" determinations under at least one if not both of the regimens.

Such a pilot could be conducted under the "alternative approaches and methods" provisions described in FEMA's REPP Manual.

- *State Input*. The new regimen will encourage inclusion of a State self-critique for after-action reports, as an input to development of corrective action plans and recommendations following an exercise. States already perform some self-assessment for FEMA in ALCs and, in the all-hazards context, State Preparedness Reports. Self-assessments would be reported to better improve best practices, and would not be subject to penalty. Additionally, OROs that identify a weakness in performance during the demonstration of a capability may be able to re-start the performance demonstration without penalty.

5 ELEMENTS OF RERP AND THEIR RISK SIGNIFICANCE

5.1 RADIOLOGICAL EMERGENCY RESPONSE LOGIC

Defining a performance-based oversight system for RERP requires understanding what tasks the ORO must perform to protect public health and safety. This section describes a simplified, high-level logic for radiological emergency response to frame RERP oversight.

Radiological emergency response relies on recognition of an emergency by the licensee. Under Appendix E to 10 CFR 50, "nuclear power reactor licensees shall establish and maintain the capability to assess, classify, and declare an emergency condition within 15 minutes after the availability of indications to plant operators that an emergency action level has been exceeded and shall promptly declare the emergency condition as soon as possible following identification of the appropriate emergency classification level."[22] The NRC has defined four emergency classification levels:

- *Notification of Unusual Event*. Events are in process or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection. No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.
- *Alert.* Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life-threatening risk to site personnel or damage to site equipment because of intentional malicious dedicated efforts of a hostile act. Any releases are expected to be limited to small fractions of the Environmental Protection Agency's (EPA) Protective Action Guideline (PAG) exposure levels.

[22] 10 CFR 50, Appendix E, provision IV.C.2. Available at: http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appe.html#5_appe.

- *Site Area Emergency*. Events are in process or have occurred which involve an actual or likely major failure of plant functions needed for protection of the public, or involve security events that result in intentional damage or malicious acts […] that could lead to the likely failure of or [prevent] effective access to equipment needed for the protection of the public. Any releases are not expected to result in exposure levels which exceed EPA PAG exposure levels beyond the site boundary.
- *General Emergency.* Events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity or […] an actual loss of physical control of the facility [due to compromised security]. Releases can be reasonably expected to exceed EPA PAG exposure levels offsite for more than the immediate site area.[23]

Under Appendix E to 10 CFR 50, licensees also must have the capability to notify responsible State and local governmental agencies (i.e., the ORO) within 15 minutes after declaring an emergency.[24] If the EPA PAG is expected to be exceeded, the notification will be accompanied by a protective action recommendation (PAR) to the ORO.

The ORO must be able to receive the licensee notification and understand the nature of the emergency declared by the licensee. This is the beginning of offsite radiological emergency response, which proceeds in conceptual phases as shown in Table 1, below.

Early Phase (During Event to a Few Days After Event)	Intermediate Phase (Follows Early Phase, After Incident Brought Under Control)	Late Phase (Ends When Remediation Is Complete)
▪ PADs made with only preliminary situational understanding and data ▪ Actions modified as additional data become available ▪ Considerations: Plume exposure, short-term exposure to deposited materials, inhalation exposure	▪ Typically overlaps with early and late phases ▪ Considerations: Additional relocation or removal of public vs. allowing to return home, food and drinking water	▪ No longer "emergency response" ▪ Considerations: Cleanup and recovery, decontamination, return and reentry

Table 1: Phases of a Radiological Release[25]

Exposure concerns and appropriate protective actions evolve over the course of the response, as shown in Table 2 on the next page. However, radiological response is *initially*

[23] NRC, "Emergency Preparedness and Response Actions for Security-Based Events" (July 18, 2005), Attachment 2, p. 2. Available at: http://www.nrc.gov/reading-rm/doc-collections/gen-comm/bulletins/2005/bl200502.pdf.
[24] 10 CFR 50, Appendix E, provision IV.D.3. Available at: http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appe.html#5_appe.
[25] EPA, "Manual of Protective Guides and Actions" (1991), p. 1-2. Available at: http://www.epa.gov/radiation/docs/er/400-r-92-001.pdf

focused on avoiding the population's exposure to external radiation from any plume, and from inhalation of material in that plume.

Phase	Potential Exposure Pathways and Incident Phases	Protective Actions Recommended
Early	External Radiation from Facility	Sheltering, Evacuation, Access Control
Early	External Radiation from Plume	Sheltering, Evacuation, Access Control
Early	Inhalation of Material in Plume	Sheltering, Administration of Potassium Iodide, Evacuation, Access Control
Early/Intermediate	Contamination of Skin and Clothes	Sheltering, Evacuation, Decontamination of Persons
Early/Intermediate/Late	External Radiation and Ground Deposition of Activity	Evacuation, Relocation, Decontamination of Land and Property
Intermediate/Late	Ingestion of Contaminated Food and Water	Food and Water Controls
Intermediate/Late	Inhalation of Re-suspended Activity	Relocation, Decontamination of Land and Property

Table 2: Protective Actions and Exposure Pathways of Concern, by Phase[26]

Whatever the licensee's recommendation, responsibility for making the protective action *decision*—PAD—rests with the ORO. Because the ORO has this responsibility, the ORO must be able to independently assess the situation in order to decide what measures are most

[26] *Ibid.*, p. 1-4.

appropriate to protect the public health and safety from excessive radiation exposure. The two primary options are evacuation or shelter-in-place, although these may be supplemented with potassium iodide (KI) to protect against uptake of radioactive iodine in the thyroid.[27] Major considerations include:

- *Incident Progression and Plant Conditions*. An emergency's classification may evolve. The Notice of Unusual Event can become an Alert if "further degradation of safety systems occurs," and that degradation could progress to failure, and then loss of containment integrity. If notified of a condition other than General Emergency, OROs are faced with deciding whether any precautionary actions should be implemented and communicated for any part of the potentially affected population.[28] OROs rely on information from licensees regarding current and expected plant conditions, and the likely rate of change in those conditions.
- *Time until Arrival of Plume vs. Evacuation Time Estimate (ETE).* Evacuation will provide total protection from any airborne release if it is completed before arrival of the plume. If evacuation of an area cannot be completed before arrival of the plume, shelter-in-place may be preferable initially.
- *Duration of Release vs. Shelter Protective Factors.* Sheltering will reduce the gamma exposure rate from deposited materials, but it is not a suitable protective action for this pathway for a long-duration exposure. Sheltering will eventually be followed by evacuation out of the EPZ for the population in the plume exposure pathway.

Any PAD must be supported by instructions to the population segments expected to implement the PAD, as well as by the mobilization of responders who assist in its implementation (e.g., to support traffic management, access control, etc.).

Once people are in a place safe from external radiation from the plume or inhalation of material in the plume, radiological emergency response focuses on attending to their needs and managing their risks of additional exposure and contamination, to stabilize the situation. Areas of safety–and restricted areas–may be better defined over time as radiological monitoring information becomes available. Over time radiological emergency

[27] They are not mutually exclusive. Under some scenarios, it may be appropriate for some segments of the population to shelter-in-place first and then evacuate. For example, a plume may travel too quickly for evacuation to be accomplished in advance of arrival. People may shelter-in-place, then evacuate to reduce exposure to deposited materials.

[28] One NRC study concluded that "precautionary efforts during Site Area Emergency are prudent." NRC, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents,'" NUREG/CR-6953, Vol. 1 (2007), pp. ix-x, 25, 64. The study noted that some instances could warrant early closure of schools, parks, government facilities, etc., at the Site Area Emergency, and early notification of the general population within the 10-mile EPZ to prepare for evacuation.

response efforts focus on reclaiming more of the impacted area for unrestricted use where achievable, and shift to community recovery.

5.2 RADIOLOGICAL EMERGENCY RESPONSE TASKS AND RISK SIGNIFICANCE

Figure 4, below, shows the high-level tasks described in the foregoing section and an assessment of their risk significance for public health and safety.

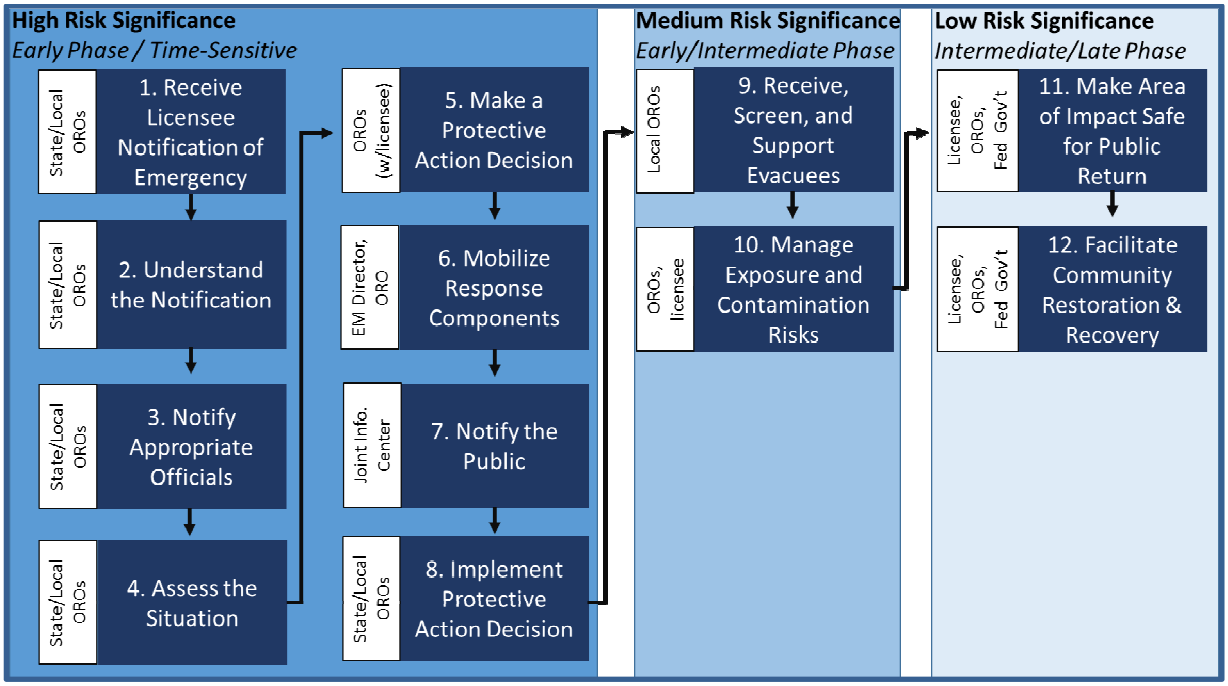

Figure 4: Radiological Emergency Response Tasks and Risk Significance

The most risk-significant offsite radiological emergency response tasks focus on avoiding the population's exposure to the plume and the material it contains. Collectively these tasks can be highly time-sensitive, depending on the scenario. Successful performance of these tasks reduces the challenge of managing subsequent risks of exposure and contamination, such as through access control or decontamination of individuals.

Managing those subsequent risks, along with reception and screening of the evacuated population, have medium risk significance. They address marginal exposure risks after the population is safe from the danger posed by the plume and material deposited on the ground.

Late phase actions focused on cleanup and recovery have low risk significance because immediate health and safety needs of the population have been addressed at this stage.

Return to the impacted area is not a requirement for individual physical health and safety, nor is broader community recovery, although both may be important psychologically.

This tiering of tasks by risk significance for public health and safety informs which tasks receive more focused and frequent oversight under a revised oversight system, as will be discussed in the next section. The remainder of this section provides more description of these high-level tasks, grouped by their risk significance.

5.3 HIGH RISK SIGNIFICANCE TASKS

- *Receive Licensee Notification of Emergency.* This response task requires OROs to have sufficient communications systems in place to receive messages from the nuclear power plant in the event of an emergency. OROs must also have sufficient staffing at all times to be able to receive and process information through those communications channels. The ORO should have a notification and warning point which receives the information. The notification and warning point may be a 911 Center, a duty officer, a designated communications center, or any other officially designated channel which can receive and disseminate information.
- *Understand the Notification.* ORO decision-makers, as well as the ORO notification and warning point, should be sufficiently trained in REP to understand the current emergency classification system (Notification of Unusual Event, Alert, Site Area Emergency, General Emergency), and the potential implications of an emergency notification. Based upon existing plans and procedures, OROs must also be able to take the appropriate next steps to notify other responders and begin incident response.
- *Notify the Appropriate Officials.* The notification and warning point begins incident response by contacting previously identified decision-makers from State and local OROS. The decision-makers involved may vary depending upon existing plans and procedures. In the event that a primary contact cannot be reached, secondary or tertiary contacts should be established to enable incident response to proceed in a timely manner.
- *Assess the Situation.* Once necessary decision-makers and OROs have been activated, an identified technical advisor or public health expert (who is trained to interpret the information being provided from the facility) will take the lead in processing information received from the plant, as well as information observed by the OROs, and synthesize it into an accurate assessment of the situation given the current information. OROs must be able to produce a projection of the plume based upon wind and weather conditions, and use this plume projection to identify the at-risk population. OROs should also demonstrate an established capability to monitor the environment outside the facility boundary for any radiation that may have been

released above ground. The technical advisor must demonstrate the ability to develop a protective action recommendation based on an understanding of information available.

- *Make a Protective Action Decision.* OROs must decide the best way to protect the public given the nature of the incident and the resources available to them. The licensee provides protective action recommendations to the ORO, which may then be accepted or revised by the ORO. Protective action decision-making typically centers on which zones within the 10-mile EPZ to evacuate and which to shelter-in-place. Plant conditions, weather and wind direction, and ETEs for the potentially affected area all factor into the decision. Use of KI is another consideration for protective action decision-making.
- *Mobilize Response Components.* In assessing the situation and determining required protective actions, OROs should gain a better understanding of the response components that will need to be involved in implementing the PAD and follow-on activities. OROs will need to mobilize firefighters, police, emergency medical technicians (EMTs), and other response elements. Sufficient response personnel should be available to fulfill requirements of the PAD. Responders may be called to a variety of subtasks, including traffic control points and activation of reception facilities and decontamination stations. Mobilization may be concurrent with or following protective action decision-making.
- *Notify the Public.* Once a PAD has been determined, the public must be informed of the steps that they should take in order to ensure their own safety. Notification of the public is a responsibility of the State and local OROs. OROs must be able to disseminate a prompt message to the EPZ population that there is an emergency (e.g., with sirens). The method of dissemination is less important than achieving coverage of the population. Any such prompt message must be followed quickly by a clear, coherent, and complete message providing instructions for implementing the PAD. A Joint Information Center should be established so that the licensee and ORO may collaborate and deliver a unified message.
- *Implement Protective Action Decision.* State and local OROs should implement the PAD in an efficient and timely manner. ORO primary responsibilities for facilitating evacuation include traffic management and ensuring transportation for persons requiring assistance. The ORO may seek to confirm implementation of the PAD. PAD implementation should account for all persons in the 10-mile EPZ, including emergency workers, non-English speaking population, persons with access and functional needs, and persons under the care of others in facilities (e.g., schools, prisons, health care facilities, etc.).

5.4 MEDIUM RISK SIGNIFICANCE TASKS

- *Receive, Screen, and Support Evacuees.* Once evacuation has been initiated, local OROs must ensure that evacuees' basic needs are met. A first need is screening individuals to determine if decontamination is necessary; contaminated individuals are not allowed into public shelters. Counties should have sufficient access to shelters to be able to accommodate displaced individuals from the plume zone in the short term. Local OROs should also have sufficient stockpiles of food and water to feed evacuees in the short term. Where an ORO cannot meet these functions on its own, it should have resource sharing agreements in place with other jurisdictions.
- *Manage Exposure and Contamination Risks.* Local OROs must be prepared to decontaminate individuals and their belongings as they evacuate the EPZ. Local OROs must also be able to decontaminate response vehicles and equipment that exit a radiation control zone. State and local OROs must also restrict access to evacuated areas until they are deemed safe for reentry. Finally, OROs may seek to mitigate the potential for ingestion of contamination by having livestock placed on stored feeds and uncontaminated water, and restricting movement of animals and agricultural products.

