NEI White Paper

Protective Action Recommendation Determination

October 2010

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Nuclear Energy Institute

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Nuclear Energy Institute, 1776 I Street N. W., Suite 400, Washington D.C. (202.739.8000)

ACKNOWLEDGEMENTS

This document was developed by the Nuclear Energy Institute (NEI) and members of the Protective Action Recommendation (PAR) Task Force.

NEI Chairperson:

- Martin Hug

Lead:

- Jack Lewis, Entergy

Industry/ORO Members:

- Paul Holland, Exelon
- Nick Avrakotos, Entergy
- Vince Miller, Ameren
- John Baer, NextEra Energy
- Patrick Mulligan, NJ DEP
- Walt Lee, TVA
- Ken Evans, Illinois EMA
- Craig Banner, PSEG
- Gary Young, PSEG
- Tim Rients, NPPD

NOTICE

EXECUTIVE SUMMARY

The purpose of this white paper is to provide a process to ensure that dose assessment information is properly weighed with plant conditions when making protective action recommendations, particularly when modification of these recommendations is required because of a wind shift.

This document is intended for use by licensees in the development of off-site protective action recommendations. The term “decision-maker(s)” as used in this document refers to licensee personnel responsible for making these recommendations—not off-site response organization personnel that make protective action decisions.

Licensees who incorporate the “Industry Positions” detailed below should be compliant with the protective action guidance in EPA-400 and the requirement of 10CFR50.47(b)(10) for a range of protective actions in the application of dose assessment results in the decision making process.

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PROTECTIVE ACTION RECOMMENDATION DETERMINATION

1 DISCUSSION

1.1 HISTORY

In 2009 and 2010, the NRC identified issues at multiple sites regarding the process for determining a follow-up protective action recommendation (PAR) when a wind shift occurs after the PAR is made based on plant conditions. In this instance, the longstanding industry practice is to make a follow-up PAR based on plant conditions, using dose assessment results only to expand the PAR to the downwind locations as necessary.

1.2 CURRENT GUIDANCE

10 CFR 50.47(b) (10) (Ref. 1) requires a licensee's emergency plan to contain a range of protective actions. Guidance related to the implementation of a range of protective actions was revised in the mid-1990s in NUREG 0654 Supplement 3 (Ref. 2) and EPA 400 (Ref. 3). Each of the subject guidance documents provides for protective action recommendation decision making based on both plant conditions and dose assessment.

Regulatory Issue Summary (RIS) 2004-13 (Ref. 6) was issued in 2004 for the purpose of clarifying to licensees the NRC position that protective action schemes must include consideration of sheltering. The RIS did not introduce any new protective action concepts or guidance.

Regulatory Issue Summary 2005-08 (Ref. 7), issued in 2005, endorsed an NEI guidance document on the implementation of a range of protective actions. The NRC-endorsed NEI guidance states the following regarding the development of initial protective action recommendations: “The minimum recommendation that shall be made at a General Emergency is to evacuate approximately 2 miles around and 5 miles downwind from the plant. Subsequent recommendations should be based on the EPA PAGs, changing plant conditions, field data or changes in meteorological conditions. In addition, the remainder of the plume EPZ should be advised to go indoors and monitor EAS broadcasts.”

None of the available guidance provides criteria for determining when and how subsequent PARs should be based primarily on dose assessment results instead of plant conditions and vice versa.

1.3 INDUSTRY ISSUES

Federal guidance referenced in Section 2.2 states that after initial protective actions are made, subsequent protective actions should be based on plant conditions and dose assessment.

Evacuation decisions involve a complex judgment requiring the consideration of plant conditions, dose assessment results and assessments of limitations on the information available at the time. Evacuation decisions should consider dose assessment information and not just default to decisions based on plant conditions. This should be the process even if the decision results in a recommendation to evacuate a smaller area than that represented by a recommendation based on plant conditions. This consideration should be reflected in licensee plans and procedures, or that licensee may be subject to NRC enforcement action. However, a better balance between potential radiation exposure to the public and the risks of evacuation may be achieved by considering plant conditions in addition to dose assessment, giving due consideration, for example, to such variables as severity of the accident and unique characteristics of off-site dose assessment modeling. In such cases, judgment by the decision-maker is required to determine whether to base the recommendation on dose assessment results or plant conditions.

Source term, meteorology and estimated durations upon which off-site dose calculations are based have a certain degree of uncertainty and unforeseeable variability.

