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American Nuclear Society

Nuclear Criticality Safety Division Newsletter

Thoughts on the History of Criticality Control Practices

David R. Smith, Chairman N16

In the very earliest experiments with fission reactions nuclear safety was a basic concern. The story of drums of boric acid on the balcony above the first reactor at Chicago's Stagg Field has been told often enough. Dr. Richard Feynman has related some of his activities in the control of nuclear risks during early fissile material production. Codes, standards, guides, regulations, and orders have emphasized these risks and the need for their effective control. Perhaps an historical review of these activities will be of interest and have some value.

Awareness of criticality risks was emphasized by the first two nuclear fatalities. These occurred at Los Alamos in what today would be called hand-stacking experiments. Following the first (8/21/45), strong administrative controls were put in place but did not prevent the second (5/21/46). As a direct result of these fatalities the critical experiments laboratory was built in Los Alamos at Pajarito Site where it still operates today. Similar laboratories followed at Oak Ridge, The Hanford Plant, and Rocky Flats. Critical facilities, largely reactor oriented, operated at Babcock and Wilcox, Pratt and Whitney, The General Electric Company, and Westinghouse, among other locations. Westinghouse also operated and continues to operate the Bettis facility for Naval Reactors of the Department of Energy (DOE).

Those who worked in the critical experiment facilities were personally and directly aware of criticality risks, and some of these people recognized the need for safety guidance to be made available to those who operated processing facilities. Accordingly they, with practitioners of nuclear safety from processing facilities, spontaneously developed the first nuclear safety guide which was published as a classified Los Alamos document in 1956. This was LA 2036. An unclassified version was soon published by Goodyear Atomic as the Nuclear Safety Guide (1957). This guide has now gone through three revisions.

Many of the same people were also involved in the slow and tedious development of consensus standards related to criticality safety. After several years work the result was ASA N6.1-1964, Safety Standard for Operations with Fissionable Material Outside Reactors. This was published by the American Standards Association (ASA) which evolved into the American National Standards Institute (ANSI). After the American Nuclear Society (ANS) came into existence in 1955 and became a nationally recognized organization these standard development activities came under the aegis of ANS as Consensus Committee N16. A consensus committee is expected to monitor fairness, openness, and due process during the development of standards. Members are expected to represent the organization for which they serve. The actual writing of standards was to be done by ANS-8, as a writing group associated with N16 and a subcommittee of the ANS Standards Committee. In June of 1968 ANS-8 completed its work on the revision of N6.1-1964 which received approval of N16 and was transmitted to ANSI at the end of 1968.

The nuclear arms race associated with the Cold War involved a large scale-up of fissile material production, perhaps without concomitant concern for criticality risks. There followed a group of five process criticality accidents in the U S between 1958 an 1964. Fortunately the procedural resources needed for enhanced risk control were largely in place, and an increased sensitivity on the part of management resulted in additional personnel and physical resources being made available. In the next thirty-five years only one additional process accident has occurred in this country. It may be noted that this improved risk control was not dependent on complex computer calculations, and was largely the result of application of fundamental safety considerations.

One may say that those early documentation efforts paid handsome dividends. The simple and

straightforward application of basic principles of risk control were very effective. The one accident that has occurred in this country since 1964 can be directly attributed to the breakdown of these principles and the failure to enforce existing procedures.

The developers of the Nuclear Safety Guide met occasionally (annually?) to discuss experimental programs of the critical experiment facilities and the needs of the AEC contractors. This informal group (sometimes referred to as the Contractors Criticality Safety Group) became popular and attendance was viewed in some circles as almost a status symbol. The group became concerned by the politics and chose to discontinue its meetings.

At about this time interest was developing in holding a more general meeting to discuss criticality control practices, and people at Los Alamos approached the Trinity Section of the ANS for sponsorship of a National Topical Meeting.

Following a favorable reception, plans were quickly formulated for a committee structure. A proposal was submitted to ANS and was granted calendar placement. Letters of invitation were sent and the technical program was organized.

At this 1966 meeting in Las Vegas several people suggested that a Criticality Safety Technical Group be organized within ANS. To evaluate this suggestion letters were sent to all attendees asking for opinions regarding the desirability of attempting to form such a Technical Group. There was some doubt that the growth would ever be of sufficient size to achieve Division status. The response was overwhelmingly favorable, and letters were sent to Dr. Hugh Paxton, Dr. Dixon Callihan, and Dr. John McBride requesting them to form an ad hoc committee to propose a slate of officers to get things started. Things were now well underway for the formation of the Technical Group, which became a Division long before most people expected.