5.5 LOW RISK SIGNIFICANCE TASKS

- *Make Area of Impact Safe for Return.* This function calls for OROs to be able to determine, for specific sites and their intended uses, an acceptable level of radioactivity and then test that that level has been achieved before the sites can be reopened for return. This may require site decontamination including the removal of topsoil. *This response task will not be evaluated in the oversight regimen.*
- *Facilitate Community Restoration and Recovery.* Once the goal of ensuring public health and safety has been met, the OROs must facilitate the return and recovery of displaced individuals and businesses. This may include financial assistance, construction assistance, or other assistance as needed to return a displaced population to normal functionality. The Federal Government may provide technical and other assistance during this time. *This response task will not be evaluated in the oversight regimen.*

A risk-informed oversight regimen allocates resources and focus on tasks that bear most directly on ensuring public health and safety. Return and restoration are important, but presuppose an already healthy and safe population that must make choices about long-term and less acute risks. Therefore, this framework provides for no performance-based oversight of these tasks, beyond requiring their periodic consideration and discussion.

6 PERFORMANCE-BASED OVERSIGHT SYSTEM FOR RERP

If a risk-informed oversight system focuses on the RERP elements most critical to the protection of public health and safety, a performance-based oversight system focuses most on whether those elements *do* what is needed to protect public health and safety. This is different from whether there are plans to perform tasks, an adequate quantity and/or quality of personnel and equipment to perform tasks to the extent and level required, or an organization of those resources. These are elements of *capability* - being able to do. The question of interest for performance-based oversight is whether the capability performs.

This section of the report outlines a system for developing "reasonable assurance" that ORO RERP capabilities perform both reliably and timely, as appropriate. It addresses:

- *Decomposition of High-Level Tasks.* Tasks presented in Section 5 above are divided into subtasks to facilitate observation, analysis, and measurement.
- *Methods, Frequency, and Conditions for Performance Demonstration.* Methods for OROs to demonstrate subtask performance are described, where possible and appropriate. Given risk significance of the parent tasks, frequency of required demonstration is also defined preliminarily. Final determination of specific frequencies and methods should be subject to a more detailed risk assessment in the future, to flesh out the conceptual framework provided here.
- *Performance Indicators and Acceptable Performance*. Preliminary measures are defined for acceptable or target performance of subtasks. Reliance on existing measures is discussed.
- *Aggregate Timeliness of Performance*. The report provides a tentative construct for rating overall performance on timeliness for protective actions. This is critical for an intelligible reasonable assurance determination.[29]
- *Alternative, Non-Performance Indicators*. For subtasks not amenable to performance demonstration, alternative metrics are proposed.
- *Issue Handling and Differential Levels of Oversight*. The report proposes how to identify and manage issues of less-than-acceptable performance, and how the proposal may enhance consistency of issue identification. The proposed system provides for gradations of unacceptable performance.
- *Enhancement of Risk Focus*. The report describes how focus on risk-significant elements should increase under a revised oversight process.

[29] Projected dose could also be the basis for an overall assessment of performance, but that option is not developed in this paper.

6.1 DECOMPOSITION OF TASKS INTO SUBTASKS

Each task identified in Section 5 of this paper consists of multiple subtasks. However, to streamline oversight, only subtasks necessary and critical for preservation of public health and safety are included in task "checklists." The complete subtasks and checklists, including proposed performance indicators for the subtasks, are at Appendix A. Each subtask is organized in a similar manner to *NEI 99-02, Revision 6: Regulatory Assessment Performance Indicator Guideline*, which discusses onsite facility preparation and response.[30] Each subtask has a name, a definition, measurement criteria (including data reporting elements and clarifying notes), and an initial effort at calculating the measurement.

Tasks and subtasks that occur in the early steps of the emergency response process tend to be simpler in scope. The focus of activity shifts from inward and management-focused to outward and community-focused as an incident progresses. As a result, emergency response performance becomes more complicated and difficult to measure.

6.2 METHODS AND FREQUENCY OF PERFORMANCE DEMONSTRATION

Performance is best tested in exercises and drills (and real-world response), using objective, measurable standards of performance where feasible. Scheduled exercises will continue to operate in eight-year cycles, incorporating a number of scenarios and conditions to test OROs' performance of tasks.

A key consideration for a performance-based oversight regimen is how often and under what conditions performance must be demonstrated in order to provide reasonable assurance that the ORO can be relied upon to perform the task adequately in a variety of emergency situations. Success in a single demonstration may not be an adequate basis to judge. For example, such a demonstration may have involved the one person on one shift who is highly skilled in a task, rather than a less adept individual on another shift who may require training or review of a procedure. There will need to be multiple communications tests, drills, and exercises, at different times of day, and sometimes with limited or no notice, in order to provide a more accurate assessment of an ORO's RERP performance. Emphasis would shift from large-scale exercises with long lead times and broad scope, to more limited functional exercises, task-focused drills, and communications tests.

To determine the ideal minimum frequency for these performance demonstrations may require more detailed analysis. In the interim, this paper proposes that a biannual functional exercise requirement focused on PADs and public messaging will generate an

[30] Nuclear Energy Institute (2009). Available at: http://pbadupws.nrc.gov/docs/ML0929/ML092931123.pdf

adequate number of observations for reasonable assurance in these task areas, with additional communications tests and drills for field teams.

Generally, tasks with high risk significance would be tested more frequently than tasks with lower risk significance. For oversight purposes, this generates more observations on the tasks most critical to ensuring public health and safety. Yet as an additional benefit, it requires OROs to spend relatively more time testing and maintaining proficiency in the most risk-significant tasks as well. This should increase the reliability of the ORO and thereby reduce risk.

Practically, the desired frequency of demonstration must be balanced with the cost of demonstrating a specific subtask. For example, a large registration or decontamination drill that requires significant resources and volunteer participation should occur less frequently than a simple communications drill of equal risk-significance that might require only a phone call. This is of particular importance if one goal for implementation of any new oversight regimen is not to increase the existing resource burden of oversight.

Table 3 shows a preliminary, qualitative approach for the determination of frequencies of subtasks, based on risk significance and resource requirements.

Resource Requirement for Single Demonstration of Subtask	**Risk Significance**		
	High	***Medium***	***Low***
High	Quadrennially	Cycle	Not evaluated in this oversight regimen
Medium	Biannually	Annually	Not evaluated in this oversight regimen
Low	Quarterly/Monthly	Biannually/Quarterly	Not evaluated in this oversight regimen

Table 3: Proposed Frequency of Subtask Demonstrations Based on Resource Requirements and Risk Significance

Table 4, below and on the following pages, shows the proposed methods and frequency for demonstrating performance of the subtasks. Methods include communications and notifications tests in addition to drills (performance of tasks regardless of scenario) and exercises (performance of tasks within the context of a given scenario). The proposed frequencies presented in this table are preliminary. Additional study of each subtask could yield more precise frequency requirements. A final determination of frequency demonstrations should require capabilities to be exercised frequently enough to generate confidence that the ORO would be able to perform a subtask during a real-world emergency, and retain the skill in between demonstrations.

Task	Subtask	Demonstration Type	Recommended Minimum Frequency
Receive Licensee Notification of Emergency	Primary Communications	Comms Test	Monthly
	Secondary Communications	Comms Test	Monthly
	24-Hour Warning Point	Comms Test	Monthly
	Alternate Communications Center	Exercise	Quadrennially
Understand the Notification	Message Comprehension	Drill (may be combined with comms test)	Monthly
	Secondary Official Message Comprehension	Drill (may be combined with comms test)	Monthly
Notify the Appropriate Officials	Timely Notification	Comms Test/Within Exercise	Monthly
	Functional Communications	Comms Test	Monthly
Assess the Situation	Radiological Expertise	Within Exercise	Biannually
	Contact Licensee	Within Exercise	Biannually
	Monitor Radioactivity	Drill	Quarterly
	Weather Evaluation	Within Exercise	Biannually
	Plume Mapping	Within Exercise	Biannually
	Risk Mapping (Dose Projection)	Within Exercise	Biannually
Make a Protective Action Decision	Consult with Experts	Within Exercise	Biannually
	Make Protective Action Decision	Exercise	Biannually
	Road Mapping	Within Exercise	Biannually
	Evacuation Mapping	Within Exercise	Biannually

	Shelter-in-Place Mapping	Within Exercise	Biannually
	KI Mapping	Within Exercise	Biannually
Mobilize Response Components	Contact Emergency Responders	Comms/ Notification Test	Quarterly
	Activate Responders	Mobilization Drill	Quadrennially
	Response Support	Drill or Within Exercise	Quadrennially
Notify the Public	Mass Notification	Exercise	Biannually
	Develop Follow-On Instruction Message	Exercise	Biannually
	Notification of Non-English Speaking Population	Exercise	Biannually
	Establish Joint Information Center	Exercise	Biannually
	Special Needs Populations	Exercise	Biannually
Implement Protective Action Decision	Evacuation	N/A	N/A
	Shelter in Place	N/A	N/A
	KI Distribution	N/A	N/A
	Emergency Worker Protection	Exercise	Biannually
Receive, Screen, and Support Evacuees	Reception Center Operation	Drill	Annually
	Radiological Monitoring	Drill	Annually
	Register Evacuees	Drill	Annually
	Congregate Care	Drill	Cycle
Manage Exposure and Contamination Risks	General Decontamination	Drill	Annually
	Emergency Worker Decontamination	Drill	Annually
	Evacuation Zone Access Control	Drill	Annually
	Secure Contaminated/Restricted Zones	Drill	Cycle
	Nuclear Facility Access Control Support	Drill	Cycle
	Identify Agricultural Contamination	Within Exercise	Annually

	Stored Feed Advisories	Within Exercise	Annually
Make Area of Impact Safe for Public Return	N/A	Exploratory/Ungraded Tabletop Exercise	Cycle
Facilitate Community Restoration and Recovery	N/A	Exploratory/Ungraded Tabletop Exercise	Cycle

Table 4: Methods for and Frequency of Subtask Demonstrations

6.3 PERFORMANCE INDICATORS AND ACCEPTABLE PERFORMANCE

Concepts for Performance Indicators

Following the determination of subtasks, objective performance measures were developed where possible for each subtask. These are available in Appendix A. Three types of measures were used:

- *Activity or Process Measures.* Process measures assess the performance of a process or activity, i.e., whether the ORO was able to perform a given task. For example, did the ORO's communications center answer when contacted?
- *Output Measures.* Output measures are assessments of the results of an activity or process that can be measured quantitatively. Quantitative output measures may be framed to give pass-fail determinations by asking if the ORO produced the expected output *x* for a given subtask. For example, did the ORO contact over x percent of farmers in the ingestion pathway EPZ with a stored feed advisory?
- *Efficiency or Time-Based Measures.* These measures assess how quickly an ORO was able to perform a subtask, or how much output the ORO is able to achieve in a unit of time. For example, did the ORO generate a message for delivery to the public within 15 minutes of notification of an emergency? Or was the ORO's evacuee screening throughput in one hour adequate to screen x percent of the EPZ population in 12 hours?

Because the focus is on performance, the measures do not reference compliance with plan provisions. Measures focus solely on achieving a defined output or outcome. To address reliability, several of the measures are extended by requiring frequent measurement over time (e.g., monthly communications tests are successful over x percent of the time).

Proposed thresholds are not included for all indicators, and in many cases the development of appropriate threshold levels will require additional study.

Modification of Existing RERP Criteria

FEMA's REPP Manual offers multiple measures and criteria to test compliance with the 16 existing planning standards. Most are not quantitative, and rely on qualifiers such as "timely" or "appropriate." Exceptions to this include:

- *Assessment Subelement 1.d.1.* At least two communications systems are available and at least one operates properly.
- *Assessment Subelement 4.b.1.* ORO can field at least two field monitoring teams.
- *Assessment Subelement 5.a.1.* Primary alert and notification covers essentially 100 percent of the EPZ.
- *Criterion 5.a.4.* FEMA and the NRC recommend that OROs and operators establish means that will reach those in approved exception areas within 45 minutes once the initial decision is made by authorized offsite emergency officials to notify the public of an incident.
- *Criterion 6.a.1.* Staff responsible for the radiological monitoring of evacuees must demonstrate the capability to attain and sustain, within about 12 hours, a monitoring productivity rate per hour needed to monitor the 20 percent EPZ population planning base. […] The monitoring sequences for the first six simulated evacuees per monitoring team will be timed by the evaluators to determine whether the 12-hour requirement can be met.
- *NUREG-0654 Criterion I.9.* Each organization shall have a capability to detect and measure radioiodine concentrations in air in the plume exposure EPZ as low as 10^{-7} µCi/cc (microcuries per cubic centimeter) under field conditions.[31]

Criteria from the REPP Manual were adapted in two ways.

First, some REPP Manual criteria required only minor changes in wording and recombination to support a subtask. For example, a number of criteria address the ability to identify contamination in the environment. These include requirements for evaluators to review calibration logs, review use of approved equipment, ensure the correct amount of equipment, ensure the correct number of responders, and conduct tests suitable to measure radioiodine concentrations in the environment. While all of these indicators may be important, proposed measures focus on final performance. The adapted measure reads:

[31] FEMA, *Radiological Emergency Preparedness Program Manual* (April 2012), *passim.* A June 2013 update is available at: http://www.fema.gov/reference-library. The update did not alter the criteria cited.

> "ORO must be able to activate and provide field monitoring teams at random times over a given period of time. To measure this, a series of unannounced tests must be performed, in which the ORO is required to provide at least two offsite monitoring teams with capability, equipment, and knowledge to accomplish a reading. During demonstration, the ORO should be required to detect elevated levels of radioiodine concentrations in the air to an amount as low as 10^{-7} µCi/cc within 1 hour of notification, even with interference from noble gases and background radiation."

Secondly and more commonly, quantitative measures were proposed for areas FEMA currently assesses qualitatively. They were also framed in terms of performance rather than compliance with plan provisions. These include many measures related to activities conducted in the EOC, such as mapping, procuring expert advice, or implementing resource agreements.

An initial review of the REPP Manual seeking ideas for both potential performance measures and capability indicators is at Appendix C. The proposed measures at Appendix B are a later evolution of this initial review; Appendix C documents consideration of the existing criteria.

6.4 AGGREGATE TIMELINESS OF PERFORMANCE

The tasks, subtasks, and performance indicators proposed would simplify the existing oversight process while refocusing it on performance. To the extent the tasks and subtasks represent the most necessary and critical actions to be performed for protecting public health and safety, failure to perform any task at a target level should trigger action, up to and including reconsideration of "reasonable assurance." Section 6.6, below, describes how the proposed RERP oversight system would define and handle issues of less than acceptable performance on task areas.

However, subtask performance is measured in different ways (timeliness, reliability on multiple trials, binary yes/no output measures). Those measurements can be combined qualitatively to produce a bottom-line judgment of reasonable assurance. Yet without a single unifying metric, that bottom line may remain difficult to communicate effectively to the public and other stakeholders, including OROs and licensees seeking to enhance performance.

The bottom line for public health and safety in RERP is whether and to what extent RERP efforts can ensure members of the public avoid receiving *any* dose of radiation as a result of a radiological emergency, or failing that, any dose in excess of accepted PAGs regarding what would constitute an unhealthy dose. However, as suggested in Table 4 above and

discussed more fully in Section 6.5 below, performance on the most important element of RERP—implementation of the PAD—is the most difficult to measure.

Construct of Problem

As discussed in Section 5.1, PADs depend on consideration of time. Figure 5 illustrates that for protective actions to be successful in avoiding exposure, the sequence from licensee notification of emergency, through making a PAD, notifying the public of the PAD, and implementing that PAD, must take less time than estimated for arrival of the plume at the zone for which protective actions are being considered.