NOTE: The industry positions that follow each issue are not meant to preclude pre-planned actions to accommodate special circumstances at individual sites. In such cases, pre-planned actions may be more appropriate for a site-specific circumstance than the industry positions and should be retained in the licensee's emergency plan.

1.3.1 Early Protective Action Recommendations

Issue 1: Initial protective action recommendations and protective action recommendations from the control room

Regulatory guidance contained in EPA-400, Information Notice 83-28 (Ref. 9), NUREG-0654 Supplement 3 and RIS 2005-08 indicates that initial protective action recommendations are made based on plant conditions (general emergency conditions exist). Licensees' emergency plans are required to provide for timely augmentation and relief of the control room staff by Technical Support Center (TSC) and Emergency Operations Facility (EOF) staff, transferring dose assessment and protective action recommendation activities from the control room to these other emergency facilities. Licensees' emergency plans call for these facilities to conduct off-site and on-site (out of plant) radiological field monitoring and environmental assessments. In addition, response personnel in these facilities monitor and analyze the radiological effluent stream for isotopic content and its effect on the radiological source term. These assessments are factored into the overall off-site dose calculations process to determine dose assessment based on actual field conditions. Control room dose assessment is based largely, if not solely, on plant monitor readings and assumptions regarding the radiological isotopic mixture and meteorological source term. These assumptions may not be representative of the actual plant conditions at the time of the accident. Control room dose calculations may overestimate or underestimate the off-site radiological dose to a greater degree than assessments performed in the TSC and EOF.

Industry position:
The minimum recommendation that shall be made in a general emergency is to evacuate approximately two miles around and five miles downwind from the plant. This initial recommendation is based on plant conditions (the general emergency condition).

If a subsequent PAR is required to be made from the control room because of a wind shift or other plant or external condition, then it is acceptable for this subsequent PAR to be based on plant conditions and to be an extension of the initial PAR, unless dose assessment results indicate that a larger area should be included or that protective action recommendations should be extended farther downwind

1.3.2 Basis for Subsequent Protective Action Recommendations

Issue 2: Screening criteria for use of dose assessment information

Although existing regulatory guidance documents indicate that subsequent PARs may be based on dose assessment information and the EPA PAGs as well as plant conditions, these guidance documents do not provide criteria for discriminating when one methodology provides a better basis for the recommendation than the other. Off-site dose calculations have certain limitations, especially when based solely on radiation monitoring information without environmental field measurements. Plant condition indications may also be limited in that the conditions may change in the time period when PARs are implemented by off-site authorities. In addition, releases from unmonitored release paths would result in highly uncertain assessments of source term.

NUREG-1228 (Ref. 8) provides for "the role of radioactive release (source term) assessment in emergency response" and "the necessity of recognizing and identifying the great uncertainties associated with performing a source term assessment." The document prescribes the judicious use of current and projected plant conditions and dose calculation to determine off-site consequences, and details the inherent inaccuracies. For example, Section 1.3 states, "For the decision makers to be able to use the source term estimate in their decision process, these uncertainties must be understood and their bases must be clear." This would appear to argue for the use of some screening criteria to assist in determining whether or not to base a subsequent PAR on dose assessment information.

Industry position:
When a subsequent PAR is required because of a wind shift or for any other reason, dose assessment results shall be used as the basis for this action when these results indicate that a larger area or areas farther downwind than indicated by the plant conditions-based PAR should be evacuated.

The following criteria (or an equivalent evaluation method) should be used to determine whether to base the PAR upgrade on plant conditions or dose assessment results:

1. *Are plant conditions understood that could impact or cause additional core damage (e.g., stable and/or magnitude of source term, core recovered, coolable geometry)?*

2. *Is the radiological release pathway understood (filtered, non-filtered, monitored, unmonitored with little or no potential for release rate to increase, little or no potential for RCS leak to increase)?*

3. *Are current and forecasted meteorological conditions known and their impact on dose assessment understood?*

4. *If available, does off-site radiological data support the protective action recommendation methodology based on dose assessment?*

A. *Radiological assessment shows EPA PAGs will be exceeded in the new sector based on an actual release.*

B. *Containment is challenged, and containment source term indicates PAGs could be exceeded in the new sector if a release were to start.*

If criteria 1 through 4 are not fully understood (or all answers are NOT "yes") ***OR*** *criteria A or B are met, then a PAR is provided to evacuate the new affected areas (sectors).*

1.3.3 Use of Containment Source Term

Issue 3: Containment source terms

It should be possible to simplify the process for developing subsequent PARs when the available source term in containment is very high. This section is intended strictly as an example of how a licensee may choose to address in part item 1 of the screening criteria in Section 1.3.2.

