April 7, 2008

Dr. William J. Shack, Chairman
Advisory Committee on Reactor Safeguards
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT: STATE-OF-THE-ART REACTOR CONSEQUENCE ANALYSES PROJECT

Dear Dr. Shack:

In your letter dated February 22, 2008, to the Chairman of the U.S. Nuclear Regulatory Commission (NRC), the Advisory Committee on Reactor Safeguards (ACRS or the Committee) made three recommendations regarding the State-of-the-Art Reactor Consequences Analyses (SOARCA) project. The ACRS also discussed other issues related to the project. Our response to the Committee's comments follow. The staff will discuss our response at upcoming ACRS meetings.

(1) The Committee recommended performing level-3 probabilistic risk assessments (PRA) for the SOARCA pilot plants before extending the analyses to other plants.

As the ACRS recognizes, the SOARCA project seeks to capture and reflect 25 years of research on developing a phenomenologically-based, analytical capability for predicting severe accident progression and timing, containment performance, fission product behavior and offsite dispersion, and associated consequences. It also intends to accurately model the plant analyzed as designed and operated including implementation of emergency operating and emergency preparedness procedures. Research indicates that high consequence scenarios are those that result in containment bypass, or containment failure, either before or shortly after vessel breach and within an interval of time that precludes effective implementation of emergency planning. Bypass events are incorporated in the SOARCA process, according to the Commission's direction. With regard to the scenarios that result in containment failure, research indicates that there is a significant time delay between onset of an accident and containment failure such that appropriate actions can be taken to mitigate the accident. Alpha mode and direct containment heating issues, once considered potentially significant contributors to early containment failure, have been resolved and shown not to be significant contributors to risk. SOARCA applies a screening criterion of core damage frequency of equal to or greater than 10^{-6} (10^{-7} for bypass events) to identify those more probable events and perform consequence analyses and not perform these analyses for the remote and speculative scenarios. However, we look at all the standardized plant analyses risk (SPAR) scenarios, check them against the licensee's PRA, and determine if any scenario will lead to containment bypass or early containment failure. Obviously, we must use judgment during this process, and limit our review to scenarios that are not excessively low (e.g., we do no consider meteor strikes). With the knowledge gained from research, including extensive knowledge and experience with PRAs, we believe we can reliably identify any high consequence scenarios that should be included in SOARCA that have a probability of occurrence lower than the screening criteria.

Therefore, while a level-3 PRA may provide the consequences for more scenarios, we do not believe these scenarios will drive the risk. Our approach focuses on the detailed integral analyses of relatively important scenarios which have been consistently identified in PRAs as important contributors to core damage and offsite release. Using the SOARCA approach, the staff believes it can most effectively demonstrate the benefits of the significant research and detailed accident progression modeling as well as the benefits from plant improvements. We do not believe that conducting level-3 PRAs will substantially affect the conclusion of the study. It is important to recall that the primary purpose of SOARCA is to demonstrate how our current understanding of severe accident progression and phenomenology and plant configurations would affect the timing and magnitude of offsite releases and the resultant offsite health effects, compared to previous analyses. SOARCA is also intended to examine how mitigation may influence our understanding of important core damage events and important containment failure modes.

(2) The ACRS recommended that the process for selecting external event sequences in SOARCA be made more comprehensive and that impact from these events on containment mitigation systems, operator actions, and offsite emergency responses be evaluated realistically.

Staff selected external events to be representative of those that might arise due to seismic, fire or internal flooding initiators. These sequences were derived from insights gained from a review of previous studies such as NUREG-1150, “Severe Accident Risks: An Assessment for Five Nuclear Power Plants,” and NUREG 1742, “Perspective Gained from the Individual Plant Examination of External Events (IPEEE) Program,” as well as from results of licensee PRAs and NRC’s SPAR models for external events. Consistent with the SOARCA strategy, when assessing sequences we focused on the functional characteristics of the sequences, the implications for accident progression and releases, and ultimately the means for mitigating the sequences. In order to further specify these sequences for the purpose of the analysis, seismically initiated sequences were chosen as representative of external event sequences. The seismic scenarios were loss of offsite power sequences and were functionally very similar to the other severe external event scenarios resulting from fires, high winds, or floods. In general, seismically initiated sequences are more restrictive in terms of the ability to successfully recover equipment or to implement onsite mitigative measures and offsite protective actions. The seismically initiated sequences were judged to be dominant contributors to the external event core damage and release frequencies

In addition, within the SOARCA, the staff will perform an evaluation of the seismic effects on infrastructure and emergency response. If a sensitivity analysis shows a significant effect on consequences a more detailed analysis may be necessary.

(3) The ACRS recommended that consequences should be expressed in terms of ranges calculated using the threshold recommended in the Health Physics Society Position Statement as well as some other lower thresholds. The ACRS also recommended performing a calculation with the linear, no-threshold model (LNT).

The staff considered the Committee’s recommendation as it prepared options for Commission consideration. The staff, in SECY-08-0029, “State-of-the-Art Reactor Consequence Analyses—Reporting Offsite Health Consequences,” dated March 4, 2008, proposed six options for projecting latent cancer health effects in SOARCA. Included in those options were several to

present single values of latent cancer fatalities (LCF) for various truncation values and LNT as recommended by the Committee. However, in consideration of the potential issues that could be associated with trying to properly communicate the results, the staff chose a metric that was not previously presented to the Committee. This metric is the mean likelihood of LCF for a population-weighted, age and gender-averaged individual living within various distances from the facility. The results would be reported both for the LNT model and for truncation at 100 microsieverts (10 millirem). This option has several advantages. Notably, it will facilitate public risk communication by providing a likelihood of consequences. These consequences can be compared with the occurrence of LCFs in the general population from causes other than a reactor accident. This metric is also consistent with the approach used in the development of the safety goal and is the same metric used in environmental impact statements.

The staff appreciates the insights provided by the ACRS on the SOARCA project and believes that these observations will help improve the outcomes of the project. The staff understands the need to address both scientific and communication issues in the presentation of the SOARA results to stakeholders. We will continue to work with the Committee as we continue with the SOARCA program.

Sincerely,

/RA/

Luis A. Reyes
Executive Director
for Operations

cc: Chairman Klein
Commissioner Jaczko
Commissioner Lyons
Commissioner Svinicki
SECY

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