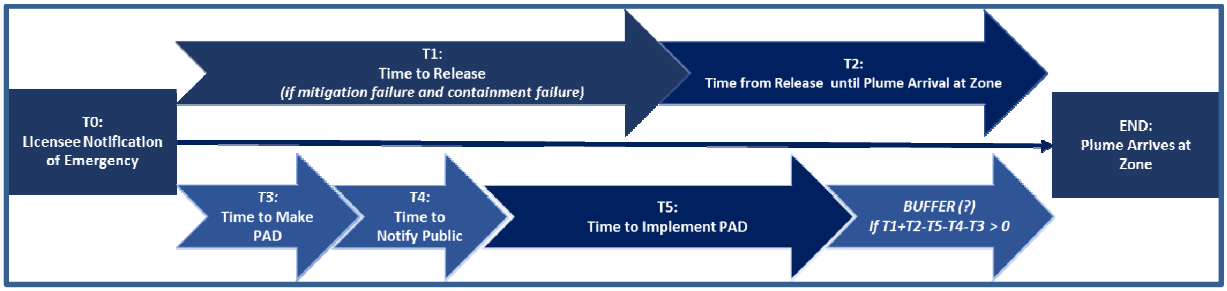

Figure 5: Time for Protection Action Decision-Making and Notification of the Public.

As shown in Figure 6, below, zones for development of protective actions within the EPZ are defined by rings of two, five, and ten miles from the plant, which are then segmented.

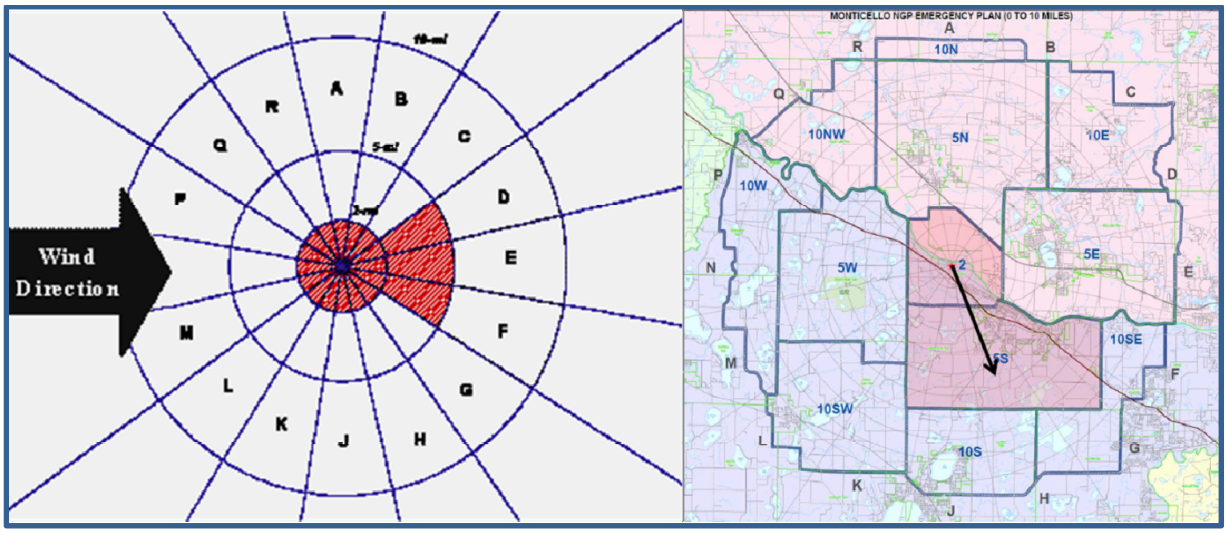

Figure 6: Emergency Response Planning Areas within the EPZ.[32]

[32] The source for the graphic on the left is http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/emerg-plan-prep-nuc-power-bg.html. The source for the graphic on the right is http://www.nationalrep.org/2012Presentations/Session%2025_Minnesota%20REP%20Initiatives_Coates&Hines.pdf.

An "ideal" zone arrangement is shown on the left of Figure 6, and an "actual" zone arrangement defined by streets, landmarks, and other easy-to-communicate features is shown on the right. Usually in a General Emergency, the appropriate PAD is to evacuate a the two-mile ring and people living in the five-mile zone(s) downwind and slightly to either side of the projected path of the release. The need to evacuate portions of the EPZ beyond five miles is assessed as the incident progresses. This is called "keyhole" evacuation. However, in a rapidly progressing incident, shelter-in-place could be the appropriate initial strategy for the two-mile ring and five-mile zones where the evacuation time estimate is longer.[33]

Assessing Timeliness of Protective Action Decision-Making and Public Notification

Assessing OROs' aggregate timeliness would occur in exercises. Focus of observation would be on the time to make a PAD and the time to notify public of the PAD *for each zone of the EPZ potentially affected by the scenario*.

In order for this not to be rote and automatic, scenarios must be varied and not known to players beforehand. In an eight-year cycle, scenarios would include at least one hostile action based incident, one scenario not progressing to a release, and two rapidly progressing emergencies. The other scenarios would involve varied source terms. Additionally, real weather would be used. Extent of play would involve only EOC personnel, not field elements, given the flexibility required. The focus would be on decision-making and crafting appropriate messages. Extent of play would need to encompass multiple hours (at least four) to account for possible changes in wind direction.

ORO players would have control over the light-shaded elements in Figure 5: their decision time and notification time to the public. OROs would make decisions for the two-mile, five-mile, and ten-mile rings. Decisions and messages would need to be appropriate. (Other subtask indicators and requirements would be addressed in the exercise, although the focus here is on timeliness.)

The scenarios would determine time to release (although the exact time would not be known to players initially). Weather conditions would determine time from release to arrival of the plume. Existing ETEs would be used for the potentially affected zones.

[33] NRC and FEMA, NUREG-0654/FEMA-REP-1, Rev. 1, Supplement 3, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants: Guidance for Protective Action Strategies" (November 2011), esp. Attachment A. Available at: http://pbadupws.nrc.gov/docs/ML1130/ML113010596.pdf.

Options for Assessing Results

Timeliness of the PAD process would be assessed against the specific scenario conditions. Success would involve having appropriate decision-making and notification occur timely enough to leave a buffer in all scenario conditions. Ability to do this consistently would add to "reasonable assurance" regarding RERP; results could be combined with assessment of the licensee's ability to timely meet its requirements for notification and protective action recommendations, to aid in overall "reasonable assurance" regarding preparedness to protect public health and safety.

A risk-informed, performance-based RERP oversight system could also include an overall timeliness metric for the critical path in ensuring public health and safety: the sequence of activities from receiving licensee notification to implementing the protective action decision.

Although a standard "design basis" decision and public notification time for all sites and scenarios may be desirable, it is likely infeasible, particularly if it is to ensure decision-making and public notification can address the worst case. Currently NUREG-0654/REP-1, Rev. 1, recommends that planning not address a single accident sequence. Consider that such a design basis might consist of:

- *Time to Release.* This could be one hour, as given for rapidly progressing emergencies in current guidance.[34]
- *Time to Arrival.* Average annual wind speeds in the U.S. at 30m and 80m do not exceed 10 mph.[35] Time to arrival at the two-to-five-mile ring would then be 15 minutes, and at the five-to-ten-mile ring would be 30 minutes.
- *Worst-Case ETE.* From a set of ETEs available in 1981, NUREG/CR-1856 gives a maximum permanent population evacuation time to evacuate the 10-mile EPZ under adverse conditions of approximately 16 hours (the 75th percentile case was six hours). The 2007 NUREG/CR-6953 said these ETE ranges were still applicable.[36]

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[34] NRC and FEMA, NUREG-0654/FEMA-REP-1, Rev. 1, Supplement 3, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants: Guidance for Protective Action Strategies" (November 2011), p. 9. Available at: http://pbadupws.nrc.gov/docs/ML1130/ML113010596.pdf. Lower times are possible if not considered likely; NUREG/CR-6953 used a source term with 40 minutes until release from the time a General Emergency was declared. These values are much lower than in the State of the Art Reactor Consequence Analyses (SOARCA) for Peach Bottom and Surry, which had containment failure in an earthquake scenario beginning at about the eight-hour mark. See: http://www.nrc.gov/about-nrc/regulatory/research/soar.html.

[35] National Renewable Energy Laboratory, Wind Maps. Available at: http://www.nrel.gov/gis/wind.html.

[36] Review of just four randomly-selected ETEs submitted to NRC in 2013 found a worst case of approximately six hours. This was for 100 percent clearance of the zone, rather than 90 percent, and in adverse winter conditions. In no case was an ETE given under 80 minutes for any zone, even for clearing only 90 percent of the zone population.

If this were the design basis, protective action decision-making and notification of the public could occur instantaneously – and initial guidance would still be to shelter-in-place, even for ETEs as low as 90 minutes. It may be possible to develop a 90th-percentile or 80th-percentile case for scenarios and ETEs rather than a worst case (i.e., completion of decision-making and public notification in X time would meet requirements for 90 percent of release scenarios and ETEs), but that is beyond the scope of this effort.[37]

Limitations

The aggregate timeliness metric would need to supplement, not supplant, the other measures. FEMA and NRC would still need to consider quality of the protective action decisions, ability to mobilize supporting resources (assumed away in this metric), and other factors, potentially including projected dose.[38] However, timeliness is a key data point to be captured and communicated for reasonable assurance.

6.5 ALTERNATIVE, NON-PERFORMANCE-BASED INDICATORS

As indicated in Table 4 and Appendix A, useful performance-based metrics for assessing protective action implementation—evacuation, shelter-in-place, and KI—in an exercise or drill environment are not available. It is not feasible to obtain large-scale public participation to test performance in these areas. Obtaining reasonable assurance on protective action implementation will require other indicators. Potential indicators are discussed below.

Evacuation

Some jurisdictions will have real-world evacuation experience, whether for hurricanes in the Southeast, wildfires in the West, or hazardous materials incidents throughout the United

[37] Research on evacuation times for other types of incidents may help scope what is feasible. One example is Mills et al., "Study of Evacuation Times Based on General Accident History," SAND94-2714 (1995). Available at: https://radtran.sandia.gov/docs/SAND94-2714.pdf The research was initially focused on cases comparable to radiological transportation accidents, but broadened in scope to capture sufficient data points. Only three of the 66 cases examined had an evacuation radius of two miles or more. The maximum evacuation time for the 66 incidents was 10 hours.

[38] Although this paper emphasizes an overall timeliness metric, the NRC's Deductive Quantification Index (DUQI) method effectively captures many of the necessary measurements that would need to be made for a dose-based assessment system. The DUQI method was developed and used in a proof of concept application for two sites with several accident sequences at each site. The analyses performed compare the potential consequences of accident scenarios when a radiological emergency response plan is fully and effectively implemented, and quantify the value of EP in terms of dose that the public avoids as a direct result of the EP program. The tool is able to quantify, given a basic accident scenario, the dose effects of a lack of PAD, untimely PAD, or incorrect PAD in terms of the population dose. The DUQI method could be incorporated into risk-informed, performance-based RERP oversight to help evaluate and determine the significance, in terms of dose, of different levels of performance in making PADs. See NRC NUREG/CR-7160, "Emergency Preparedness Significance Quantification Process: Proof of Concept" (2013). Available at: http://pbadupws.nrc.gov/docs/ML1316/ML13164A285.pdf

States. These jurisdictions may claim credit for the real-world implementation of evacuation. Evaluation should address whether the evacuation was of a scale to approximate a RERP-related evacuation, and whether it was completed within a reasonable timeframe for a RERP-related evacuation (e.g., was it accomplished in the same or less time as the ETE for an equivalent area of the EPZ?). NRC has studied the applicability of non-RERP evacuations to RERP.[39]

However, not all ORO jurisdictions will have relevant real-world evacuation experience in the course of a RERP evaluation cycle. An indicator is necessary to track, if not the ability to implement an evacuation, then whether there can be confidence in the approved ETE and its underlying assumptions.[40] Under Appendix E to 10 CFR 50, NRC already requires licensees to track Census annual population estimates, and to advise if estimated population increase between decennial censuses would affect the longest ETE value for any zone in the two- or five-mile rings or for the overall 10-mile EPZ to increase by 25 percent or 30 minutes, whichever is less.

It may be possible to construct an evacuation feasibility index to monitor trends affecting the ability to evacuate. Such an index could address not only population, but also availability of transportation, conditions of the road network, and congestion (capacity relative to normal demand) of the road network, and theoretical capacity. The American Highway Users Alliance developed an evacuation capacity index for a 2006 report, but it examined 37 urban areas.[41] Indices not specific to evacuation have also been constructed for urban areas. There is a travel time index, and the Federal Highway Administration has developed travel time reliability measures within its monthly congestion reporting–but again, for urban areas.[42,43] Data availability and frequency of updates could be issues for such an index.

Surveys regarding evacuation behavior are possible, but surveys are recommended for developing ETEs which are to be updated at least every 10 years.

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[39] NRC, NUREG/CR-6864, Vol. 1, "Identification and Analysis of Factors Affecting Emergency Evacuations" (2005). Available at: http://pbadupws.nrc.gov/docs/ML0502/ML050250245.pdf.

[40] Development of ETEs is described in NUREG/CR-7002, "Criteria for Development of Evacuation Time Estimate Studies" (2011). Available at: http://pbadupws.nrc.gov/docs/ML1130/ML113010515.pdf.

[41] American Highway Users Alliance, "Emergency Evacuation Report Card" (2006). Available at: http://orise.orau.gov/csepp/documents/planning/evacuation-documents/federal-reports/evacuation_report_card2006.pdf

[42] Texas A&M Mobility Institute, "2012 Urban Mobility Report" (2012). Available at: http://mobility.tamu.edu/ums/.

[43] Federal Highway Administration, "Travel Time Reliability" (no date). Available at: http://ops.fhwa.dot.gov/publications/tt_reliability/brochure/ttr_brochure.pdf.

Shelter-in-Place

Shelter-in-place is the least burdensome protective action to implement. The issues of interest are whether the need to shelter in place is communicated, whether it is received, and whether there is compliance. Communication of a shelter-in-place PAD (where appropriate) is tested under a Notify the Public subtask for Mass Notification, which proposes a survey to test whether notification is received. Such a survey could be expanded to ask whether the recipient of the notification would shelter in place or contribute to a shadow evacuation.

KI Distribution

For KI, the main available indicator would be an inventory. The current oversight system has provided that "quantities of […] KI available and storage locations(s) will be confirmed by physical inspection at the storage location(s) or through documentation of current inventory submitted during the exercise, provided in the ALC submission, and/or verified during an SAV. Available supplies of KI must be within the expiration date indicated on KI bottles or blister packs. As an alternative, the ORO may produce a letter from a certified private or state laboratory indicating that the KI supply remains potent, in accordance with U.S. Pharmacopoeia standards."[44] This does not address performance of distribution, but only availability of KI for distribution.

6.6 ISSUE HANDLING AND DIFFERENTIAL LEVELS OF OVERSIGHT

Performance-based oversight requires clear, objective performance measures. "Objective" does not always mean "quantitative." Some subtasks involve demonstration of multiple elements, but these can be addressed with a question tree using simple binary ("yes/no") questions.

Using objective performance measures for RERP oversight enables consistent evaluations across all OROs. Many indicators in the current oversight regimen allow for subjective determinations. While subjective judgment cannot be eliminated, the current oversight system may magnify its potential effects by offering only a small range of potential outcomes when issues are identified. Those are areas requiring corrective action (ARCAs) and deficiencies.

ARCAs are relatively moderate assessments that do not indicate a significant reduction to public safety. ARCAs require some corrective action to be made, and require a subsequent re-demonstration of a capability, either during the exercise, or at a future scheduled date.

[44] FEMA, "Radiological Emergency Preparedness Program Manual" (2012), demonstration guidance subelement 1.e., p. III-34.

Deficiencies are assessments such that there would be a significant degradation in public safety should an emergency at a nuclear power plant occur. As noted in Section 2.1, FEMA's determination that the radiological emergency plan (or the ability to implement it) is inadequate initiates a 120-day window to take action on deficiencies to FEMA's satisfaction or face withdrawal of the plan's reasonable assurance determination. Within that time the State must either correct the deficiency or provide a timeline for doing so. If after 120 days (or the agreed upon timeline) the deficiencies are not corrected, FEMA notifies the Governor, the NRC, other agencies, and the public that FEMA has withdrawn "reasonable assurance." This escalates the issue to the NRC, which, after review and agreement with the determination, gives the licensee 120 days to correct the problem or face enforcement action. Enforcement action could include ordering the plant to stop operations until the issue is addressed.