The new criticality safety technical group/division was naturally interested in the activities of ANS-8 and the standards subcommittee welcomed this interest. Though ANS-8 was procedurally responsible to N16, this was a relaxed relationship and the desire for good standards was paramount.

Dr. Callihan served as the first chairman of N16 and continued in that position for many years. Initially he was also Chairman of ANS-8 until appointing Mr. Jack McLendon of Y-12 to fill that position. When Dr. Callihan withdrew from chairing N16 in 1981 his Vice-Chairman, David R. Smith, was elected Chairman by the members of N16 and approved by the Standards Steering Committee. Mr. Smith later designated Ronald K. Knief as his Vice-Chairman.

The chairmanship of ANS-8 passed from Mr. McLendon, on his retirement, to Joseph T. Thomas. Mr. Thomas, in turn, was succeeded by Dr. McLaughlin, the current Chairman. Both appointments were the prerogative of the N16 Chair.

For some four decades the professionals of nuclear criticality safety have codified good practices into guides and standards, following the consensus principle. The resulting documents, supplemented by presentations at national and international technical meetings and one textbook, constitute the current literature of criticality safety.

Nuclear Criticality Safety Division (2000-2001)

Officers

Chair: Doug Croucher (303-966-2175, croucher@polnow.net)
Vice Chair: Jack Bullington (270-441-6860, bullingtonjs@pgdp.usec.com)
Secretary: James Baker (505-665-2814, jbaker@lanl.gov)
Treasurer: Trent Primm (865-574-0566, rtp@ornl.gov)

Executive Committee and Committee Chairs

2002 Kathleen Bhanot, International Relations, (77-276-4237, keb3@bnfl.co.uk)
2001 Christa Boman, Publications, (804-522-5927, ncsdnews@att.net)
2000 Stephen Bowman, Liaison to 2001 Topical, (865-574-5263, st5@ornl.gov)
2001 Tom Doering, Membership, (702-295-4382, Thomas_Doering@ymp.gov)
2000 Song Huang, Honors and Awards, (925-422-6516, huang3@llnl.gov)
2001 Kevin Kimball, (770-497-8818, kkimball@nisyscorp.com)
2000 Richard Paternoster, (505-667-4839, rpaternoster@lanl.gov)
2002 Jeffrey Philbin, (505-845-9036, jsphilb@sandia.gov)
2002 Richard Taylor, (865-574-3529, rgt@ornl.gov)
Ron Marble, Program Committee Chair, (423-574-6059, marblerc@ornl.gov)
Jerry McKamy, Education, (301-903-8031, jerry.mckamy@eh.doe.gov)
Thomas McLaughlin, ANS-8 Chair, (505-667-4789, tpm@lanl.gov)
Cecil Parks, Nominating Committee Chair, (865-574-5280, cvp@ornl.gov)
John Schlesser, ANS-8 Liaison, (505-665-2815, johna@lanl.gov)
R. Michael Westfall, Fellow Award-Coordinator, (423-574-3530, rwe@ornl.gov)

Program Committee

Ron Marble

The ANS Annual Meeting is June 4-8, 2000, in San Diego, CA. The NCSD sessions are: 1) Data and Analysis for Nuclear Criticality Safety; 2) Student Research in Nuclear Criticality Safety; 3) Application of Fixed Neutron Absorbers as Engineered Safety Features; 4) Criticality Safety Issues and Analysis for DOE Spent Nuclear Fuel: Transportation, Storage, and Disposal (Embedded Topical); and 5) A

poster session on the Tangled World Wide Web of Criticality Safety.

The ANS Winter Meeting is scheduled for November 12-17, 2000, in Washington DC. The NCSD sessions are below and paper submittals are due at ANS Headquarters by June 23, 2000. See www.ans.org for a copy of the Call for Papers. Please contact Ron Marble, if the paper submittal will be delayed beyond that point.

Data and Analysis for Nuclear Criticality Safety. This session is the general session for NCSD papers, which do not fit any other session topic. For more information contact Ron Marble, (270-441-5346, marblerc@ornl.gov).