When a release from containment is not occurring, then containment source term available for release may be used in determining subsequent protective actions. The licensee may use a reading on the containment high-range radiation monitor in this instance. Such values should only be used as the sole determinant of subsequent protective action recommendations when they represent significant fuel damage, such as the value used in NEI 99-01 (Ref. 5) equivalent to a release of 20 percent gap activity and representing a potential loss of the containment barrier. Licensees may use different values for the radiation monitor based on containment spray availability, as this system reduces iodine source term when it is in service.

1.3.4 Use of Dose Assessment Results

Issue 4: Dose assessment application and timing requirements

It is anticipated that a discrete amount of time will pass from the declaration of a general emergency (and issuance of initial PARs) to the point that all criteria are met for basing a subsequent PAR on dose assessment information alone. Off-site dose calculations will be performed multiple times in this period whether or not they will provide a basis for subsequent protective actions. However, once conditions change that may cause a new off-site dose calculation to be performed, the process of performing this calculation will take a certain amount of time to complete.

Care must be exercised when performing dose assessments to ensure release durations are representative of the conditions present. While using durations that are too short can underestimate exposure, using excessively long durations may force unneeded evacuations of members of the public. Licensees should evaluate release durations for given situations in advance to provide reasonable default durations for use when the release duration is unknown.

NOTE: The following industry positions are predicated on the fact that the conditions described in Section 1.3.2 above have been met for basing subsequent PARs on dose assessment.

Industry position:
Subsequent PARs when no release is in progress:
When a release from containment is not occurring and the containment source term is below the threshold as defined in Section 1.3.3 of this document, then the PAR should not be expanded to new areas.

Subsequent PARs for the initiation of a release:
It is understood that the initiation of a release may result in uncertainties that would negate the use of dose assessment methodology and result in using plant conditions for a subsequent PAR basis when a release begins. However, if the screening conditions are met, then these subsequent PARs should be based on dose assessment results. PARs should only be expanded to additional areas if the EPA-400 PAGs have been exceeded for those additional areas.

Subsequent PARs for ongoing release in progress:
When a release is in progress, subsequent PARs should be based on dose assessment results and only expanded if the EPA-400 PAGs have been exceeded in the new areas. The new PAR should be based on the current dose assessment results rather than delaying the PAR for the completion of a new dose calculation.

1.3.5 Changes in Containment Barrier Status

Issue 5: Application of containment barrier status

Initial PARs based on plant conditions because of the declaration of a general emergency have some of their basis in the fact that the containment fission product barrier is either failed or challenged as defined by site-specific EAL criteria. This condition may not exist for subsequent PARs, given the progression of the event and mitigative actions taken by plant operators.

Industry position:
PARs for new areas should not be made when a potential loss or loss of the containment fission product barrier as defined by the licensee's EALs does not exist.

2 REFERENCES

(Ref. 1)10 CFR 50.47(b)(10): A range of protective actions including sheltering, evacuation and prophylactic use of iodine has been developed for the plume exposure pathway EPZ for emergency workers and the public. Guidelines for the choice of protective actions during an emergency, consistent with federal guidance, are developed and in place and protective actions for ingestion pathway EPZ appropriate to the locale have been developed (66 FR 5440, Jan 19, 2001).

(Ref. 2) NUREG 0654 FEMA REP I Supplement 3: Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants-Criteria for Protective Action Recommendations for Severe Accidents (July 1996).

(Ref. 3) EPA 400-R-92-001: Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (October 1991).

(Ref. 4) NUREG 0654 FEMA REP 1: Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants-Criteria for Protective Action Recommendations for Severe Accidents, Appendix I Emergency Action Level Guidelines. (November 1980).

(Ref. 5) NEI 99-01: Methodology for Development of Emergency Action Levels (February 2008).

(Ref. 6) NRC Regulatory Information Summary RIS 2004-13: Consideration of Sheltering in Licensees Range of Protective Action Recommendations (August 2004).

(Ref. 7) NRC Regulatory Information Summary RIS 2005-08: Consideration of Sheltering in Licensees Range of Protective Action Recommendations (June 2005).

(Ref. 8) NUREG-1228: Source Term Estimation During Incident Response to Severe Nuclear Power Plant Accidents (October 1988).

(Ref. 9) Information Notice No. 83-28: Criteria for Protective Action Recommendations for General Emergencies (May 1983).