If exercise assessments escalate to the level of plant shutdown, the basis must be clear and defensible. Because the current system lacks objective measures, there is room for substantial variations in judgment of how significant the assessment may be. Table 5, below, shows by FEMA Region the average number of ARCAs and deficiencies given per exercise, from a review of 288 After Action Reports ranging from 1999 to 2012. While it is possible the OROs' performance varied by Region, the results suggest that some Regional personnel may be more likely to issue ARCAs and deficiencies than colleagues in other Regions.

FEMA Region	Mean # of ARCAs/Exercise	Mean # of Deficiencies/ Exercise
I	**11.20**	**0.69**
II	6.70	0.15
III	8.30	0.49
IV	**1.03**	**0.06**
V	2.04	0.07
VI	1.54	0.28
VII	2.20	0.40
VIII	N/A	N/A
IX	5.82	0.09
X	5.20	0.00
Mean	3.81	0.21

Table 5: Mean Number of ARCAs and Deficiencies by FEMA Region (1999-2012)

Among the deficiencies cited, one involved a school evacuating children upon declaration of an Alert rather than a Site Area Emergency as required in approved plans. Several deficiencies involved issuing alerts and notifications to the public just a few minutes after the 15-minute deadline (one of the few hard, quantitative measures in current oversight). In the former case, significance was unclear. In the latter case, while it constitutes unacceptable performance on a highly risk-significant task, it is not clear that entering a process involving the possibility of shutting down the plant is preferable to a lesser penalty.

The NRC's significance determination process for onsite issues provides for a greater range of options. It uses four color-coded levels for individual assessments, each indicating a stronger degradation in plant safety, and pertains to the seven cornerstones of the reactor oversight process (ROC), including onsite emergency preparedness:

- *Green.* Performance is within an expected performance level in which the related cornerstone (i.e., important areas of assessment such as emergency preparedness, mitigation systems, etc.) objectives are met, though minor reductions in safety margin may occur.
- *White.* Related cornerstone objectives are still being met with a minimal reduction in safety margin.
- *Yellow.* Related cornerstone objectives are being met but with a moderate reduction in safety margin.
- *Red.* There is a significant reduction in safety margin in the area measured by the performance indicator.

The NRC has a response (action) matrix for combining individual findings to determine an appropriate level of oversight response:

- *Column I.* All findings are green, and baseline oversight continues.
- *Column II.* There are no more than two white findings in different cornerstones. Staff hold a public meeting with utility management, corrective actions are required, and baseline inspections follow up on the corrective actions.
- *Column III.* There are three white findings or a yellow finding; the safety margin for the cornerstone is considered minimally reduced. Senior Regional leadership hold a public meeting with senior utility management; the utility conducts a self-assessment under NRC oversight, and the NRC conducts additional inspections focused on the cause of degraded performance.
- *Column IV.* There have been repetitive evaluations at Level III (three white findings or a yellow), there are multiple yellow findings, or there is one red finding; there are longstanding unresolved issues or significant reduction in the safety margin. NRC headquarters' Executive Director for Operations holds a public meeting with senior utility management; the utility develops a performance improvement plan under

NRC oversight; there is an NRC team inspection; there is a Demand for Information, Confirmatory Action Letter, or Order.

- *Unacceptable Performance.* There is an unacceptable reduction in the margin of safety. The plant is not permitted to operate; the Commission meets with senior utility management; there is an order to modify, suspend, or revoke the operating license.[45]

A performance-based oversight regimen for offsite response should also incorporate multiple levels of evaluative oversight for each subtask and task. Table 6, below, shows a proposed evaluation and oversight scheme. This is *not* intended to be a direct translation of the NRC's Emergency Preparedness Significance Determination Process, which applies only to onsite EP.[46]

Portions of the NRC's color scheme are used for consistency. While the green, white, and yellow assessment levels have been preserved, they have been devised to fit actions and consequences appropriate to offsite RERP and FEMA oversight. Instead of a "green" assessment being defined as a minor negative assessment, this framework proposes that "green" is equivalent to performing a subtask with no anticipated consequences for public health and safety. The "white" assessment level is retained as a level indicating a minor reduction in public health or safety, while the "yellow" assessment indicates a moderate reduction to public health or safety. The "red" assessment level has been dropped from consideration to avoid confusion, since in the EP cornerstone, a "red" may only be given in the event of a real-world emergency response failure. Instead, an "orange" assessment level has been introduced for problems in performing high-risk tasks and subtasks of such degree that they do not allow for unqualified reasonable assurance that the ORO's RERP capabilities would adequately protect public health and safety if needed. Each subtask in Appendix A has a target or "green" level of performance. Gradations of unacceptable performance remain to be defined.

Risk significance of a task determines what ratings may apply to the subtasks. Only subtasks for highly risk-significant tasks are subject to the "orange" assessment level, as these are the subtasks projected to have the most consequences for public health and safety. For medium-risk tasks, the most severe assessment that can be given is a "yellow," as even a

[45] See NRC, "Detailed Reactor Oversight Process Description." Available at: http://www.nrc.gov/reactors/operating/oversight/rop-description.html. Although the term "column" is not used on that page, it is used for the action matrix included in the NRC Inspection Manual, Chapter 0305, "Operating Reactor Assessment Program," p. F-1-1. Available at: http://pbadupws.nrc.gov/docs/ML1208/ML12089A066.pdf

[46] NRC, "Technical Basis for Emergency Preparedness Significance Determination Process." Available at: http://pbadupws.nrc.gov/docs/ML1228/ML12284A512.pdf

complete failure to perform a task is not expected to lead to severe consequences for public health and safety. Table 6 explains the proposed evaluation schema in greater detail.

Green	*Subtask:* A subtask has generally been performed in a satisfactory manner. Where issues have arisen in an exercise or drill, they were identified first by the ORO and re-demonstrated immediately to meet the green performance measure.
	Task: A task has generally been performed in a satisfactory manner. Up to one white subtask may occur within a task, and the task performance can still be considered green.
White	*Subtask:* A subtask has been performed, but has fallen tolerably short of the target demonstration criteria. Marginal decreases to public health and safety may be expected in the event of a radiological emergency. Subtask performance must be re-demonstrated at the next applicable, scheduled evaluation opportunity within the cycle. How performance will be corrected and improved is an internal matter for the ORO. The re-demonstration will be evaluated on its own merits (i.e., if performance is again white, the subtask evaluation does not escalate to yellow).
	Task: All subtasks within a task have been performed, but two subtasks have yielded white assessments, or one subtask has yielded a yellow assessment. Marginal decreases to public health and safety would be expected in the event of a radiological emergency.
Yellow	*Subtask:* A subtask has been performed, but has fallen short of the demonstration criteria to a degree that would likely result in degradation of public health and safety in the event of a radiological emergency. The State ORO is required to provide FEMA with a root cause analysis and proposed corrective action, and re-demonstrate the subtask at the next appropriate, scheduled evaluation opportunity. For subtasks of the high risk significance tasks, failure to re-demonstrate the subtask performance to at least a white assessment will escalate to an orange subtask assessment.

	Task: At least two subtasks within a task have yielded a yellow assessment. Some degradation of public health and safety could be expected in the event of a radiological emergency. If three or more high-risk tasks are assessed as yellow, the ORO is treated as if it has an orange task assessment.
Orange	*Subtask:* The orange assessment level is reserved only for subtasks of the most risk-significant tasks, and is assessed when ORO performance of the subtask is at a level likely to result in significant degradation of public health and safety in the event of a radiological emergency. If an orange subtask assessment occurs, FEMA will lead a root cause analysis (requiring meetings, interviews, and potentially the review of capability elements such as plans, training records, equipment status, etc.), and develop a corrective action plan for the ORO to follow. The ORO will re-demonstrate the subtask within a specified period of time. If the re-demonstration is not successful, FEMA will notify NRC to require licensee intervention to help correct the problem.
	Task: At least two subtasks of a highly risk-significant task have been assessed orange, resulting in the determination that an ORO is unable to ensure public health and safety in the event of a radiological emergency. For an orange task rating, FEMA will notify NRC and initiate a comprehensive review of ORO plans, organization, equipment, training, and exercises to develop a performance improvement plan for the ORO's RERP, delivered within a specified period of time (for example, 120 days). The ORO will have a specified period of time to implement all requirements of the performance improvement plan, monitored by FEMA. The ORO must then demonstrate at least white-level performance in all subtasks of the tasks that led to the performance improvement plan. If at the end of that period, the performance has not been improved to tolerable levels, FEMA withdraws its "reasonable assurance" determination for the ORO RERP and refers the matter to NRC.

Table 6: Proposed Evaluative Schema for Performance Based Oversight

As noted in the chart, OROs should be allowed the opportunity to identify and rectify their mistakes in a timely manner, depending on level of performance. There are several ways that this may be accomplished:

- *First*, if OROs are able to self-identify a mistake in their demonstration of a task or subtask while the task is being demonstrated or immediately following a failed demonstration, they may be given the opportunity to restart the activity being performed, without penalty by evaluators.
- *Second*, if OROs are given a marginally less-than-target yet tolerable (white) assessment, they may re-demonstrate at the next opportunity; how they correct performance is their concern.
- *Third*, if OROs are given a moderately negative (yellow) assessment, they may develop a corrective action plan allowing the OROs to work to fix any problems, and re-demonstrate them, without long-term ramifications for the licensee. The corrective action plan must, however, be documented and shared with FEMA.
- *Finally*, if an orange finding yields significant concerns that an ORO will not be able to provide for public safety in the event of a radiological emergency, Federal staff may be sent to develop and monitor implementation of a performance improvement plan, to ensure that OROs take specific steps to enable improved performance. If performance does not improve, FEMA refers the matter to NRC. As is currently the case, NRC has discretion in what it elects to do in response, up to suspending plant operations. However, the multiple steps that will already have been taken to rectify a set of issues deemed significant for public health and safety, culminating in a failed attempt to resolve the issues through a performance improvement plan, should ensure heightened concern for the request.

The proposed evaluation scheme addresses both issues mentioned previously. By introducing an expanded range of determinations and response options along with a systematic means for combining the individual assessments, each task and the overall ORO program may be evaluated systematically and appropriately, with a focus on resolving performance issues. Additionally, by tying evaluations to metrics that have a definite quantification or threshold that must be met, potential subjectivity should be reduced. Introducing performance-based, quantifiable metrics, and tying these to a graduated evaluation system, offers promise for improving the overall consistency of RERP oversight, while providing a reasonable assurance that public health and safety needs are being met.

6.7 ENHANCEMENT OF RISK FOCUS

The RERP oversight scheme proposed herein has several features to ensure a focus on risk-significant elements:

- *Performance Focus.* The oversight system is designed to focus on actual performance. Task performance contributes more directly to reducing risk than do enablers of task performance, whose contribution to risk reduction is more difficult to gauge.
- *Task Stratification by Risk Significance.* Tasks have been identified as high, medium, and low risk. The basis for this determination is the tasks' contribution to a defined public health and safety goal of avoiding exposure. The determination of risk significance has implications for oversight. For example, yellow ratings on three high-risk tasks will receive a higher level of follow-on oversight than yellow ratings on medium- or low-risk tasks. As previously mentioned, *only* high risk tasks can be subject to an orange assessment. Further, low risk tasks are not formally evaluated; they have no defined subtasks (meaning they can never be rated even yellow under the proposed scheme). Oversight and evaluation resources are then allocated away from low risk tasks.
- *Subtask Selection.* Only subtasks deemed necessary and critical are included for evaluation. Oversight and evaluation resources are not spread over an extensive set of subtasks and criteria that may not be critical to performance of risk-significant tasks.
- *Gradation of Assessments against Objective Measures.* There is or will be a scale for unacceptable performance of all subtasks that have performance measures. The scale allows for more middle ground in addressing unacceptable performance before escalating the involvement of oversight resources to high levels that may not be warranted by the risks posed.

Whether the proposed oversight system will necessarily enhance focus on risk-significant elements compared to the current system is difficult to prove absent additional resource information for both.

As noted above in Section 6.6., a review of FEMA-identified deficiencies from 1999 to 2012 showed some deficiencies that were not necessarily risk-significant, or at least not to the point of considering the shutdown of a reactor. However, this was anecdotal. For fuller consideration, Table 7 below groups all deficiencies given from 1999 to 2012 into several broad categories, gives examples for each grouping, and offers a preliminary determination on the risk significance of these deficiencies within the proposed performance-based oversight system, based on the risk significance of the analogous task.

Type of Deficiency	Number Given	Example(s)	Significance Determination
Alert and Notification Problems- Responder Error	17	Sending faxes instead of notification to start sirens, taking more than 15 minutes to start sirens	High Significance
PADs for Responders Not Transmitted	7	Responders not directed to take KI, responders do not receive notification to take KI	High Significance
PADs for Public Not Transmitted	7	Public not advised of evacuation routes, public not advised to take KI	High Significance
Communication Errors	6	Incorrect messaging released, inability to contact and activate necessary personnel, not reaching out to confirm receipt of EAS messages	High Significance
Deviation From Plans	5	Releasing children from school in violation of plans, helicopter refusing to fly given release in violation of plans	Indeterminate
Alert and Notification Problems- Mechanical Error	4	Digi-Cart system did not work, lack of backup power source	High Significance
Failure to Develop PADs to Adequately Secure Public	3	Failure to identify special needs individuals requiring transportation, evacuation orders sending evacuees into plume path	High Significance
Access Control Problems	1	Failure to establish access control in evacuation zone in timely manner	Moderate Significance

Table 7: Number of Deficiencies by Type (1999-2012)

Table 7 shows that in most instances the current oversight system has identified deficiencies for areas that are significant to protecting public health and safety in radiological emergency. Problems with alert and notification of the public were most common, followed by a failure to provide or transmit protective action decisions. These deficiencies, should they occur in a real- world incident, would all result in a public unaware of an emergency or actions they should take to protect themselves.

However, deficiencies were assigned for deviations from plans where the demonstrable impact on public health and safety was not clear. For example, as noted previously, a school chose to evacuate children when an Alert was declared, contrary to plans. In another, a surveillance helicopter claimed it would not fly into the EPZ given the release, contrary to plans. It is unclear why these were deficiencies rather than ARCAs. Thus there is a potential to misallocate resources to issues that are not risk-significant, or not highly risk-significant.

Also as noted previously, deficiencies were assigned for alert and notification delays of a few minutes. While this could be significant, particularly in a rapidly progressing emergency, it may not warrant raising the possibility of shutting down the reactor. Again, there is potential for misallocating resources relative to risk.

Given its performance focus, stratification of tasks by risk, selection of only necessary and critical subtasks, and gradation of assessments, the proposed RERP oversight process should serve to enhance the focus of ORO and oversight resources on risk-significant elements.

7 CONSISTENCY WITH PROPOSED ONSITE PERFORMANCE-BASED OVERSIGHT

The NRC's "Elements of a Performance-Based Emergency Preparedness (PBEP) Regulatory Regimen"[47] (hereafter "*Elements*") offers a preliminary proposal for a voluntary performance-based emergency preparedness regulatory regimen for licensees. The offsite RERP oversight regimen proposed here follows the spirit of *Elements* and is largely consistent with it, although there are points of divergence. Areas of similarity include:

- *Focus on Performance in Lieu of Compliance.* NRC's *Elements* seeks to "focus oversight and licensee efforts on actual performance competencies [demonstrated] during drills and exercises, rather [than] compliance issues." Variations in plans, training attendance, and response organization "would not matter so long as performance was acceptable." Reasonable assurance determinations would focus on demonstration of competencies rather than compliance. The same focus on performance underlies the proposal for offsite RERP oversight.
- *Goals.* Stated goals for *Elements*' PBEP regimen are similar to the ones identified in Section 3 of this paper. (However, *Elements* included goals for State and local officials, whereas this paper is silent on goals for licensees.) For example, both regimens are concerned with ensuring immediate notification of emergency conditions from licensee to ORO and rapidly alerting and informing the public of protective action decisions.
- *Scenario Variation and Secrecy. Elements* specifies that licensees must not use the same scenario in sequential evaluated exercises, and that emergency teams should

[47] Available at: http://pbadupws.nrc.gov/docs/ML0804/ML080440163.pdf.

not know scenario specifics in advance of an exercise. Section 6.4. of this paper calls for scenarios to "be varied and not known to players beforehand" in testing the ability make timely PADs and communicate them to the public.

