ANS-8 Nuclear Criticality Safety Consensus Standards – Current Initiatives

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INTRODUCTION

The nuclear criticality safety (NCS) consensus standards are developed as using rigorous procedures of the Standards Board of the American Nuclear Society. These procedures have been accredited by the American National Standards Institute, Inc., as meeting the criteria for American National Standards. The Nuclear Criticality Safety Consensus Committee (NCSCC) that approved all 18 NCS consensus standards is balanced to ensure that competent, concerned, and varied interests have had an opportunity to participate. The ANS-8 subcommittee (ANS-8) consists of 17 NCS experts with many years of experience as end users of ANS standards who serve on standard working groups to develop and maintain standards. ANS-8 ensures that the technical content of the standards is adequate for NCS community use. Attempts are made to ensure that ANS-8 consists of NCS professionals with a diverse range of experience such that all standards are applicable to as many sites as possible. ANS-8 is a very active subcommittee, and some active projects in progress are discussed in this paper:

- basis statement development for all standards,
- development of a glossary for consistency of definitions across all ANS-8 standards, and
- Considering the Criticality Safety Support Group (CSSG) Recommendation 2016-04 to the ANS Standards Board for changes in several ANS-8 standards.

ACTIVE PROJECTS

Basis Statement Development

During the last revision of ANSI/ANS-8.1-2014 [1], a request for clarification [2] was submitted by a member of the NCS community in October 2007 involving issues with the process analysis (PA) requirement and the double contingency principle (DCP) recommendation/technical practice. The ANS-8.1 working group could not achieve a consensus position to respond to the clarification request because of a lack of experience in the basis and intent of the PA requirement and DCP recommendation. Because of the importance of the request, and the lack of consensus amongst among the ANS-8.1 working group members, a request was sent to the 1998 working group chair and members to respond to the request by the co-chairs of ANS-8.1 at the time. The 1998 working group chair sent a response that was used to provide a response to the requester. This process was tedious, embarrassing, time-consuming, and totally unacceptable. The working groups should be able to respond to requests quickly, accurately, and efficiently; however, working group attrition and the lack of knowledge and documentation makes responding to clarification or interpretation requests quite difficult. In 2017, the ANS-8 subcommittee chair (author) requested that all working groups develop basis statements for their requirements and recommendations and to document the results of their working group discussions. This will allow working groups to discuss the requirements and recommendations in their standards and to determine and document basis statements that provide future working groups with the information they need to support standard revisions and requests for clarification. Furthermore, this approach supports training new working group members to become proficient supporting standard activities in the future.

Development of an NCS Standards Glossary

The NCSCC recently developed a draft glossary to support consistency of ANS standards aimed to provide consistent guidance for standard working groups. For example, six ANS standards—ANS-8.1, ANS-8.3, ANS-8.6, ANS-8.10, ANS-8.12, and ANS-8.20—provide a definition for "Criticality Accident." The definitions in the different standards are similar but some vary to some degree. Figure 1 provides a comparison of the definition of "Criticality Accident" for each of these aforementioned standards.

ANS Standard	Definition
1	The release of energy as a result of accidental production of a self- sustaining or divergent neutron chain reaction.
3	The release of energy as a result of accidental production of a self-sustaining or divergent neutron chain reaction.
6	The release of energy as a result of accidentally producing a self-sustaining or divergent neutron chain reaction

ANS Standard	Definition
10	The release of energy as a result of the accidental production of a self-sustaining or divergent neutron chain reaction.
12	The release of energy as a result of accidentally producing a self-sustaining or divergent neutron chain reaction.
20	The release of energy as a result of accidentally producing a self-sustaining or divergent neutron chain reaction.

Fig. 1. Definitions for "Criticality Accident" in ANS-8 Series Standards.

ANS Standard	Definition
14	The establishment of confirmation of the truth or accuracy of a fact by investigation, comparison with a standard, or reference to the facts.
21	Determination that a condition or property meets specified criteria, such as presence of minimum amounts and effectiveness of neutron absorbing material in a specific geometry within a facility, equipment, or fuel component.
24	The process of confirming that the computer code system correctly performs intended numerical calculations.

Fig. 2. Definitions for "Verification" in ANS-8 Series Standards.

The definitions in Fig. 1 are close to identical, but a few different definitions are evident in the comparison. A more significant example is for the term, "Verification" to support the requirement for computational validation. Fig. 2 shows several definitions for this term that are quite inconsistent. A summary of ANS-8 series standard glossary terms and phrases will be discussed at the NCSCC meeting this fall, and consistent terms/phrases are to be chosen to ensure consistency in future revisions.

CSSG Recommendation 2016-04

The CSSG operates as the technical support group to the United States Department of Energy/National Nuclear Security Administration (DOE/NNSA) Nuclear Criticality Safety Program (NCSP) Manager and provides operational and technical expertise pertinent to the NCS needs of the DOE mission. In 2016, the CSSG generated clarifications and specific suggestions to the ANS Standards Board, ultimately to ANS-8, for updates to several ANS standards: ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*; ANS-8.10, *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement*; and ANS-8.23 *Nuclear Criticality Accident Emergency Planning and Response*. The CSSG recommended the following:

> *The omission of guidance from ANSI/ANS-8.1-2014 regarding economic considerations and risk in perspective provides the background and bases for similar concerns throughout the balance of all of the ANSI/ANS-8.xx standards, but in particular ANSI/ANS-8.10 and -8.23. This lack of guidance from the ANSI/ANS consensus standards organizations (i.e., Working Groups, Subcommittee and Consensus Committee) has resulted in less than complete information regarding the interpretation, application and accommodation of the standards requirements ("shall") and recommendations ("should") as they relate to the prevention and/or mitigation of criticality accidents that might result from rare, calamitous events at non-reactor nuclear facilities. This is particularly significant for situations when personnel are not at risk of significant radiation exposures.*

Specific recommendations were made by the CSSG for each of these standards to address the intent of their recommendation. ANS-8 has had internal discussions about this recommendations, and ANS-8.1 and ANS-8.23 have discussed extensively at the working group level the perceived need by the CSSG and have worked to achieve consensus on potential changes to these standards to address the CSSG recommendations. This work is in progress, and the ANS-8.10 working group intends to address the recommendations after the ANS-8.1 standard completes their revision.

CONCLUSIONS

In addition to routine business in ANS-8, such as standard revisions and maintenance activities, a few active projects are important for future working groups. In particular, the basis statement project is invaluable for teaching the next generation of NCS standard working group volunteers. Likewise, the development of an ANS glossary is crucial to ensure consistency of terms and phrasing during standard revisions. The CSSG recommendation 2016-04 provides specific recommendations for several standards for the ANS-8.1, ANS-8.10, and ANS-8.23 standards regarding economic considerations and risk in perspective. The CSSG recommendation has been discussed at great length in the ANS-8.1 working group and discussed prior to the generation of the last revision of ANS-8.23. ANS-8.10 will consider the recommendation based on the details of the final revision of ANS-8.1 in the near future.

REFERENCES

1. ANSI/ANS-8.1-2014, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," American Nuclear Society (2014).

2. D. G. BOWEN and N. W. BROWN, “Revision to ANS-8.1, ‘Nuclear Criticality Safety in Operations with Fissionable Material Outside of Reactors,’” *Trans. Am. Nucl. Soc.*, **109**, 2013.
3. United States Department of Energy/National Nuclear Security Administration Nuclear Criticality Safety Program, Criticality Safety Support Group Recommendation 2016-04, https://ncsp.llnl.gov/sites/ncsp/files/2021-10/tasking_2016-04_response-complete.pdf, January 23, 2018.