Questions on White Paper
"Proposed Methodology and Criteria for Establishing the Technical Basis for Small Modular Reactor Emergency Planning Zone" (ML13364A345)

1. On page i of the white paper, it is stated that the approach is based on some key assumptions, including "the expectation of enhanced safety inherent in the design of Small Modular Reactors (SMRs) (e.g., increased safety margin, reduced risk, smaller and slower fission product accident release, and reduced potential for dose consequence to population in the vicinity of the plant)." What are the key design features and operational programs relied upon for this to be a good assumption, particularly the slower fission product accident release and reduced potential for dose consequence?

2. On page iv, the white paper states that "…establishing an acceptable methodology and criteria early via this white paper is essential to support SMR design certification applications expected to be submitted beginning in 2014."
    a. Will SMR combined license (COL) applicants use this white paper to arrive at conclusions which are sufficient to propose a plume exposure emergency planning zone (EPZ) for their specific sites? If so, what guidance will be provided to address the impact of different structural and reactor core designs on the source terms?
    b. On page i, the white paper has a disclaimer that it "is limited to the consideration of plume exposure EPZ." However, the paper states on page 10 that "the EPZ size decision should be made in context with decisions on the SMR planning standards and confirmation of a substantial base for expansion of response." On page 25, Section 4.4, the paper reiterates that "these planning elements should be integrated with the decision on the EPZ." Please explain how this integration will inform the plume exposure EPZ size, since the paper states on page 2 that planning standards "are not addressed in the paper."
    c. If the Nuclear Energy Institute (NEI) intends for planning standards to be generic for SMRs as stated on page iv of the white paper, how will the 16 planning standards currently found in 10 CFR 50.47(b) inform all plume exposure SMR EPZs?

3. On page 2, the white paper states that it is "a first step to reflect" on lessons learned from the Fukushima Dai-ichi accident. On page 6, it mentions NRC's Near Term Task Force (NTTF) review of insights from the Fukushima Dai-ichi accident.
    a. Provide information on how the lessons learned from the Fukushima Dai-ichi accident and NRC's NTTF review may inform the size of plume exposure EPZs for SMRs.
    b. In light of the Fukushima Dai-ichi multi-unit accident, how does SMR modularity impact the described methodology and criteria for assessing the size of plume exposure EPZs for SMRs?

ENCLOSURE

4. On page 7 of the white paper, Methods for Estimation of Leakages and Consequences of Releases (MELCOR), Modular Accident Analysis Program Version 5 (MAAP5), and the State-of-the-Art Reactor Consequence Analysis (SOARCA) are examples given of advanced tools and models. These tools and models are designed for large light water reactors (LWRs). Although SMRs are conceptually similar to LWRs, there is little operational or experimental data. Please provide an explanation of how these tools and models can be extrapolated for SMR analysis to inform plume exposure EPZ size.

5. On page 10, it is stated that the intent of the methodology is to be "part of an integrated, decision-making process for SMR EPZ sizing which uses risk-informed judgment...such that the technical basis for EPZ size is insights, not just numbers or criteria." Please clarify what is meant by "risk-informed judgment" and how the insights will be used.

6. The white paper indicates that a number of technical issues with establishing the proposed generic methodology and criteria have not been resolved. For example on page 15, “one acceptable way” of using the probabilistic risk assessment (PRA) for accident scenario selection is discussed. In the footnote on that page, it states that “other approaches” to accident sequence selection and grouping could be used. The footnote on page 17 provides another example. The discussion of accident source term evaluation on page 18 suggests that a method for determining source terms for multi-module core damage events needs to be developed. When and how will these and perhaps other parts of the methodology be determined? What process is envisioned for completing development of the methodology?

7. The paper states that the MELCOR Accident Consequence Code System (MACCS) code is an appropriate tool to calculate consequences for the analyses. The paper also states that insights from the NRC's use of MACCS for the SOARCA will be used to inform use of the code for this purpose.
    a. Considering that MACCS has not previously been used for SMR analyses to support EPZ sizing, will NEI provide more information or guidance on the use of the MACCS code for this purpose? Topics that could be different for this proposed use of MACCS are the determination of the basis for code input and model assumptions (including appropriate nodalization of the near-field), sources of information for input, use of conservatism, addressing uncertainty, and input and assumptions for the local area and population.
    b. Which information from SOARCA is proposed to be used, and how will it be used?
    c. Will a test case or pilot case be provided for demonstrating how MACCS and SOARCA information would be applied in a realistic situation?

8. Are emergency response actions, such as evacuation modeled for all three criteria, using MACCS? If evacuation is modeled in the analyses, provide a discussion on why this is appropriate.