- *De-emphasis of Large Biennial Exercises*. *Elements* notes that some competencies are not amenable to testing in large biennial exercises. Section 4.2 of this paper calls for testing critical tasks through frequent functional exercises (such as for testing PAD development and communications as described in section 6.4) and drills, moving away from a focus on large-scale biennial exercises.
- *Performance Standards.* Both documents call for performance standards (objective measures) for each element to be demonstrated. This paper has proposed measures for subtasks (see Appendix A).
- *Differential Levels of Oversight*. Both documents note that increased oversight should only result from crossing clear thresholds of performance or failures in significant corrective actions.
- *Concern for Communicating Reasonable Assurance*. Both papers posit that use of objective performance standards or measures will improve understanding of reasonable assurance.

Despite the similarities, there are also differences. The most significant one is that *Elements* proposes making a performance-based oversight regimen strictly voluntary, running in parallel with the current system. This proposal for offsite RERP oversight specifically rejects the idea of implementing the requirements of two separate oversight processes as overly burdensome for evaluation and oversight authorities. It is also potentially confusing for OROs. A pilot program and transition period are proposed instead.

A second difference involves *Elements*' use of performance indicators to "measure success between inspections" (including NRC evaluations of drills and exercises). The possibility of OROs' using the performance measures for self-evaluated or peer-evaluated drills and exercises between Federally overseen drills and exercises is not addressed—but then neither is it rejected. It may make sense given the frequency of demonstration initially proposed for some subtasks, in order to help ensure no net change in resource requirements in transitioning from the current RERP oversight regimen.

A third difference involves the elements to be evaluated. *Elements* contains multiple proposed metrics focused on activating centers and making them operational. This report generally treats facilities as an enabler of performance, not a focus of evaluation. There is a proposed subtask on activating an alternate communications center, given the importance of ensuring reliability for this function. Overall, however, the consistencies outweigh the

differences. *Elements* and the proposed performance-based oversight concept presented in this document could be complementary systems.

8 ADDITIONAL DEVELOPMENT REQUIRED

Since the Three Mile Island accident, oversight of offsite radiological emergency preparedness has evolved into a complex oversight regime, with the original sixteen planning standards supplemented by over a hundred assessment criteria. While these planning standards and the oversight system built upon them have served to provide defense-in-depth protection to the American public from a radiological disaster for over 30 years, there is room to reduce the oversight burden on OROs by refocusing on what OROs must *do*, not what they must say in their plans.

This paper has outlined a more risk-informed, performance-based oversight system for offsite RERP. The system is based not on a list of things to include in plans, but on a conceptual model of the basic tasks that must be performed to ensure public health and safety in a radiological emergency. Subtasks have objective and outcome-based metrics for gauging performance, with clear thresholds for acceptability. Levels of less-than-target performance are associated with different levels of oversight, corrective action, and re-demonstration in order to allocate resources appropriately against risks.

The proposed offsite RERP oversight system is consistent with proposals for performance-based oversight of licensees. In both, the focus on objective measures of performance rather than subjective determinations of compliance should offer more meaningful reasonable assurance determinations to the public, and more flexibility for emergency preparedness efforts to licensees and OROs.

There are gaps. How to demonstrate the implementation of protective actions, especially evacuation, remains unclear. The minimum frequency of demonstration needed to provide reasonable assurance on subtask performance remains more relative than precisely specified. Degrees of unacceptable performance have not been defined or validated for all subtasks. Additional work needs to be done in all these areas.

Next steps include studying whether and how the proposed performance-based oversight approach could integrate successfully both with onsite emergency preparedness requirements and with recent all-hazards preparedness policy initiatives from the White House, DHS, and FEMA. Implementation details and their resource implications also remain to be developed. However, a conceptual framework now exists in sufficient detail to guide further development of a risk-informed, performance-based RERP oversight concept.

APPENDIX A: SUBTASK CHECKLISTS

Each subtask on the following pages is organized in a similar manner to NEI 99-02 Revision 6: "Regulatory Assessment Performance Indicator Guideline," which discusses onsite facility preparation and response.[48] For each indicator, an attempt is made to provide an indicator name, a definition of the indicator, measurement criteria for each subtask (including data reporting elements and clarifying notes), and an initial effort at calculating the subtask.

Also included is a proposed method and frequency of demonstration.

Unlike NEI 99-02, each measure (except for binary process measures) has values linked to evaluation categories. For example, in a time based indicator, the ideal or target time would be labeled "green," an unacceptable time that is expected to have small impact on public health and safety would be labeled "white," an unacceptable time that is expected to have a moderate to major impact on public health and safety would be labeled "yellow."

Determining thresholds for assessments for each subtask requires more literature review, expert consultation, and analysis. Sample threshold levels are provided for some indicators. For some time-based metrics, the target value is given only as a letter value (e.g.: "x") indicating the need for additional analysis to determine a threshold value. However, the level of detail in this framework should serve to guide fuller development.

[48] Nuclear Energy Institute (2009). Available at: http://pbadupws.nrc.gov/docs/ML0929/ML092931123.pdf.

Task 1: Receive Licensee Notification of Emergency

Subtask: Primary communications

Description: The primary means of communication from licensee to ORO is functional.

Measurement: Primary communications system should be tested multiple times throughout the period of performance, to test that the system is functional. "Functional" means that a connection is made. Must demonstrate positive performance at least 90% (tentative) of the time to yield a positive finding. Tests should be conducted at least monthly to yield accurate findings.

Calculation:

Green: (# of successful tests)/(total # of tests) >/= 0.90

White: (# of successful tests)/(total # of tests) >/= w

Yellow: (# of successful tests)/(total # of tests) >/= y

Orange: (# of successful tests)/(total # of tests) < y

Demonstration Type: Communications test

Demonstration Frequency: Monthly

Subtask: Secondary communications

Description: Licensee and ORO have a functional, secondary means of communication.

Measurement: Secondary communications system should be tested multiple times throughout the period of performance, to test that system is functional. "Functional" means that a connection is made. Must demonstrate positive performance at least 90% (tentative) of the time to yield a positive assessment. Tests should be conducted at least monthly to yield accurate assessments.

Calculation:

Green: (# of successful tests)/(total # of tests) >/= 0.90

White: (# of successful tests)/(total # of tests) >/= w

Yellow: (# of successful tests)/(total # of tests) >/= y

Orange: (# of successful tests)/(total # of tests) < y

Demonstration Type: Communications test

Demonstration Frequency: Monthly

Subtask: 24-Hour Warning Point

Description: ORO's primary communications center is staffed at all times to receive a message.

Measurement: Call or otherwise contact ORO's primary communications center at random times throughout the period of performance, to test that someone is available to answer the phone or secondary means of communication. Call must include notification that this is a test or drill. Must answer phone/device at least 90% (tentative) of the time to yield a positive finding. Calls should be conducted on a monthly (or more frequent) basis, at all times of day and night. Test may be combined with tests of primary and secondary means of communications.

Calculation:

Green: (# successfully answered calls)/(total # of calls) >/= 0.90

White: (# successfully answered calls)/(total # of calls) >/= w

Yellow: (# successfully answered calls)/(total # of calls) >/= y

Orange: (# successfully answered calls)/(total # of calls) < y

Demonstration Type: Communications test

Demonstration Frequency: Monthly

Subtask: Alternate Communications Center

Description: ORO can continue to receive notifications in the event of a primary facility being rendered unusable.

Measurement: At least quadrennially, as a condition of play, render ORO primary communications/watch center unusable. ORO must be able to identify and set up an alternate location for continuity of operations, and maintain required communications from this secondary facility.

Calculation: This indicator requires two capability demonstrations.

Green: Is ORO able to identify an alternate facility? Y or N. Is ORO able to establish operations at alternate facility? Y or N. Must achieve yes to both.

White: Is ORO able to identify an alternate facility? Y or N. Is ORO able to establish operations at alternate facility? Y or N. Must achieve yes to both, but may have trouble with one.

Yellow: Is ORO able to identify an alternate facility? Y or N. Is ORO able to establish operations at alternate facility? Y or N. Only achieves 1 demonstration of capability.

Orange: ORO cannot demonstrate either capability.

Demonstration Type: Exercise

Demonstration Frequency: Quadrennially

Task 2: Understand the Notification (Emergency Classification Levels)

Subtask: Message comprehension

Description: Staff at communications/watch center who receive a message are able to comprehend emergency classification levels/severity of emergency.

Measurement: Done in conjunction with ability to receive a notification. Various levels of emergency are presented to the respondent. Respondent is then queried about the meaning of the classification level, and the actions that would be necessary on his or her part. Should demonstrate understanding of emergency response levels at least 90% (tentative) of the time.

Calculation:

Green: (# of times able to explain response levels)/(total # of queries about response levels) >/= 0.90

White: (# of times able to explain response levels)/(total # of queries about response levels) >/= w

Yellow: (# of times able to explain response levels)/(total # of queries about response levels) >/= y

Orange: (# of times able to explain response levels)/(total # of queries about response levels)< y

Demonstration Type: Drill (may be combined with communications test)

Demonstration Frequency: Monthly

Subtask: Secondary official message comprehension

Description: Other appropriate officials who receive the message from original offsite message recipient are able to comprehend emergency classification levels/severity of emergency.

Measurement: On at least a quarterly basis, secondary staff at communications/watch center are questioned about the meaning of the classification levels, and the response actions that would be necessary on their part. Should demonstrate understanding of emergency response levels at least 75% (tentative) of the time.

Calculation:

Green: (# of times able to explain response levels)/(total # of queries about response levels) >/= 0.75

White: (# of times able to explain response levels)/(total # of queries about response levels) >/= w

Yellow: (# of times able to explain response levels)/(total # of queries about response levels) >/= y

Orange: (# of times able to explain response levels)/(total # of queries about response levels) < y

Demonstration Type: Drill (may be combined with communications test)

Demonstration Frequency: Monthly

Task 3: Notify the Appropriate Officials

Subtask: Timely notification

Description: Offsite message recipient at communications center is able to contact appropriate officials/decision makers within reasonable amount of time following receipt of notification of emergency.

Measurement: During exercise play, communications center is able to contact appropriate officials in the chain of command within 15 minutes (tentative) of notification of an emergency.

Calculation:

Green: (recorded time that message recipient successfully contacts officials)/(recorded time that message was received) </= 15 minutes

White: (recorded time that message recipient successfully contacts officials)/(recorded time that message was received) </= w

Yellow: (recorded time that message recipient successfully contacts officials)/(recorded time that message was received) </= y

Orange: (recorded time that message recipient successfully contacts officials)/(recorded time that message was received) > y

Demonstration Type: Exercise

Demonstration Frequency: Monthly

Subtask: Functional communications

Description: Functional primary and backup systems are in place to disseminate message to ORO primary personnel and other response organizations.

Measurement: On at least a quarterly basis, both primary and functional communications systems must be tested for ability to connect with officials/decision makers at least 75% (tentative) of the time. This could serve as both a test of systems, as well as a test of ability to actually reach decision-

makers, or their backups in chains of command.

Calculation:

Green: (# of successfully answered communications transmissions)/(total number of attempted communications) >/= 0.75

White: (# of successfully answered communications transmissions)/(total number of attempted communications) >/= w

Yellow: (# of successfully answered communications transmissions)/(total number of attempted communications) >/= y

Orange: (# of successfully answered communications transmissions)/(total number of attempted communications) < y

Demonstration Type: Communications test

Demonstration Frequency: Monthly

Task 4: Assess the Situation

Subtask: Radiological expertise

Description: A team of decision-makers and radiological technical advisors successfully interprets information related to a radiological event or release.

Measurement: State or local EOC personnel responsible for producing assessments accurately interpret information provided regarding the emergency at least 90% of the time (tentative). Information may include figures about the severity of an emergency, radioactive dosage and PAGs in the event of a release, plume projections given weather conditions, and other information related to the preservation of public safety in a radiological emergency. To ensure that the interpretation is accurate, playing a pre-developed scenario will ensure that "correct" answers are available to grade the technical advisor's performance against.

Calculation:

Green: (# of times radiological technical advisor/decision-maker is able to correctly interpret information)/(# of times radiological technical advisor receives information) >/= 0.90

White: (# of times radiological technical advisor/decision-maker is able to correctly interpret information)/(# of times radiological technical advisor receives information) >/= w

Yellow: (# of times radiological technical advisor/decision-maker is able to correctly interpret information)/(# of times radiological technical advisor receives information) >/= y

Orange: (# of times radiological technical advisor/decision-maker is able to correctly interpret information)/(# of times radiological technical advisor receives information) < y

Demonstration Type: Exercise

Demonstration Frequency: Biannually (but multiple demonstration points within each exercise)

Subtask: Contact licensee

Description: ORO can demonstrate ability to contact nuclear plant for questions pertaining to a developing situation.

Measurement: ORO can demonstrate use of communication systems to communicate with nuclear plant in real time to gain information within 15 minutes of requiring information about a situation x% of the time.

Calculation:

Green: (# of times ORO is able to successfully communicate with nuclear plant within 15 minutes)/(# of times ORO attempts to communicate with nuclear plant) >/= g

White: (# of times ORO is able to successfully communicate with nuclear plant within 15 minutes)/(# of times ORO attempts to communicate with nuclear plant) >/= w

Yellow: (# of times ORO is able to successfully communicate with nuclear plant within 15 minutes)/(# of times ORO attempts to communicate with nuclear plant) >/= y

Orange: (# of times ORO is able to successfully communicate with nuclear plant within 15 minutes)/(# of times ORO attempts to communicate with nuclear plant < y

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Monitor radioactivity

Description: ORO can demonstrate capability to monitor the environment outside the facility boundary for increased levels of radioactivity.

Measurement: ORO must be able to activate and provide field monitoring teams at random times over a given period of time. To measure this, a series of unannounced tests must be performed, in which the ORO is required to provide at least 2 offsite monitoring teams with capability, equipment, and knowledge to accomplish a reading. During exercise, the ORO should also be required to detect elevated levels of radioiodine concentrations in the air to an amount as low as 10^-7 µCi/cc within x hours of notification, even with interference from noble gases and background radiation.

Calculation: Two calculations must be performed for this measure.

Green: First: (# of unannounced tests in which ORO is able to successfully perform an offsite

monitoring test within *g* hour of notification)/(total # of unannounced offsite monitoring tests) >/= 0.90. Second: ORO is able to detect elevated levels of radioiodine concentration as low as 10^-7 µCi/cc in a test within *g* hour of notification. ORO meets both elements.

White: First: (# of unannounced tests in which ORO is able to successfully perform an offsite monitoring test within *g* hours of notification)/(total # of unannounced offsite monitoring tests) >/= 0.90. Second: ORO is able to detect elevated levels of radioiodine concentration as low as 10^-7 µCi/cc in a test within *g* hour of notification. ORO meets both elements, but may have difficulties.

Yellow: First: (# of unannounced tests in which ORO is able to successfully perform an offsite monitoring test within *g* hours of notification)/(total # of unannounced offsite monitoring tests) >/= 0.90. Second: ORO is able to detect elevated levels of radioiodine concentration as low as 10^-7 µCi/cc in a test within *g* hour of notification. ORO meets only one element.

Orange: ORO is unable to meet either element.

Demonstration Type: Drill

Demonstration Frequency: Quarterly

Subtask: Weather evaluation

Description: ORO can demonstrate ability to evaluate current and future real world weather conditions that may have a direct impact on the protective actions necessary to protect the public.

Measurement: ORO has direct access to a weather authority (such as the National Weather Service) or meteorologist who is able to provide guidance on real-world weather and its effect on a nuclear emergency. Random tests should be performed over a given period of time, and should assess whether the ORO can contact weather service in a timely manner, and whether meteorologist can produce accurate implications of forecast weather in a timely manner

Calculation: 2 calculations must be made to capture this subtask.

Green: First: (# of times ORO successfully contacts weather evaluator within x minutes)/(total # of times ORO attempts to contact weather authority)>/= g. Second: Time it takes for weather service to produce accurate implications of forecast weather </= G minutes.

White: First: (# of times ORO successfully contacts weather evaluator within x minutes)/(total # of times ORO attempts to contact weather authority)>/= w. Second: Time it takes for weather service to produce accurate implications of forecast weather </= W minutes.