Burnup Credit: A Combined Industry and Regulatory Effort. In August 1999, the USNRC released Interim Staff Guidance related to the implementation of burnup credit in the criticality safety evaluation of transport and storage casks for spent nuclear fuel. Furthermore, burnup credit is being utilized in a risk-informed approach associated with evaluating the potential for criticality in a permanent US repository for spent fuel. Internationally, work groups sponsored by the OECD and IAEA continue to seek international cooperation related to modeling, validation, and data development. This session will encourage papers that focus on the current progress in understanding issues and facilitating utilization of burnup credit in criticality safety analysis. Session organizers: Mark DeHart, (865-576-3468, udq@ornl.gov) and Tom Doering, (702-295-4382, Thomas, Doering@ymp.gov).

Lessons-learned from the Tokai-mura Nuclear Criticality Accident. The criticality accident in Japan prompted nuclear facilities around the world to review their criticality safety programs and assess the potential for a similar type occurrence in their respective facilities. This session is intended to highlight those assessments. Papers related to programmatic and technical evaluations are encouraged in the following areas: Criticality safety culture/conduct of operations; oversight, review, and assessment techniques and methodologies; training and qualification verification; and the implementation of NCS controls. Session organizer**: Peter Angelo** (865-241-4559, angelopl@ornl.gov)

Implementation of NCS Controls. One of the more difficult tasks of a practicing criticality safety engineer is effective implementation of the derived basis of safety for given fissile material process equipment or facilities. The purpose of this session is to encourage sharing of "best practices" in effective implementation of NCS controls. Papers are requested which discuss the methodology used for implementing passive, active, or administrative controls used for one or more controlled parameters. Session organizer: Lon Paulson (910-675-5460, lon.paulson@gene.ge.com.

Criticality Safety Standards Poster Session. The ANS Standards Program includes the writing and publishing of American National Standards regarding nuclear criticality safety. Criticality safety standards sponsored by the International Standards Organization are of increasing interest. The poster session provides an opportunity for national and international working groups to present the status of their respective standards and future goals of their project. Session organizer: John Schlesser (505-665-2815, johna@lanl.gov)

News & Announcements

- Congratulations! to Stephen M. Bowman and James E. Horwedel who won the **NCSD Best Paper Award** at the 1999 Annual ANS Meeting for their paper, "KENO3D Visualization Tool for KENO V.a Geometry Models".
- Congratulations! to Peters J. Jaegers and Rene Sanchez who won the **NCSD Best Paper Award** at the 1999 Winter ANS Meeting for their paper: "Initial Experiment Results from Zeus, An Intermediate-Energy Neutron Spectrum Experiment".
- Appreciation to Son Huang, Jennifer Burch, and John Pearson for organizing the awards.
- The next **NCSD topical meeting** will be an embedded topical meeting at the ANS June 2001 Meeting in Reno, Nevada. The theme of the meeting is "Implementing Criticality Safety in the New Millennium". General chair of the meeting is Steve Bowman from ORNL and the Technical Chair is Fitz Trumble from Westinghouse Safety Management Solutions.
- ANS Transactions Compilation "**Nuclear Criticality Safety Experiments, Calculations, Experiments, and Analyses – 1958 to 1998: Compilation of Papers from the Transactions of the American Nuclear Society**," edited by Brian L. Koponen is now available. The compilation contains 734 summaries published since 1982 plus 50 not included in a similar compilation published in 1982 as UCRL-53369. 1473 paper summaries published from 1958 to 1998 are indexed and included in author and subject concordances. Available in 3 volumes. Vol. 1 includes an index and concordances and Vols. 2&3 contain the summaries of 785 papers. 1382 pp., PB, $325. Order from Golden Valley Publications, 669 Joyce St., Livermore, CA 94550-2312, USA; phone (925) 447-0614; fax: (503) 212-6246 or email GoldenValleyPubl@aol.com
- The NCSD made a contribution to the Macintosh Missions in honor of Jim Mincey. A letter was sent from the Division to the Missions and the family. Some excerpts from the letter: "Please find enclosed monetary contributions from numerous people who knew Mr. Jim Mincey's competency, contributions, and significant commitments to education, training, science, technology, and human relations in the professional field of nuclear engineering, specifically nuclear criticality safety. These people were kindly touched by Jim's knowledge and his assistance to their profession. Because of his profound professional and personal impact on these people they have chosen to make their collective contributions in memory of Jim through the Nuclear Criticality Safety Division of the American Nuclear Society (ANS). ….In closing, it has been noted that the nuclear criticality safety community can best honor Jim by following the extraordinary example he set in placing integrity and perseverance first in the pursuit of safety. Jim directed his considerable intellectual ability to doing the right thing in the right way at the right time. Although it is impossible always to be right, and sometimes even to know what 'right' really means when complex issues must be addressed, Jim came as close to doing the impossible as one can ever hope. For us in the criticality safety community, Jim cannot be replaced. We can only strive to use the example he set as a guidepost in all the professional and personal activities that we undertake."

