

REGULATORY BACKGROUND ON MULTIUNIT RISK

Many nuclear power plants (NPPs) are co-located at a single site. Specifically, there are 32 sites with two operating reactors and three sites with three operating reactors in the U.S.¹ In addition, some sites are physically near to each other such that they are essentially challenged by the same external hazards (Hope Creek is near Salem Units 1 & 2, and FitzPatrick is near Nine Mile Point Units 1 & 2). With few exceptions², probabilistic risk assessments (PRAs) of NPPs have focused on estimating the risk of a single NPP, which may or may not be co-located with other NPPs.

To a certain extent, the focus on developing single-unit PRAs is understandable. Each NPP in the U.S. has a separate license. However, regulations recognize the potential for multiunit accidents. For example, 10 CFR Part 50, Appendix A, General Design Criterion 5 states:

Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impact their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

Another example is 10 CFR 100.11(b), which provides requirements for determining the exclusion area, the low population zone, and the population center distance for multiunit sites:

Subsection (b)(1): If the reactors are independent to the extent that an accident in one reactor would not initiate an accident in another, the size of the exclusion area, low population zone and population center distance shall be fulfilled with respect to each reactor individually.

Subsection (b)(2): If the reactors are interconnected to the extent that an accident in one reactor could affect the safety of operation of any other, the size of the exclusion area, low population zone and population center distance shall be based on the assumption that all interconnected reactors emit their postulated fission product releases simultaneously.

In response to the accident at Three Mile Island, the Nuclear Regulatory Commission (NRC) issued an action plan (NUREG-0660). Item II.B.8 involved a two-phase rulemaking proceeding on degraded-core accidents. In the second phase (termed the “long-term rulemaking”), the NRC identified the need to consider the effects of an accident in a reactor plant on an adjacent plant in a multiple reactor site. This issue was subsequently dropped at the Commission’s direction, as discussed in the Staff Requirements Memorandum to SECY-82-1B:

There are other issues listed in Item II.B.8 of NUREG-0660 that the Commission believes have minimal value for improved safety and, therefore, need not be considered further: namely, effects of severe accidents at multiunit sites and post-accident recovery plans.

¹ These counts exclude the two-unit San Onofre site where both units are being permanently shutdown, the two additional units under construction at the Summer site, and the two additional units under construction at the Vogtle site.

² The Seabrook PRA is a notable exception.

Moreover, the Commission's Safety Goals, which define acceptable risk, are applied on a per-reactor basis. NUREG-0880 summarizes comments made by the public as the Safety Goals were being formulated in the early 1980s:

Some commenters objected to the originally proposed individual and societal numerical guidelines because they were to be applied on a per-site basis. This would have resulted in tighter requirements being imposed on plants at multiunit sites than at single-unit sites. The Commission decided not to impose a regulatory bias against multiunit sites. Therefore, the quantitative design objectives were changed from risks per site to risk per plant.

As a result of the Commission's decision to apply the Safety Goals on a per-reactor basis, there has been no previous regulatory impetus to estimate the total risk of a multiunit site.

In response to the Fukushima Dai-Chi accident, staff concluded in the NRC's Near Term Task Force (NTTF) Report that "a sequence of events like those occurring in the Fukushima accident is unlikely to occur in the United States and could be mitigated, reducing the likelihood of core damage and radiological releases." Nevertheless, the NTTF issued twelve recommendations to enhance NRC regulation and safety. As described in SECY-12-0095, "Tier 3 Program Plans and 6-Month Status Update in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Subsequent Tsunami" numerous actions, such as orders and requests for information, are in progress which will enhance the resources (e.g. equipment, procedures, and emergency response staffing) available to respond to a multiunit event; thus further reducing multiunit risk. In addition, seismic and flooding walkdowns were conducted, furthering reducing multiunit risk. Seismic and flooding re-evaluations are in progress and will likely reduce multiunit risk even further.

References

1. U.S. Nuclear Regulatory Commission, "NRC Action Plan Developed as a Result of the TMI-2 Accident," NUREG-0660, ADAMS Accession No. ML063250131, May 1980.
2. U.S. Nuclear Regulatory Commission, "Safety Goals for Nuclear Power Plant Operation," NUREG-0880, Rev. 1, ADAMS Accession No. ML071770230, May 1983.
3. U.S. Nuclear Regulatory Commission, "SECY-82-1B – Proposed Commission Policy Statement on Severe Accidents and Related Views on Nuclear Reactor Regulation," ADAMS Accession No. ML12241A543, March 24, 1983.
4. U.S. Nuclear Regulatory Commission, "Safety Goals for Nuclear Power Plant Operation," NUREG-0880, ADAMS Accession No. ML071770230, Rev. 1, May 1983.
5. U.S. Nuclear Regulatory Commission, "State-of-the-Art Reactor Consequence Analyses (SOARCA) Report," NUREG-1935, ADMAS Accession No. ML12332A053, November 2012.

6. A.C. Payne, et al., "Evaluation of Severe Accident Risks: Peach Bottom, Unit 2," NUREG/CR-4551, Vol. 4, Rev. 1, Part 1, ADAMS Accession No. ML063490176,
7. R.J. Breeding, et al., "Evaluation of Severe Accident Risks: Surry, Unit 1," NUREG/CR-4551, Vol. 3, Rev. 1, Part 1, ADAMS Accession No. ML070540210, October 1990.
8. C. Miller, et al., "Recommendations for Enhancing Reactor Safety in the 21st Century, the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," ADAMS Accession No. ML111861807, July 12, 2011.