Yellow: First: (# of times ORO successfully contacts weather evaluator within x minutes)/(total # of times ORO attempts to contact weather authority)>/= y. Second: Time it takes for weather service to produce accurate implications of forecast weather </= Y minutes.

Orange: First: (# of times ORO successfully contacts weather evaluator within x minutes)/(total # of times ORO attempts to contact weather authority) < y. Second: Time it takes for weather service to produce accurate implications of forecast weather > Y minutes.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Plume mapping

Description: ORO can demonstrate the ability to develop detailed plume maps of the area of likely impact.

Measurement: ORO uses available resources, samples and information to produce an accurate map of projected plume, given current or provided release and wind conditions, x% of the time.

Calculation:

Green: (# of times ORO produces accurate plume map from current or provided weather conditions)/(# of times ORO is asked to produce plume map) >/= g

White: (# of times ORO produces accurate plume map from current or provided weather conditions)/(# of times ORO is asked to produce plume map) >/= w

Yellow: (# of times ORO produces accurate plume map from current or provided weather conditions)/(# of times ORO is asked to produce plume map) >/= y

Orange: (# of times ORO produces accurate plume map from current or provided weather conditions)/(# of times ORO is asked to produce plume map) < y

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Risk mapping (dose projection)

Description: ORO can demonstrate the ability to identify people at risk in a radiological event.

Measurement: ORO develops accurate projections of integrated dose, including gross radioactivity measurements from contamination data (water and air) and produces assessments for population in 10-mile EPZ within x hours of notification of protective action recommendation, X% of the time.

Calculation:

Green: (# of times ORO accurately produces an integrated dose assessment within x hours of protective action recommendation from plant)/(# of times ORO attempts to produce an integrated dose assessment)>/= g

White: (# of times ORO accurately produces an integrated dose assessment within x hours of protective action recommendation from plant)/(# of times ORO attempts to produce an integrated dose assessment)>/= w

Yellow: (# of times ORO accurately produces an integrated dose assessment within x hours of protective action recommendation from plant)/(# of times ORO attempts to produce an integrated dose assessment)>/= y

Orange: (# of times ORO accurately produces an integrated dose assessment within x hours of protective action recommendation from plant)/(# of times ORO attempts to produce an integrated dose assessment) < y

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Task 5: Make Protective Action Decision

Subtask: Consult with experts

Description: ORO can demonstrate ability to consult with technical advisors for advice on maximum protection of public health and safety.

Measurement: ORO consults with technical advisor to review protective action recommendations provided by licensee, and determine if recommendations are adequate. When deemed necessary, the technical advisor provides additional recommendations for protective action.

Calculation:

Green: Does ORO consult with technical advisor? Y or N. Does technical advisor review recommendations? Y or N. Does technical advisor provide additional recommendation for protective action if he/she deems necessary? Y or N. Must answer Y to 3/3 questions.

White: Does ORO consult with technical advisor? Y or N. Does technical advisor review recommendations? Y or N. Does technical advisor provide additional recommendation for protective action if he/she deems necessary? Y or N. Must answer Y to 2/3 questions.

Yellow: Does ORO consult with technical advisor? Y or N. Does technical advisor review recommendations? Y or N. Does technical advisor provide additional recommendation for protective action if he/she deems necessary? Y or N. Answers Y to 1/3 or 0/3 questions.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Make protective action decision

Description: ORO leaders review recommendations from technical advisor and licensee and make a

protective action decision for public health and safety.

Measurement: Do decision-makers in the ORO reach a protective action decision in exercise play within x minutes of receiving protective action recommendation from nuclear licensee?

Calculation:

Green: Decision-makers in the ORO reach a protective action decision within g minutes of receiving protective action recommendation from nuclear licensee?

White: Decision-makers in the ORO reach a protective action decision within w minutes of receiving protective action recommendation from nuclear licensee?

Yellow: Decision-makers in the ORO reach a protective action decision within y minutes of receiving protective action recommendation from nuclear licensee?

Orange: ORO is unable to provide within y minutes.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Road mapping

Description: ORO can develop on a map or mapping system a representation of roads that will require access control/blocking.

Measurement: ORO must develop or provide a map identifying roads leading into the 10-mile EPZ that will require access control, as well as access control points for each road.

Calculation:

Green: Can ORO provide an accurate map of roads and access control points in the 10-mile EPZ within g hours of receiving protective action recommendations from licensee?

White: Can ORO provide an accurate map of roads and access control points in the 10-mile EPZ within w hours of receiving protective action recommendations from licensee?

Yellow: Can ORO provide an accurate map of roads and access control points in the 10-mile EPZ within y hours of receiving protective action recommendations from licensee?

Orange: ORO is unable to provide within y hours.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Evacuation mapping

Description: ORO can identify on a map or mapping system zones for evacuation.

Measurement: ORO must develop or provide a map identifying evacuation zones in the 10-mile EPZ.

Calculation:

Green: Can ORO provide an accurate map of evacuation zones in the 10-mile EPZ within g hours of receiving protective action recommendations from licensee?

White: Can ORO provide an accurate map of evacuation zones in the 10-mile EPZ within w hours of receiving protective action recommendations from licensee?

Yellow: Can ORO provide an accurate map of evacuation zones in the 10-mile EPZ within y hours of receiving protective action recommendations from licensee?

Orange: ORO is unable to provide within y hours.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Shelter-in-place mapping

Description: ORO is able to identify on a map or mapping system zones for shelter in place.

Measurement: ORO must develop or provide a map identifying zones for shelter in place in the 10-mile EPZ.

Calculation:

Green: Can ORO provide an accurate map of zones for shelter in place in the 10-mile EPZ within g hours of receiving protective action recommendations from licensee?

White: Can ORO provide an accurate map of zones for shelter in place in the 10-mile EPZ within w hours of receiving protective action recommendations from licensee?

Yellow: Can ORO provide an accurate map of zones for shelter in place in the 10-mile EPZ within y hours of receiving protective action recommendations from licensee?

Orange: ORO is unable to provide within y hours.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: KI mapping

Description: ORO is able to identify on a map or mapping system zones for administration of KI.

Measurement: ORO must develop or provide a map identifying zones for administration of KI within the 10-mile EPZ, and within the 50 mile EPZ as needed.

Calculation:

Green: Can ORO provide an accurate map of zones for administration of KI in the 10-mile EPZ/50 mile EPZ within g hours of receiving protective action recommendations from licensee?

White: Can ORO provide an accurate map of zones for administration of KI in the 10-mile EPZ/50 mile EPZ within w hours of receiving protective action recommendations from licensee?

Yellow: Can ORO provide an accurate map of zones for administration of KI in the 10-mile EPZ/50 mile EPZ within y hours of receiving protective action recommendations from licensee?

Orange: ORO is unable to provide within y hours.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Task 6: Mobilize Response Components

Subtask: Contact emergency responders

Description: ORO able to establish contact with emergency responders working in or near the 10-mile EPZ (police, EMTs, firefighters) in a timely manner.

Measurement: ORO is able to contact police, EMTs, firefighters and other first responders working in or near the 10-mile EPZ within 15 minutes (tentative) of making protective action decision.

Calculation: Requires 3 demonstrations of capability.

Green: ORO able to contact police within 15 minutes of making protective action decision? Y or N. ORO able to contact EMTs within 15 minutes of making protective action decision? Y or N. ORO able to contact firefighters within 15 minutes of making protective action decision? Y or N. ORO able to contact other (if needed) within 15 minutes of making protective action decision? Y or N. Must demonstrate all.

White: ORO able to contact police within 15 minutes of making protective action decision? Y or N. ORO able to contact EMTs within 15 minutes of making protective action decision? Y or N. ORO able to contact firefighters within 15 minutes of making protective action decision? Y or N. ORO able to contact other (if needed) within 15 minutes of making protective action decision? Y or N. Must

demonstrate at least 2/3.

Yellow: ORO able to contact police within 15 minutes of making protective action decision? Y or N. ORO able to contact EMTs within 15 minutes of making protective action decision? Y or N. ORO able to contact firefighters within 15 minutes of making protective action decision? Y or N. ORO able to contact other (if needed) within 15 minutes of making protective action decision? Y or N. Must demonstrate 1/3.

Orange: ORO able to contact police within 15 minutes of making protective action decision? Y or N. ORO able to contact EMTs within 15 minutes of making protective action decision? Y or N. ORO able to contact firefighters within 15 minutes of making protective action decision? Y or N. ORO able to contact other (if needed) within 15 minutes of making protective action decision? Y or N. ORO unable to demonstrate any element.

Demonstration Type: Communications/notification test

Demonstration Frequency: Quarterly

Subtask: Activate responders

Description: ORO is able to demonstrate the ability to notify and activate necessary off-duty personnel.

Measurement: ORO can contact and activate off-duty personnel within x hour of notification of event. Off-duty personnel should be contacted via telephone or other method. In an ideal test, off-duty personnel would be required to report for duty in a designated location (e.g., for training), but due to overtime staffing concerns this may not be possible for many jurisdictions. Instead can use the ability to contact responders as a proxy measure, OR can attempt to use demonstration of successful mobilization of response components either in a series of drills, or in a massive mobilization exercise, tied to a time requirement. This test may occur in an unannounced environment in order to be a true demonstration of capability.

Calculation: 2 calculations are possible to test responder activation. Both are not necessary, though in a mobilization drill, a response activation call drill should also occur.

Green: First: (# of off-duty responders who respond to activation call drill)/(total # off duty responders contacted) >/= G Second: (# of off-duty responders who report to a designated location following an activation call within x hours)/(total # off duty responders who receive activation call) >/= g

White: First: (# of off-duty responders who respond to activation call drill)/(total # off duty responders contacted) >/= W Second: (# of off-duty responders who report to a designated location following an activation call within x hours)/(total # off duty responders who receive activation call) >/= w

Yellow: First: (# of off-duty responders who respond to activation call drill)/(total # off duty

responders contacted) >/= Y Second: (# of off-duty responders who report to a designated location following an activation call within x hours)/(total # off duty responders who receive activation call) >/= y

Orange: First: (# of off-duty responders who respond to activation call drill)/(total # off duty responders contacted) </= Z Second: (# of off-duty responders who report to a designated location following an activation call within x hours)/(total # off duty responders who receive activation call) < y

Demonstration Type: Drill

Demonstration Frequency: Quadrennially (if massive mobilization drill)

Subtask: Response support

Description: ORO is able to demonstrate the ability to bring in additional emergency service personnel through existing mutual aid agreements, contract services, or through contact with other agencies/levels of government.

Measurement: Some portion of needs could likely be taken care of through mobilizing response components. However, to the extent that needs remain, measurements must capture whether the ORO is able to successfully contact resource support providers listed in existing plans or agreements, whether ORO can obtain a [notional] commitment for asset(s) relied upon in the plan, and whether ORO can obtain an estimated delivery time for asset(s) relied upon in plan (with a recording of the time). This would not need to be demonstrated frequently, but since it supports a task with high risk significance it should be tested at least quadrennially.

Calculation: Measuring this subtask requires 3 demonstrations of capability.

Green: First: (# of resource support providers ORO is able to contact)/(total # resource support providers) >/= g. Second: (# of resources ORO obtains notional commitment for)/(total # of resources ORO requests) >/= G. Third: Average estimated delivery time for committed assets </= 24 hours. Must demonstrate 3/3.

White: First: (# of resource support providers ORO is able to contact)/(total # resource support providers) >/= g. Second: (# of resources ORO obtains notional commitment for)/(total # of resources ORO requests) >/= G. Third: Average estimated delivery time for committed assets </= 24 hours. Must demonstrate at least 2/3.

Yellow: First: (# of resource support providers ORO is able to contact)/(total # resource support providers) >/= g. Second: (# of resources ORO obtains notional commitment for)/(total # of resources ORO requests) >/= G. Third: Average estimated delivery time for committed assets </= 24 hours. Must demonstrate 1/3.

Orange: ORO cannot demonstrate any of the three elements.

Demonstration Type: Exercise/Drill

Demonstration Frequency: Quadrennially

Task 7: Notify the Public

Subtask: Delivery of mass notification

Description: ORO is able to use a range of communications devices to reach x% of the EPZ population within 15 minutes.

Measurement: Primary alert and notification methods cover x% of the 10-mile EPZ population, and can reach them within 15 minutes. The range of communications devices may include emergency messaging over television or radio, cellular emergency alert system, sirens, or other methods as deemed appropriate. It is beyond the scope of an exercise to monitor the entire population during an exercise. Instead, this should serve as a proxy measure that the communications systems extend over a wide enough range and in a diverse enough manner to reach an estimated 100% of the population. For example, a combination of cellular emergency alert systems and sirens might be projected to reach x% of the population through the vast majority of the population having cellular phones (and a secondary method operating to reach those who do not).

Notification tests can serve to meet requirements within a number of tasks, as public information and notification is critical throughout all phases of a radiological emergency. For example, though not explicitly listed as subtasks here, it is important for the ORO to notify the public of the protective action plan, including any evacuation routes, registration stations, decontamination stations, shelters, special needs facilities, or other relevant information to assist in the implementation of the protective action plan.

Calculation: Test of emergency alert system(s) able to disseminate emergency notification to an estimated x% of population. Estimation may come from executing a drill utilizing available communications systems, and following this with a random survey of the population in the 10-mile EPZ to determine if they received a test alert. This sample may be extrapolated to determine how much of the population could be reached in an emergency.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Develop follow-on emergency instruction message

Description: ORO develops an accurate and correct instructional message to the public for implementing the protective action decision.

Measurement: Within 15 minutes (tentative) following initial PAD, ORO develops an appropriate warning/instructional message that includes protective actions to be taken by the general public, evacuation routes by affected areas, methods to maximize shelter-in-place protection, a public inquiry number, and what evacuees should or should not take with them.

Calculation:

Green: ORO is able to develop or provide instructional messaging within 15 minutes following initial PAD.

White: ORO is able to develop or provide instructional messaging within w minutes following initial PAD.

Yellow: ORO is able to develop or provide instructional messaging within y minutes following initial PAD.

Orange: ORO is unable to develop or provide instructional messaging within y minutes following initial PAD.

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Subtask: Notification of non-English speaking population

Description: ORO develops messages in languages other than English for delivery to non-English speakers comprising a significant percentage of the population.

Measurement: Within 15 minutes following delivery of follow-on message, ORO develops an appropriate warning/instructional message equivalent to its English-language message in each language other than English spoken by more than 10,000 people within a given county or five percent of the voting-age population within a given county.

Calculation:

Green: ORO is able to develop or provide instructional messaging in non-English languages spoken by 10,000 people or over 5% of the population in counties within the EPZ within 15 minutes following the initial follow-on message.

White: ORO is able to develop or provide instructional messaging in non-English languages spoken by 10,000 people or over 5% of the population in counties within the EPZ within w minutes following the initial follow-on message.

Yellow: ORO is able to develop or provide instructional messaging in non-English languages spoken by 10,000 people or over 5% of the population in counties within the EPZ within y minutes following the initial follow-on message.

Orange: ORO is unable to develop or provide instructional messaging in non-English languages spoken by 10,000 people or over 5% of the population in counties within the EPZ within y minutes following the initial follow-on message.

Demonstration Type: Exercise

Demonstration Frequency: Biannually
Subtask: Establish joint information center **Description:** The ORO must establish a Joint Information Center (JIC) with the licensee in order to yield unified responses to questions from public and media. **Measurement:** The ORO and licensee must work together to establish a Joint Information Center functional within x minutes of a Site Area Emergency. **Calculation:** Green: (time JIC is established)- (time Site Area Emergency is declared) </= g minutes White: (time JIC is established)- (time Site Area Emergency is declared) </= w minutes Yellow: (time JIC is established)- (time Site Area Emergency is declared) </= y minutes Orange: (time JIC is established)-(time Site Area Emergency is declared) > y minutes **Demonstration Type:** Exercise **Demonstration Frequency:** Biannually
Subtask: Special needs populations **Description:** ORO is able to alert and notify schools, licensed care facilities, correctional facilities, and persons with specific evacuation support requirements within the 10-mile EPZ. **Measurement:** Demonstrate the capability to alert and notify *all* public school districts, correctional facilities and special care facilities that are expected or may necessitate protective actions for students. Demonstration requires that OROs actually contact public school systems/etc. during exercise. **Calculation:** Green: (# of facilities successfully alerted and notified within 15 minutes)/(total # of facilities) >/= g White: (# of facilities successfully alerted and notified within 15 minutes)/(total # of facilities) >/= w Yellow: (# of facilities successfully alerted and notified within 15 minutes)/(total # of facilities) >/= y Orange: (# of facilities successfully alerted and notified within 15 minutes)/(total # of facilities) < y **Demonstration Type:** Exercise **Demonstration Frequency:** Biannually

Task 8: Implement Protective Action Decision

Subtask: Evacuation

Description: ORO is able to evacuate population in evacuation zones within required time, whether through lateral evacuation, radial evacuation, staged evacuation, or shelter-before-evacuation.