9. In the evaluation of accident consequences against Criteria b and c, will each selected accident scenario have a separate consequence analysis or will the scenarios be grouped? If scenarios are grouped, what is the basis for the grouping (e.g., core damage frequency, release frequency, release characteristics)?

10. The discussion of the scenario selection process for Criterion b is not clear in some areas. For example, is the white paper stating that using the SOARCA process as adapted to SMRs results in a cut-off frequency of 1E-8/plant-year for steps 1 and 2? Also, define an “intact containment” and explain how “intact containment severe accident scenarios” contribute to dose in the EPZ. Finally, provide examples of what is meant on page 15 by “precluded by design.”

11. With respect to the analysis done against Criterion c, the proposed methodology states that fuel handling accidents and spent fuel pool accidents will be considered. How are these accident scenarios determined?

12. On page 15, it is stated that SMRs would need to use per plant year, rather than per reactor year, indicating that accidents occurring on more than one reactor coincidentally will be considered. How many coincident core damage events will be assumed to develop the design basis accident offsite dose estimates to compare against the Protective Action Guides?

13. On page 18, it is stated that an accident source term evaluation must consider multi-module accidents, if they are credible. Please describe the basis for the conclusion that "source terms and associated dose would not be expected to be additive" for multi-module SMRs.

14. Page 18 lists five documents that provide the basis for accident sequence selection for operating reactor designs. How will these be adapted for SMRs?

15. The paper states that specifics of the methodology for determining the probability of dose exceedance will need to be defined as part of implementation. Can more details on this topic be provided?

16. What is the proposed probability basis for Criterion c (probability of dose exceedance)? Is it probability over weather trials; over scenarios; over accident classification (frequent, infrequent, severe); over type (internal, external, low power and shutdown, internal flood, internal fire, other); over release categories; or something else?

17. In the discussion of “Comparison against Early Severe Health Effect Risk” on page 19, SMR applicants are offered the option of using conditional or absolute probability of exceeding a whole body acute dose of 200 rem for showing that the EPZ size provides for a substantial reduction of early severe health effects. This is a fundamental parameter; therefore, explain why a consistent approach is not used. Clarify how the

use of absolute probability does not contradict the concept that layers of defense-in-depth should be as independent as possible.

18. On page 20, Regulatory Guide 1.200 and American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) RA-Sa 2009 are identified as the necessary guidance for demonstrating sufficient technical adequacy of the base PRA. This guidance does not address all relevant initiating events and operating modes, nor does it address Level 2 PRA. How will the lack of guidance in these additional important areas be addressed?

19. On page 21, the need for acceptance values for the level of uncertainty in plant core damage frequency (CDF) and large early release frequency (LERF) is discussed. The guidance given for establishing the acceptance values is not clear; please provide additional explanation. Also, provide the rationale for the suggestion that the smallness of a single SMR core should be credited when the metrics put forth are for a plant (i.e., per plant-year) and a plant may contain several cores.

20. On page 21, while proposing cumulative plant risk design objectives for CDF and LERF, the paper states that "[T]he acceptance values should also factor in the smaller core power for SMRs." Please explain how a smaller core correlates with or changes acceptance values for CDF and LERF.

21. Regarding the first bullet in Section 4.1 on page 22, would the design features of the facility that “facilitate application of [regional] assets” be described in the final safety analysis report? Would specific special treatment requirements be assigned to them?

22. Regarding the second bullet in Section 4.1 on page 22, would the modeling of mitigation strategies in the Level 2 PRA (including use of severe accident management guidelines and extreme damage mitigation guidelines) and results of analysis with that Level 2 model be discussed in Chapter 19 of the final safety analysis report? How would the availability and reliability of the onsite portable equipment and regional assets be factored into the analysis?

23. The paper is not clear on how risk insights and defense-in-depth considerations will collectively inform the size of the plume exposure EPZ. Provide an example with explanations on how these concepts are merged to inform the methodology and criteria for determining plume exposure SMR EPZ size.

24. Regarding the third bullet in Section 4.2 on page 23, please describe how the plant simulator would be used to address uncertainty associated with control room layout, shift staffing, emergency response, and operating procedures.

25. Several options for addressing low frequency/high consequence events (cliff-edge effects) are identified in Section 4.3. Will these options be evaluated further to

determine pros and cons and under what conditions one option would be better than another?

26. Throughout the paper, enhanced plant capabilities are referenced. Please clarify what is meant by this phrase.

27. Please expand on aspects of this proposed methodology as they are specifically related to qualitative and quantitative approaches that contribute to decreasing the current 10 mile plume exposure EPZ.