EMERGENCY PREPAREDNESS FREQUENTLY ASKED QUESTION (EPFAQ)

EPFAQ Number: 2015-009 **Date Accepted for Review:** 09-Oct-15
Originator: KEN EVANS
Organization: ILLINOIS EMERGENCY MANAGEMENT
Relevant Guidance: NEI 99-01 REV. 6
Applicable Section(s): EALs AG1 and AS1
Status: Public Comment Period

QUESTION OR COMMENT:

The implementation guidance provided in NEI [Nuclear Energy Institute] 99-01, Revision 6 [“Development of Emergency Action Levels for Non-Passive Reactors”], for EALs [emergency action levels] AG1 and AS1 is vague in reference to the selection of the source term. The developer notes provided on pages 42 and 46 (for AS1 and AG1, respectively) do not specify an actual source term. The only guidance provided is the fourth bullet, which states, “Acceptable sources of this information include, but are not limited to, the RETS [Radiological Effluent Technical Specifications]/ODCM [Offsite Dose Calculation Manual], and values used in the site’s emergency dose assessment methodology.” While developers are cautioned to ensure that the method used results in a logical escalation in the ECL [emergency classification level], they are not provided guidance for the selection of an appropriate source term. As a result, some licensees have used an ODCM source term that contains only noble gases. This is not considered to be a realistic source term for a General Emergency or Site Area Emergency Classification, in that at this accident level severity, the source term would be expected to include non-noble components. For example, the EALs for AS1 and AG1 include dose set points of 500 and 5000 mrem thyroid CDE [committed dose equivalent], respectively. Because it is recognized that the iodine fraction of the source term could be limiting in these EALs, the thyroid CDE PAG [protective action guide] was also included in AS1 and AG1. Excluding non-noble components in calculations of effluent set points for these two EALs results in values that are extremely large and non-conservative. Based on the above, is it acceptable to use a noble gas only source term for the threshold calculation of effluent monitor readings for EALs AG1 and AS1?

PROPOSED SOLUTION:

The guidance in NEI 99-01, Revision 6, is flexible with respect to the selection of a source term for use in calculating effluent monitor readings for EAL thresholds. In previous versions of NEI 99-01, the preferred source term was that associated with the ODCM. In NEI 99-01, Revision 6, Developer Note wording was added to explicitly allow consideration of “values used in the site’s emergency dose assessment methodology,” as well as other appropriate source terms. This was done to address issues with insufficient spacing between EAL threshold values for different emergency classification levels and limitations on the range of some effluent monitors (e.g., a calculated threshold value could be higher than the range of a monitor).

It should be kept in mind that the effluent monitor reading EALs are used prior to the establishment of a dose assessment capability using real-time meteorological data. Once the dose assessment capability is established, the effluent monitor reading EALs are no longer used. As required by their emergency plans, each licensee has an on-shift dose assessment capability that can be established shortly after the initiating event (typically within 15 minutes and no later than 30 minutes). A release occurring this early in an event would most likely be composed primarily of noble gases. The ODCM source term is therefore an appropriate basis for calculating effluent monitor readings used in EALs because it is typically composed mostly of noble gases.

Finally, the Developer Notes for Initiating Condition AG1 state, in part, "The effluent monitor readings should correspond to a dose of 1,000 mrem TEDE [total effective dose equivalent] or 5,000 mrem thyroid CDE at the 'site-specific dose receptor point' (consistent with the calculation methodology employed) for one hour of exposure." [*A similar Developer Note is included with Initiating Conditions AA1 and AS1.*] Nuclear power plant effluent release points typically have one radiation monitor. Given that the effluent monitor reading EALs are calculated using an assumed source term, the EAL threshold value will necessarily be determined by identifying the controlling Protective Action Guide dose limit – either the 1 rem TEDE dose or the 5 rem thyroid CDE dose. In other words, a licensee would calculate the effluent monitor readings that correspond to 1 rem TEDE and 5 rem thyroid CDE, and then select the lower value as the EAL threshold. It is expected that the TEDE dose would govern in cases where the assumed source term is dominated by noble gases (e.g., very little iodine), and the associated effluent monitor reading would be selected as the EAL threshold value.

NRC RESPONSE:

1. Based on the above, is it acceptable to use a noble gas only source term for the threshold calculation of effluent monitor readings for EALs AG1 and AS1?

There may be accident sequences for which a noble gas-only source could be appropriate, but there are also sequences when it may not be. Summarily ignoring radionuclides other than noble gases is not an acceptable approach for developing EAL thresholds for EALS AS1 and AG1. The initiating condition for EAL ASI and AGI both specify a release of gaseous radioactivity resulting a TEDE dose or a thyroid CDE. The TEDE dose is a sum of external and internal (CEDE) dose. In order for a radiation monitor threshold to serve as an indication that the initiating condition may be met, the threshold calculations need to consider the potential significant radionuclides in the release stream that contribute to CDE and CEDE. Summarily ignoring the contributions of radionuclides other the noble gases could result in a non-conservative EAL threshold, that is, the initiating condition could be met before the EAL threshold was met.

Establishing the reading of a radiation monitor corresponding to an EAL threshold relies on the assumption of parameters that are impossible to know at the time the threshold is being determined. The two unknowns are: (1) the release stream source term, and (2) the meteorological conditions at the time of the release. The difference between the assumed values and those that actually exist at the time of the release creates uncertainty in the EAL threshold. This is compensated for by performing timely dose assessments.

The release source term is used to: (1) establish the isotopic mix of the release stream that the monitor is detecting and measuring, and (2) normalize the dose conversion factors (DCFs) for the assumed isotopic mix. The response of a radiation monitor is dependent of the energy of the emissions that enter the detector. One (1) µCi/cc of Xe-133 (0.067 MeV) will not yield the same reading as 1 µCi/cc of I-131 (0.365 MeV). Radiation detectors are normally designed to achieve a flat response with energy, but typically only achieve 15-20% variation with energy.

The NRC notes that newer digital radiation monitoring systems have an embedded engineering unit conversion factor in the channel database that converts the detector count rate to µCi/cc before displaying it. These factors are typically established by the architect-engineer based on the vendor's isotopic efficiencies of the detector and an isotopic source term established by the architect-engineer. The differences between the EAL projected accident source term and the source term used in establishing the monitor engineering unit conversion factor need to be considered.

While there are natural phenomena and engineered design features that can mitigate a release of radioiodines, the release of radioiodines is still a significant concern, especially considering their greater dose contribution than that for noble gases. A thyroid CDE EAL threshold can be more limiting than a TEDE threshold. Although the iodine radionuclides may not significantly contribute to the radiation monitor response (e.g., low sensitivity to iodine radionuclides), the radionuclides are still in the release stream and will contribute to the CEDE and CDE dose identified in the initiating condition.