Measurement: N/A (impractical). *May involve real-world demonstration, constructed index, etc.*

Calculation: N/A

Demonstration Type: N/A

Demonstration Frequency: N/A

Subtask: Shelter in place

Description: ORO is able to have population appropriate zones seek shelter within required time, whether through shelter-in-place, shelter in enhanced facilities, or shelter-before-evacuation.

Measurement: N/A (impractical). *May rely on survey data.*

Calculation: N/A

Demonstration Type: N/A

Demonstration Frequency: N/A

Subtask: KI distribution

Description: ORO has distributed or has the ability to distribute KI to the public, responders, special needs populations and transients.

Measurement: N/A. *May use inventory as proxy, rather than a performance measure.*

Calculation: This is a proposed proxy measure.

Green: (total # of doses disseminated to emergency workers) + (total # of doses available to emergency workers) = total emergency worker population? Y or N. (total # of doses disseminated to correctional facilities) + (total # of doses available to institutionalized individuals) = total incarcerated population? Y or N. (total # of doses disseminated to the public) + (total # of doses available to the public) = total population in 10-mile EPZ, including incarcerated population. Y or N. Demonstrate 3/3

White: (total # of doses disseminated to emergency workers) + (total # of doses available to emergency workers) = total emergency worker population? Y or N. (total # of doses disseminated to correctional facilities) + (total # of doses available to institutionalized individuals) = total incarcerated

population? Y or N. (total # of doses disseminated to the public) + (total # of doses available to the public) = total population in 10-mile EPZ. Y or N. Demonstrate 2/3

Yellow: (total # of doses disseminated to emergency workers) + (total # of doses available to emergency workers) = total emergency worker population? Y or N. (total # of doses disseminated to correctional facilities) + (total # of doses available to institutionalized individuals) = total incarcerated population? Y or N. (total # of doses disseminated to the public) + (total # of doses available to the public) = total population in 10-mile EPZ, including incarcerated population. Y or N. Demonstrate 1/3

Orange: ORO is unable to perform any of the required subtasks

Demonstration Type: N/A

Demonstration Frequency: N/A

Subtask: Emergency Worker Protection

Description: ORO is able to develop protective actions for responders in the 10-mile EPZ, and effectively implement them for affected responders.

Measurement: Demonstrate the capability to alert and notify responders of protective action decisions affecting them (including administration of KI or shelter in place). In place of actually requiring demonstration of KI ingestion, can determine that have stockpile of KI available, and are able to comprehend the order to ingest when directed to do so.

Calculation: Requires 2 calculations

Green: First: (# of responders alerted to protective action decisions for responders)/(total # responders) >/= g. Second: (# of responders who have KI available)/(total # of responders) >/= G

White: First: (# of responders alerted to protective action decisions for responders)/(total # responders) >/= w. Second: (# of responders who have KI available)/(total # of responders) >/= W

Yellow: First: (# of responders alerted to protective action decisions for responders)/(total # responders) >/= y. Second: (# of responders who have KI available)/(total # of responders) >/= Y

Orange: First: (# of responders alerted to protective action decisions for responders)/(total # responders) < y. Second: (# of responders who have KI available)/(total # of responders) < Y

Demonstration Type: Exercise

Demonstration Frequency: Biannually

Task 9: Receive, Screen, and Support Evacuees

Subtask: Reception center operation

Description: ORO must be able to demonstrate the ability to establish and operate an appropriate number of reception centers for citizens evacuating the 10-mile EPZ.

Measurement: Demonstration will process simulated evacuees, to process evacuees at the reception center. Ideally, these "evacuees" will be actual residents of the 10-mile EPZ. Registration centers should be able to handle at least 20% of the total population of the EPZ within 12 hours. However, this figure is infeasible to conduct in a drill setting. Instead, a 1 hour drill should be conducted, if possible including "evacuees" totaling a threshold amount of the population for a 1 hour time period (possibly 1.66%, 1/12 of 20%). "Evacuees" should include special needs populations, and non-English speakers.

Calculation:

Green: (# of evacuees processed in 1 hour drill)/(total population of 10-mile EPZ) >/= g

White: (# of evacuees processed in 1 hour drill)/(total population of 10-mile EPZ) >/= w

Yellow: (# of evacuees processed in 1 hour drill)/(total population of 10-mile EPZ) < w

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Radiological monitoring

Description: ORO must demonstrate the ability to monitor residents of EPZ for contamination.

Measurement: ORO may use hand-held instruments, portal monitors, or other equipment as necessary, and should have sufficient number of trained staff to operate monitoring equipment. ORO should demonstrate the ability to monitor 20% of the EPZ in a 12 hour period. In a drill setting, this may involve calculating the hourly rate of monitoring necessary to meet the 20% threshold (possibly 1.66% per hour), and conducting a 1 hour drill, using a pool of volunteer "evacuees," who may be recycled through to avoid undue burden on the local population.

Calculation:

Green: (# of evacuees monitored per hour)/(total number of residents in 10-mile EPZ) >g

White: (# of evacuees monitored per hour)/(total number of residents in 10-mile EPZ) >/= w

Yellow: (# of evacuees monitored per hour)/(total number of residents in 10-mile EPZ) < w

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Register evacuees

Description: ORO must be able to register and address the needs of evacuees- either online, or through registration stations.

Measurement: Conduct a drill/reception center demonstration as part of a full scale exercise. Could require demonstration for each affected county. Registration stations as a whole must be able to account for x% of total population in EPZ. This should be a throughput measure that can extrapolate from a small sample of volunteer "evacuees" to give an estimate of an ORO's ability to deal with the entire population. To better approximate need to rapidly process registration of evacuees, could monitor ability to achieve a certain rate of registration (# of registrants/hr). Ideally, bring in "evacuees" from local 10-mile EPZ so that this can serve as a learning experience for them as well.

Calculation:

Green: (# evacuees registered)/(allotted time) >/= (required # evacuees registered)/(allotted time)

White: (# evacuees registered)/(allotted time) >/= w

Yellow: (# evacuees registered)/(allotted time) < w

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Congregate care

Description: ORO must be able to provide sufficient public shelter for evacuees from the 10-mile EPZ.

Measurement: Demonstrate the ability to set-up shelters adequate to accommodate 20% (tentative) of the EPZ population, *including addressing access and functional needs*. Because of the volume of this test, does not need "evacuees" to participate, but should test availability of beds, staff and supplies. Because this is a massive sheltering exercise, congregate care should only be tested once every 8 years. However, it is also important to note that this does have all-hazards value outside of radiological emergencies, and a congregate care test may be supplemented by demonstration of capacity during an actual emergency requiring a significant evacuation (e.g. hurricane or earthquake).

Calculation: Requires 2 calculations

Green: First: (# of persons congregate care facilities in host or support jurisdictions can accommodate)/(total population in 10-mile EPZ) >/= 0.20 Second: (# congregate care facilities meeting ADA requirements without modification)/(# congregate care facilities) >/= G

White: First: (# of persons congregate care facilities in host or support jurisdictions can

accommodate)/(total population in 10-mile EPZ) >/= w Second: (# congregate care facilities meeting ADA requirements without modification)/(# congregate care facilities) >/= W

Yellow: First: (# of persons congregate care facilities in host or support jurisdictions can accommodate)/(total population in 10-mile EPZ) < w Second: (# congregate care facilities meeting ADA requirements without modification)/(# congregate care facilities) < W

Demonstration Type: Drill

Demonstration Frequency: Once per cycle

Task 10: Manage Exposure and Contamination Risks

Subtask: General decontamination

Description: ORO must demonstrate the ability to decontaminate people and vehicles.

Measurement: ORO must be able to decontaminate victims, vehicles attempting to evacuate the EPZ, and pets or animals. Effective decontamination involves contamination control measures, such as safety requirements and decontamination protocol to be in place. Decontamination should occur in a timely and efficient manner. While the ORO should have the capacity to decontaminate 20% (tentative) of the EPZ population in a 12 hour period, conducting such a drill would be massive and infeasible. Instead, the ORO should be required to decontaminate a certain number of victims and vehicles, with a maximum time allowed for each decontamination. The mean time for all decontamination demonstrations should not exceed the maximum allowed time.

Calculation: Calculation of this subtask requires 2 demonstrations.

Green: First: (total time for all demonstrations of human decontamination)/(total # of human decontaminations) </= g minutes. Second: (total time for all demonstrations of vehicle decontamination)/(total # of vehicle decontaminations) </= G

White: First: (total time for all demonstrations of human decontamination)/(total # of human decontaminations) </= w minutes. Second: (total time for all demonstrations of vehicle decontamination)/(total # of vehicle decontaminations) </= W

Yellow: First: (total time for all demonstrations of human decontamination)/(total # of human decontaminations) > w minutes. Second: (total time for all demonstrations of vehicle decontamination)/(total # of vehicle decontaminations) > W

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Emergency worker decontamination

Description: ORO has the ability to monitor and decontaminate emergency workers and emergency

service vehicles.

Measurement: The ORO should have the ability to decontaminate all emergency workers and emergency service vehicles operating in the 10-mile EPZ. Again, because such a drill would be massive, it would be infeasible. A decontamination drill for emergency workers and vehicles could be conducted in coordination with a general decontamination drill, using similar time maximum time allowed.

Calculation: Calculation of this subtask requires 2 demonstrations.

Green: First: (total time for all demonstrations of responder decontamination)/(total # of responder decontaminations) </= g minutes. Second: (total time for all demonstrations of emergency vehicle decontamination)/(total # of emergency vehicle decontaminations) </=G

White: First: (total time for all demonstrations of responder decontamination)/(total # of responder decontaminations) </= w minutes. Second: (total time for all demonstrations of emergency vehicle decontamination)/(total # of emergency vehicle decontaminations) </= W

Yellow: First: (total time for all demonstrations of responder decontamination)/(total # of responder decontaminations) >/= > w minutes. Second: (total time for all demonstrations of emergency vehicle decontamination)/(total # of emergency vehicle decontaminations) > W

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Evacuation Zone Access Control

Description: ORO able to establish access control for evacuation zones and other non-plant restricted zones.

Measurement: Required demonstration of implementing access control for evacuation zone through a drill. May involve limited number of roads, or complete functional test establishing access control to all roads in 10-mile EPZ. Response time needed to establish access control into evacuation zone should not exceed x hours from the notification of protective action decision.

Calculation:

Green: (X time recorded) – (Z maximum time allowed) </= g

White: (X time recorded) – (Z maximum time allowed) </= w

Yellow: (X time recorded) – (Z maximum time allowed) > w

Demonstration Type: Drill

Demonstration Frequency: Annually

Subtask: Secure contaminated/restricted zones

Description: ORO has the ability to secure potentially contaminated areas.

Measurement: This subtask may be a shared responsibility of the facility operator, the ORO, NRC, and FEMA, especially during the intermediate to late phases of a radiological event. During the early phase (as a release is occurring or just after occurring), the ORO would likely be responsible for providing physical security to contaminated areas, which is the primary concern for this subtask. Ability to rapidly establish physical security perimeters around a designated area during a drill setting could serve as an effective proxy for securing multiple zones in the EPZ. The time allowed to establish a physical security perimeter will vary by plant depending upon the size, population, road access, and geographic features in the 10-mile EPZ.

Calculation: (Time required to establish physical security perimeter in drill)/(time allowed to establish physical security perimeter in drill) </= x

Green: (Time required to establish physical security perimeter in drill)/(time allowed to establish physical security perimeter in drill) </= g

White: (Time required to establish physical security perimeter in drill)/(time allowed to establish physical security perimeter in drill) </= w

Yellow: (Time required to establish physical security perimeter in drill)/(time allowed to establish physical security perimeter in drill) > w

Demonstration Type: Drills

Demonstration Frequency: Once per cycle

Subtask: Nuclear facility access control support

Description: ORO is able to effectively assist nuclear facility with controlling and restricting access to the facility when needed.

Measurement: Required demonstration of implementing access control for nuclear facility through a drill. May involve limited restriction of access, or test of complete access control. Response time needed to establish access control into evacuation zone should not exceed x hours from the notification of protective action decision. This may not need to be tested every performance period, but could be tested in conjunction with hostile action drills.

Calculation:

Green: (X time recorded) – (Z maximum time allowed) </= g

White: (X time recorded) – (Z maximum time allowed) </= w

Yellow: (X time recorded) – (Z maximum time allowed) > w

Demonstration Type: Drill

Demonstration Frequency: Once per cycle

Subtask: Identify agricultural contamination

Description: ORO is able to identify farms/livestock/agriculture that have potential to become contaminated in the event of a release.

Measurement: ORO must develop or provide a map identifying locations of farms possessing livestock or agriculture with potential to become contaminated in the event of a release. Map must account for 50 mile ingestion pathway, or beyond if plume projections exceed 50 miles.

Calculation:

Green: ORO provides an accurate map of potentially affected farms in the 50 mile ingestion pathway one within g minutes.

White: ORO provides an accurate map of potentially affected farms in the 50 mile ingestion pathway one within w minutes.

Yellow: ORO cannot provide an accurate map of potentially affected farms in the 50 mile ingestion pathway within w minutes.

Demonstration Type: Exercise

Demonstration Frequency: Annually

Subtask: Stored feed advisories

Description: ORO is able to advise farmers to shelter and place at-risk livestock on stored feed.

Measurement: ORO is able to use a variety of communications methods to advise x% of farmers in plume pathway within 50 miles to place livestock on stored feed, or take other preemptive actions. Should be tested in a drill setting, with OROs having to contact farmers, notifying them that this is just a drill.

Calculation:

Green: (# of farmers contacted)/(population of farmers in ingestion pathway zone) >/= g

White: (# of farmers contacted)/(population of farmers in ingestion pathway zone) >/= w

Yellow: (# of farmers contacted)/(population of farmers in ingestion pathway zone) < w

Demonstration Type: Exercise

Demonstration Frequency: Annually

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APPENDIX B: EVALUATION TOOLS

The All-hazards Response and Preparedness Assessment Tool (ARPAT), developed by Science Applications International Corporation (SAIC), aids in organizing information for assessments and presenting it in a more visually appealing manner. This functionality could be especially useful under the current RERP oversight system, given the large amount of documentation it collects for determinations on the adequacy of plans and supporting documentation. It is not clear whether it would be useful for the performance-based RERP oversight system proposed in this paper.

ARPAT is designed to support assessments for FEMA REPP, among other constructs. ARPAT presents a visual map of the 16 planning standards, linked to a central "Overall Evaluation" category, as shown in Figure B-1.