NCSD Elections

The ballots have been sent out for the NCSD elections. The voting will be closed on April 25, 2000 so please return your ballots on time. Roy Trenton (Trent) Primm, III and Robert E. Wilson are running for the position of Vice Chair/Chair Elect. Brian O. Kidd and Stephen M. Bowman are running for Secretary. James S. Baker and Chris Robinson are running for

Treasurer. Jack Davis, Calvin Manning, Jerry McKamy, Lon Paulson, Valerie Putnam and Kevin Reynolds are all running for executive committee. In addition, NCSD members Doug Croucher and Dennis Tollefson are running for the ANS Board of Directors.

The NCS Division is looking for suggestions for various positions on the NCSD committees. Please contact Doug Croucher if you are interested or would like to suggest someone.

NCSD Web Site & Newsletter

Be sure to check out the new NCSD Web site! The web site has been updated and has moved! The new address is: http://ncsd.ans.org. The web site has news, division meeting minutes, resources, links, and more. Please contact Mark DeHart (udq@ornl.gov) or Kevin Kimball (kkimball@nisyscorp.com) if you have suggestions for the web site. Also, please provide any comments or information for the NCSD Newsletter to Christa Boman (ncsdnews@att.net).

NCSD Awards

There are two new NCSD Awards. The awards will be presented at the upcoming ANS winter meeting in Washington, DC in November, 2000.

The first award is the **NCSD Award for Distinguished Service.** This award is for outstanding service in carrying out the activities of the NCSD, including leadership in governance functions, the development of its technical program, the organization of topical meetings, workshops and tutorials, professional consensus standards, and other functions performed by special committees. This award is only available to NCSD members with at least 10 years membership. The second award is the **NCSD Award for Technical Excellence**. This award is for outstanding contributions in the development and application of nuclear criticality safety technology. These contributions include, but are not limited to: 1) the performance and evaluation of experimental measurements pertinent to NCS; 2) the development of analytical and computational NCS methods; 3) notable NCS engineering applications such as the definition of upset conditions for complex fissile systems and/or the establishment of novel reactivity control strategies; 4) the development of the technical bases for effective and useful NCS guides, standards, and regulations; and 5) the development and conduct of NCS education and training programs in these technical areas. There are no NCSD membership requirements for this award.

The NCSD Honors & Awards Committee is soliciting written nominations from NCSD members. The submittal should indicate which award and include the name, affiliation, address, e-mail address, and telephone number of both the candidate and the sponsor. Up to 500 words of written narrative should describe how the candidate has met the criteria for the award in sufficient detail as to provide the information for the extended citation. The H&A Committee will confirm the qualifications of nominees and select the awardees by consensus. A nomination form is included with the NCSD newsletter and is also on the NCSD web site at ncsd.ans.org. **Please remember that the deadline for nominations is July 31, 2000!** Submit nominations to: R. Michael Westfall, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6370 (rwe@ornl.gov).

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Training Courses

University of New Mexico - Contact Bob Busch at busch@unm.edu or (505) 277-8027 or visit *http://www-chne.unm.edu/ncssc/* for more information on the following courses:

July 11-13, 2000	July 17-21, 2000	July 25-27, 2000
3rd Annual Criticality Safety Assessments Workshop	***NCS Short Course***	***7th Annual Worshop for Managers***

University of Tennessee, Knoxville – Contact Lee Dodds at hld@utk.edu or (423) 974-2525 or visit *http://www.engr.utk.edu/nuclear/TIW.html* for more information on the Tennessee Industry Weeks NCS Short Course scheduled for August 14-18, 2000.

SCALE Training – Contact Kay Lichtenwalter at x4s@ornl.gov or (865) 574-9213 or visit *http://www.cped.ornl.gov/scale* for more information on the following courses:

May 15-19, 2000	October 15-20, 2000	October 16-20, 2000
SCALE KENO-VI Criticality Course	**SCALE KENOV.a Criticality Course**	***SCALE Shielding Source Terms***

Los Alamos National Lab – Contact Tom McLaughlin at tmp@lanl.gov or (505) 667-4789, or visit *http://orion.lanl.gov/course_outline.html* for more information on 2-day, 3-day, Basic 5-day, and Advance 5-day Nuclear Criticality Safety Training Courses.