



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001

ACRSR-2263

July 27, 2007

The Honorable Dale E. Klein  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

SUBJECT: DRAFT NUREG/CR, REVIEW OF NUREG-0654, SUPPLEMENT 3,  
"CRITERIA FOR PROTECTIVE ACTION RECOMMENDATIONS FOR  
SEVERE ACCIDENTS"

Dear Chairman Klein,

During the 544<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, July 11-13, 2007, we reviewed the results of the protective action recommendation (PAR) study performed by the Sandia National Laboratories (SNL) and documented in a draft NUREG/CR, titled "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents'." During our review, we had the benefit of presentations by and discussions with representatives of the NRC staff and the industry. We also had the benefit of the documents referenced.

### CONCLUSIONS AND RECOMMENDATIONS

1. The NUREG/CR report, which documents the results of the PAR study, should be published.
2. We concur with the staff that Supplement 3 to NUREG-0654/FEMA-REP-1, Revision 1 should be revised.
3. The revisions to Supplement 3 to NUREG-0654/FEMA-REP-1, Revision 1 should take into consideration model uncertainties, complexity of decision-making and related industry work.

### DISCUSSION

Current regulatory guidance for the development of PARs for severe reactor accidents following the declaration of General Emergency is provided in Supplement 3 to NUREG-0654/FEMA-REP-1, Revision 1. Supplement 3 places high emphasis on early evacuation and provides ambiguous guidance on sheltering.

The staff is concerned that the emphasis of Supplement 3 on early evacuation may have had the unintended consequence that some licensees have overly restricted their consideration and use of sheltering, as evidenced in the design of their notification forms. In addition, since Supplement 3 was issued in 1996 there have been technological advances in emergency preparedness, improvements in evacuation time

estimates (ETEs), and improvements in the understanding of accident progression and in dose estimation techniques.

In a Staff Requirements Memorandum dated October 3, 2003, the Commission directed the staff to evaluate the NRC's PAR guidance to assure that it continues to reflect the current state of knowledge. The staff has undertaken a review and evaluation of the recommendations of Supplement 3 to determine whether sheltering or other alternative PARs could reduce potential health effects in the event of a severe accident.

An evaluation of alternative protective actions has been performed by SNL for the staff. A suite of alternative protective actions was considered:

- Radial evacuation
- Lateral evacuation
- Staged evacuation
- Shelter-in-place followed by radial evacuation
- Shelter-in-place followed by lateral evacuation
- Preferential sheltering followed by radial evacuation
- Preferential sheltering followed by lateral evacuation

Technological advances in evacuation planning were identified and considered in the evaluation. Issues associated with implementation of, and public response to, the alternative PARs were reviewed.

The PAR study assumes that a rapidly evolving source term is credible. The report explicitly states that if future studies conclude that such a source term is not credible, then the results of the study may require reconsideration. At this time, considering challenges that may arise both from conventional reactor safety concerns and security concerns, we concur with the staff's position that emergency preparedness is a critical element of defense-in-depth that should include protective actions for any scenario involving a potential release from the containment, including those with rapidly evolving source terms.

To assess the relative benefit of alternative PARs, consequence analyses were performed for a generic site with a uniform population density. Three accident scenarios were analyzed: a rapidly progressing accident, a slowly progressing accident, and an accident with no loss of containment. Associated source terms were derived from NUREG-1150 and the LaSalle integrated risk assessment study, and included a rapidly evolving source term and a slowly evolving source term. The MELCOR Accident Consequence Code System Version 2 (MACCS2) code was used to perform the consequence analyses. The effectiveness of alternative PARs (compared to the baseline case of radial evacuation) was studied as a function of the ETE and the choice of source term.

The analyses showed that in scenarios with rapidly evolving source terms of relatively high magnitude and short duration, shelter-in-place followed by evacuation is more effective than immediate evacuation, especially at sites characterized by relatively large ETEs. For more slowly progressing source terms, radial evacuation generally performed well, and therefore should remain a major element of protective strategies as recommended in Supplement 3.

The study provides significant insights on the potential benefit of alternative strategies for some credible accident scenarios. Based on these insights, the staff concludes that Supplement 3 should be revised. We concur.

In addition to the work already performed, the staff should consider the following in revising Supplement 3 to NUREG-0654:

- The effectiveness of the PAR strategies evaluated in the SNL study is assessed based on MACCS2 calculations without any discussion of the uncertainties associated with such calculations. The results show that the effectiveness of a strategy is sensitive to the value of ETE. The staff is pursuing rulemaking to assure that licensees evaluate ETEs using better methods than those used in the past. At this time, we have no opinion whether rulemaking is warranted, but do agree with the staff that credible ETEs are important to sound decision-making on PARs. The staff should consider whether uncertainties in ETEs and other uncertainties such as uniformity of population density (as assumed in the study) may affect the ranking of PAR strategies. Uncertainties in the predicted outcome, could, in some cases, make implementation issues and human response to alternative PAR strategies a better basis for recommending a specific PAR.
- Additional PAR strategies could complicate and slow down the decision-making process within the Emergency Response Organization (ERO) during a severe accident. Future revisions of Supplement 3 should address the impact of additional options on the ability of the EROs to make timely decisions and recommendations.
- During our meeting, Industry representatives presented preliminary results of an industry sponsored risk-informed evaluation of PARs. The staff and the ACRS have not had the opportunity to formally review and comment on this work. Insights may be drawn from this work that could contribute to the revision of Supplement 3. Also, the current work on the State-of-the-Art Reactor Consequence Analyses (SOARCA) project may provide some important insights in this area.

We would like to have the opportunity to review the proposed revisions to NUREG-0654, Supplement 3.

Dr. Dana Powers did not participate in the Committee's deliberations regarding this matter.

Sincerely,

*/RA/*

William J. Shack  
Chairman

Reference:

1. Draft NUREG/CR-XXXX, Volume 1, SAND2007-XXXX, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents,'" dated 2007.
2. NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents," dated July 1996.
3. Memorandum dated October 3, 2003, from Annette L. Vietti-Cook, Secretary, to William D. Travers, Executive Director for Operations, Subject: Staff Requirements - Briefing on Emergency Preparedness Program Status, 9:00 A.M., Wednesday, September 24, 2003, Commissioners' Conference Room, One White Flint North, Rockville, Maryland. (Open to Public Attendance).
4. Memorandum dated June 29, 2006, from Annette L. Vietti-Cook, Secretary, to Luis A. Reyes, Executive Director for Operations, Subject: Staff Requirements - Briefing on Status of Emergency Planning Activities, (Two Sessions) 9:30 A.M. and 1:00 P.M., Tuesday, May 2, 2006, Commissioners' Conference Room, One White Flint North, Rockville, Maryland (Open to Public Attendance).
5. NUREG 1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," dated December 1990.
6. NUREG/CR-5305, Volume 1, "Integrated Risk Assessment for the La Salle Unit 2 Nuclear Power Plant, Phenomenology and Risk Uncertainty Evaluation Program (PRUEP)," dated August 1992.

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1. Draft NUREG/CR-XXXX, Volume 1, SAND2007-XXXX, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents,'" dated 2007.
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