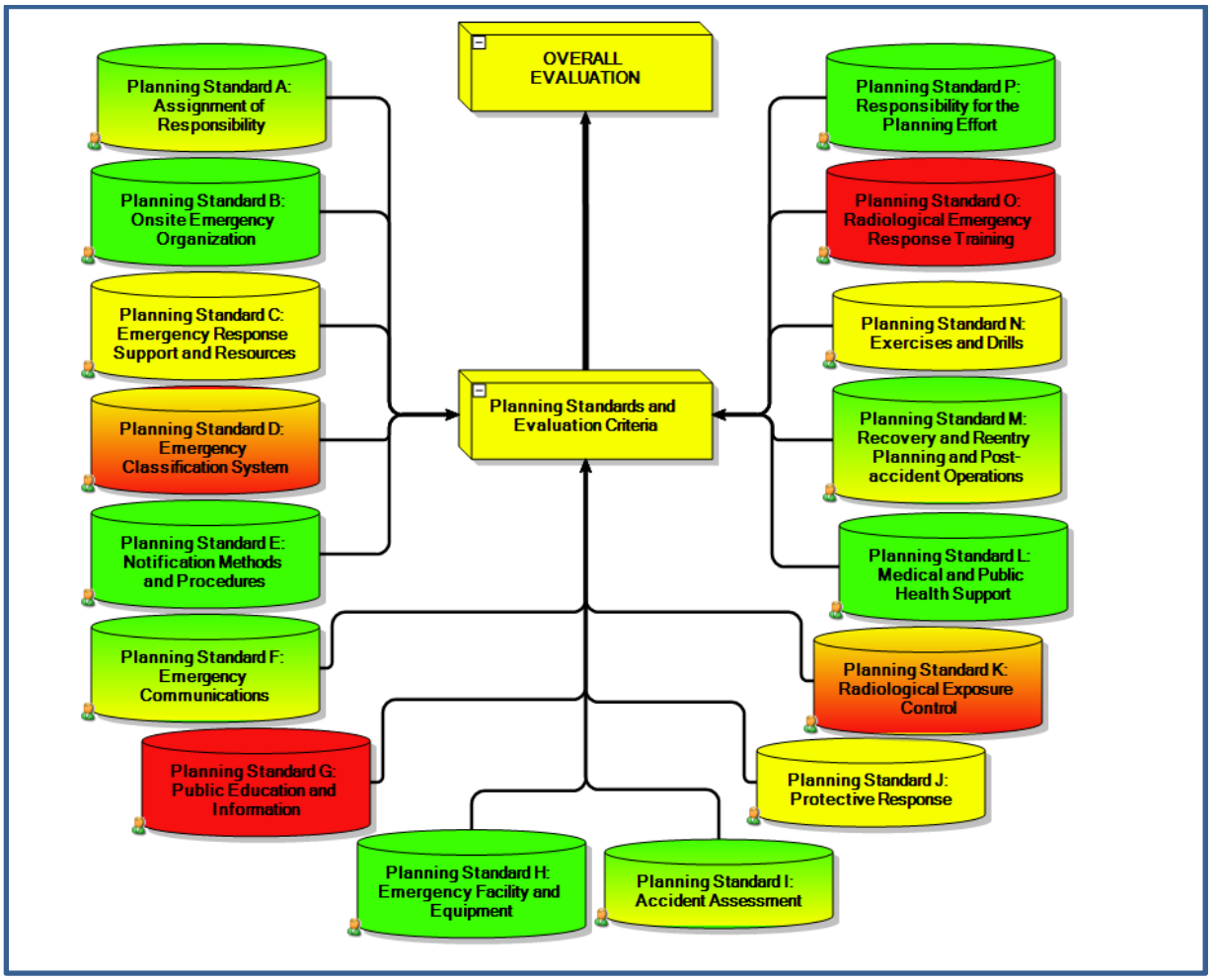

Figure B-1. ARPAT Summary Screen.

Each of the 16 current planning standards exists as a separate folder, within which each assessment criterion affiliated with a task is listed in a separate line, to be coded according to whether performance was "Adequate," "Adequate with Consequences," "Inadequate," or "Not Applicable." These rankings are color coded green-yellow-red, and when entered for all of the criteria, produce a visual depiction of the planning standard, shaded green, yellow, red, or some mix thereof depending on how well the ORO met the mix of criteria for the planning standard. When all planning standards have been entered, a complete evaluation map is produced, with visualization of the areas of greatest strength and weakness.

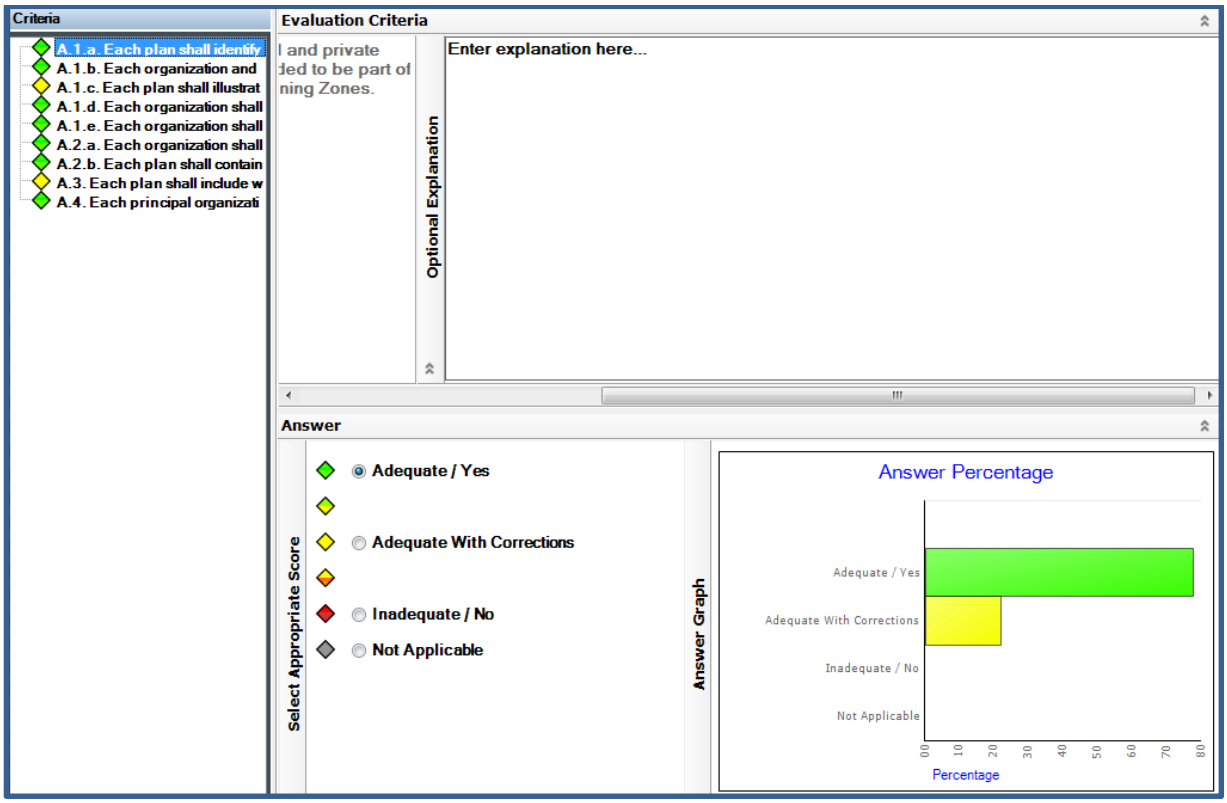

Figure B-2. ARPAT Data Entry.

ARPAT also allows explanations to be attached to each score, allowing an easy means of organizing a plan review or an after-action report. Additionally, documents may be attached to the planning standard folder, operating as a repository for additional relevant information about mutual aid agreements, capability improvement projects, or other important documents.

ARPAT could have some utility for concisely presenting performance-based oversight results. To fit the framework proposed in this paper, however, it would require several significant changes. First, the planning standards would need to be changed to reflect the

new critical tasks. The folders attached to each critical task would also need to be changed to reflect the subtasks for each. Within these subtasks, the green-yellow-red scoring would need to be altered to include “white” categories, and to replace the “red” assessment level with the “orange” assessment level.

Additionally, the scoring in the generation of the visual map depiction would need to be altered to reflect the new scoring standards imposed for each task. For example, if a task contained two white subtasks and four green subtasks, instead of the task appearing to blend the two colors to depict the task, it would need to adopt the rule that two white subtasks equals a white task.

If ARPAT were to be used for a performance-based oversight system, the document storage subfolder organization would need to be reworked to focus less on mutual aid agreements and capabilities improvement projects, and instead operate as a general repository, linked to a task or subtask folder, and able to be tagged appropriately by type.

The ARPAT software would ultimately have no significant effect on RERP oversight, and would not be required for use the proposed performance-based oversight system. However, it could be modified for evaluators interested in compiling a well-organized and visually appealing folder of an exercise or exercise cycle for the ORO associated with a particular nuclear power plant site.

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APPENDIX C: INITIAL REVIEW OF EXISTING CRITERIA

Extract from Deliverable 4.2a:

For some RERP elements, performance may be difficult to demonstrate directly. In those instances, indicators of capability may be useful to suggest that adequate performance is possible or likely.

To support initial consideration of which RERP elements are most suitable for performance-based oversight, the project team has reviewed existing documentation – principally the FEMA REPP Manual – to find objective performance criteria or capability indicators that have already been developed. All-hazards National Preparedness Goal core capability metrics have also been considered.

The table below and on the following pages lists, for each standard, *performance measures (PM)* and *capability indicators (CI).* Those not drawn from existing REPP documentation are indicated with an asterisk (*). For existing REPP criteria, citations are given for either the demonstration criteria or the planning criteria. Some of these are followed by italicized suggestions for a more quantitative and objective measure that could be adapted from the existing REPP criteria. Existing RERP elements most suitable for performance-based oversight will be those with existing quantitative PMs.

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
A – Assignment of Responsibility	▪ **CI: Number of activations of ORO (State and each locality) Emergency Operations Center over previous year for real-world incidents and exercises. Portion of such activations involving 24-hour (multi-shift) operations.*	NO	Generally involves planning input for performance, not performance itself. Suggested CI may also be indicator for "training" (job proficiency) for general emergency response.
C – Emergency Response Support and Resources		NO	Generally involves identification of outside resources available to assist. See comment under H regarding resource typing.

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
D – Emergency Classification System		NO	Involves yes/no determination of whether ORO is using same classification and emergency action levels as licensee.
E – Notification Methods and Procedures	▪ **PM:** Activities associated with primary alerting and notification of the public are completed in a timely manner following the initial decision by authorized offsite emergency officials to notify the public of an emergency situation. The initial instructional message to the public must include as a minimum the elements required by current REP guidance. (Criterion 5.a.1) *Initial instructional message to population is ready for transmission in X minutes.* ▪ **PM:** Backup alert and notification of the public is completed within a reasonable time following the detection by the ORO of a failure of the primary alert and notification system. (Criterion 5.a.3) *Message is ready for delivery by backup system within the recommended 45 minutes following identification of need for backup notification.* ▪ CI: Primary alert and notification method covers 100 percent of the 10-mile EPZ population. ▪ CI: Computation of siren operability (percentage of	YES	Existing criteria may be made more explicit and quantitative.

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
	sirens operable) for the immediately preceding calendar year is at least 90 percent, based on simple average of all regularly conducted tests employed as part of testing program. (FEMA-REP-10)		
F – Emergency Communications	▪ **PM:** Periodic test results of primary and backup communications systems (to demonstrate 24/7 availability of a primary and at least one backup system). (Criterion 1.d.1) *Percentage successful test results.*	YES	
G – Public Education and Information	▪ **CI: Results of survey indicating whether 10-mile EPZ population understands alert signals, knows by what means to receive information, knows evacuation concept, knows evacuation routes and host site, and has prepared an evacuation or shelter-in-place kit.*	NO	
H – Emergency Facilities and Equipment	▪ CI: Quantities of monitoring instruments required, based on the number of field monitoring teams and reception center requirements, and quantities available by model. (H.10) *Percentage of requirement available. Portable monitoring units per emergency worker. Portal monitoring units per EPZ population.* [Availability] ▪ CI: Periodic operational checks and calibration of monitoring instruments.	NO	Generally involves input for performance, not performance itself. Determinations on adequate equipment may require a resource typing effort for RERP under the auspices of the National Incident Management System and Emergency Management

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
	Percentage successful test results. [Reliability] ▪ CI: Number and contents of emergency kits, and number of items in each emergency kit. (H.11)		Assistance Compact. This would define, for example, field monitoring teams of different capacities, and the equipment requirements for each. Such definitions would enable: (1) monitoring of team status (number of teams operationally ready vs. reconstituting vs. assigned), (2) better gauging outside resources available under mutual aid.
I – Accident Assessment	▪ **PM:** Two or more FMTs must demonstrate the capability to make and report measurements of ambient radiation to the field team coordinator, dose assessment team, or other appropriate authority. (Criterion 4.a.3) *Percentage of accurate readings (from simulation source) delivered within X time.* ▪ **PM: Number of timely and accurate (given available source term and meteorological data) independent plume projections developed during drills and exercises over previous eight quarters,*	YES	Criteria may need to be made more explicit and quantitative. Suggested PM criterion is based on a licensee performance indicator.

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
	given "opportunities" to do so.		
J – Protective Response	▪ **PM:** Demonstrate the capability to alert and notify *all* public school systems/districts of emergency conditions that are expected to or may necessitate protective actions for students. Demonstration requires that the OROs actually contact public school systems/districts during the exercise. *Percentage of districts successfully contacted within X time*. ▪ **PM:** Demonstrate capability to mobilize one third of the resources necessary to monitor 20 percent of the 10-mile EPZ population within a 12-hour period. (Criterion 6.a.1) ▪ **PM:** Staff responsible for the radiological monitoring of evacuees must demonstrate the capability to attain and sustain, within 12 hours, a monitoring productivity rate per hour needed to monitor the 20 percent EPZ population planning base. The monitoring productivity rate per hour is the number of evacuees that can be monitored, per hour, by the total complement of monitors using an appropriate procedure. (Criterion 6.a.1) ▪ CI: Availability of [blankets, cots, food supplies for congregate care centers]	YES	

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
	must be verified by providing the evaluator a list of sources with locations and estimates of quantities. (Criterion 6.c.1) ▪ CI: OROs must plan for a sufficient number of congregate care centers in host/support jurisdictions to accommodate a minimum of 20 percent of the EPZ population. (Criterion 6.c.1) ▪ CI: Inventories of KI sufficient for use by: (1) emergency workers; (2) institutionalized individuals, as indicated in capacity lists for facilities; and (3) where stipulated by the plans/procedures, members of the general public (including transients) within the plume pathway EPZ. (Criterion 1.e.1) *Percentage of estimated requirement available in inventory.* ▪ CI: Number of persons without private transportation [personally owned vehicles] in 10-mile EPZ. (J.10.g) *Number of such persons as percentage of EPZ population; number of such persons as percentage of identified non-private transportation capacity.*		
K – Radiological Exposure Control	▪ CI: Sufficient quantities of appropriate direct-reading and permanent record dosimetry and dosimeter chargers must be available for issuance to all emergency workers who will be dispatched to perform an	NO	

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
	ORO mission. (Criterion 1.e.1) *Dosimeters divided by emergency personnel*. [Availability] ▪ CI: Dosimeters must be inspected periodically for electrical leakage (Criterion 1.e.1) *Percentage of dosimeters tested, and percentage of successful test results.* [Reliability]		
L – Medical and Public Health Support	▪ **PM:** Approximate response time needed to establish controlled areas and fully prepare necessary medical/radiological staff. (L.1) *Specify a maximum time from notification; specify ability to demonstrate throughput of some percentage of requirement, similar to demonstrating monitoring for congregate care.* ▪ CI: There is at least one primary and one backup medical facility for treatment of contaminated injured, and each has at least one trained physician and one trained nurse to perform and supervise treatment of contaminated injured individuals. (L.1; REPP Manual, p. III-63) ▪ CI: Maximum number of contaminated injured or exposed patients who could be treated at one time. (L.1) *This maximum divided by 10-mile EPZ population.*	YES	Criteria may need to be made more explicit and quantitative.

NRC/FEMA Planning Standard	Performance Measure (PM) / Capability Indicator (CI)	Existing PM?	Comments
M – Recovery and Reentry Planning and Post-Accident Operations		NO	
N – Exercises and Drills	▪ CI: *Number and frequency of drills and exercises conducted for different purposes (e.g., ingestion pathway, medical drills).*	NO	Generally involves planning input for performance, not performance itself.
O – Radiological Emergency Response Training	▪ *CI: Percentage of ORO members who have participated in a radiological emergency preparedness exercise over previous eight quarters.*	NO	Generally involves planning input for performance, not performance itself. CI given is based on a licensee indicator. It is listed for training rather than exercises as a matter of maintaining proficiency.
P – Responsibility for the Planning Effort		NO	Generally involves planning input for performance, not performance itself.

Table C-1. Review of Existing Criteria for Actual or Implied Quantitative Measures and Indicators.