

The DOE Criticality Safety Support Group – A Retrospective Perspective

Fitz Trumble

DOE CSSG, Chair
URS Professional Solutions
2131 S Centennial Drive, Aiken SC 29801
Fitz.Trumble@urs-ps.com

David Erickson

DOE CSSG, Deputy Chair
Savannah River Nuclear Solutions
707-C, Rm 228
Aiken, SC 29808
David.Erickson@srs.gov

ABSTRACT

The Department of Energy (DOE) Nuclear Criticality Safety Support Group (CSSG) came into being as a response to the DNFSB recommendation 1997-2 “*Criticality Safety*” which dealt with the continuation of criticality safety at defense nuclear facilities in the Department of Energy Enterprise. The DNFSB was concerned over the lack of capability management of practical experience pertinent to avoiding a criticality accident in non-reactor environments. One of the specific recommendations of 1997-2 was to “*Identify a core group of criticality experts experienced in the theoretical and experimental aspects of neutron chain reactions to advise on the above steps and assist in resolving future technical issues*”. The CSSG, a group of 10 recognized experts in criticality safety, was chartered in late 1997 to address the recommendation. Members of the CSSG are drawn from DOE employees and contractor staff to provide advice and technical support to help meet the criticality safety needs of DOE missions, including stockpile stewardship, materials stabilization, transportation, storage, facilities lifecycle (design through decommissioning), and waste disposal.

The CSSG is an integral part of the DOE Nuclear Criticality Safety Program (NCSP) developed to maintain and enhance the operational and technical criticality safety expertise and capability within the Department of Energy Enterprise. This paper outlines the history, purpose and continuing contribution of the CSSG as well as providing an understanding of the interfaces between the DOE CSSG, the DOE Criticality Safety Coordinating Team (CSCT), the ANS Nuclear Criticality Safety Division and the EFCOG Criticality Safety Subgroup.

Key Words: Criticality Safety, Criticality Safety Support Group, Department of Energy, Nuclear Criticality Safety Program

1. INTRODUCTION

More than fifteen years ago, in response to concerns raised by the Defense Nuclear Facilities Safety Board (DNFSB), the Department of Energy (DOE) established the Criticality Safety Support Group to serve as a technical advisory group. The group, whose purpose is to provide technical guidance to the DOE in the development and maintenance of competency in the field of nuclear criticality safety, has remained active and engaged throughout this 15+ year period. The CSSG has provided significant service in four distinct areas: development of competency within the criticality safety discipline, driving consistency in regulations and the practice of criticality safety, technical support to criticality safety programs, and programmatic support to the DOE’s Nuclear Criticality Safety Program (NCSP). Over the years the CSSG has tackled some of the most pressing criticality safety issues, always with a mind toward ensuring DOE

resources are used wisely and are providing real improvements in criticality safety “on-the-floor” operations.

2. DISCUSSION

A brief review of the history of the CSSG formation, accomplishments in each of the four service areas, interfaces between the CSSG and other groups, impacts attributable to the CSSG and the future of the CSSG will all be discussed.

2.1 CSSG History

To understand the state of criticality safety that prompted the formation of the DOE CSSG, one needs to go back to the early 1990s after the Cold War ended. DOE was reducing funding and beginning to close facilities related to the weapons production efforts in order to capitalize on the “peace dividend”. By the early 1990s all of the general purpose criticality experiment facilities had been closed with the exception of TA-18 at Los Alamos National Laboratory (LANL). There were serious considerations underway to close TA-18 as well. It was in this atmosphere that the Defense Nuclear Facilities Safety Board (with Dr. Herb Kouts as the primary driver) wrote DNFSB Recommendation 1993-2 (93-2). In this recommendation the DNFSB recognized both the likely detriment from closure of the experiments facility and raised the concern that due to these closures many of the criticality safety engineers would no longer have “hands on” experience with systems at or near the critical state. The DNFSB recommended to DOE that they keep the experimental capability active at LANL to ensure that criticality safety engineers received both the theoretical and experimental experience necessary to be effective in preventing a criticality safety accident. They also reminded DOE that there were still some discrepancies between the existing calculational models and the experimental results that could only be resolved by the capability to perform additional experiments. Based on this recommendation DOE kept the TA-18 facility funded and experiments continued.

By 1997 the DNFSB (again championed by Dr. Kouts) wrote a recommendation on criticality safety competence. In DNFSB recommendation 1997-2 (97-2) the DNFSB again noted the decline in personnel with first-hand experience with systems at or near the critical state, and noted that the large increase of criticality safety engineers were being trained on the job without practical experience and with an over-reliance on criticality computational techniques which led to overly complex analytical models being used. This was, in the DNFSB's perspective, causing reductions in the productivity of several DOE facilities. The DNFSB also expressed a concern that the decades long period without a criticality accident in the United States (see Figure 1) may be leading to a sense of complacency within DOE. In 1997-2 the DNFSB made nine sub-recommendations associated with: coordinating experimental activities, organizing calculations and experiments in criticality safety, developing a way to interpolate and extrapolate between these data, using this information to create guidance and bounding curves, developing a course of instruction in criticality safety which includes “hands on” experiments to serve as a foundation for criticality qualification, and establishing a group of technical experts to advise DOE on the accomplishment of these sub-recommendations and to help resolve future technical issues. This group of technical experts was formed and named the CSSG.

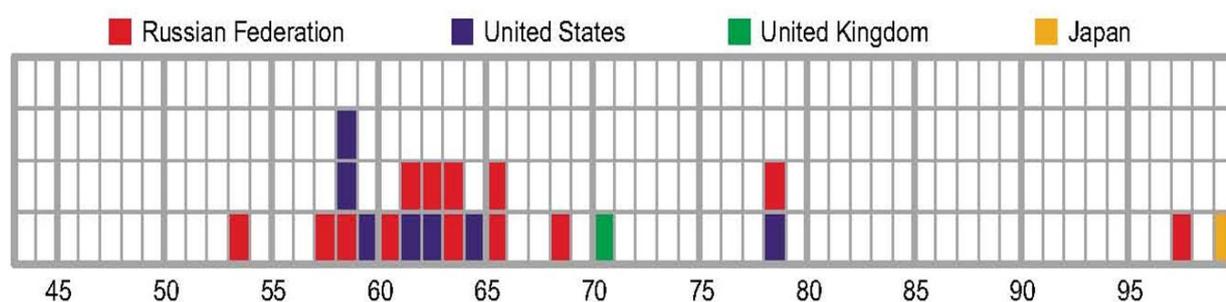


Figure 1. Chronology of process criticality accidents.

The CSSG was chartered in 1997 in direct response to 97-2 sub-recommendation 8 which stated DOE should “*Identify a core group of criticality experts experienced in the theoretical and experimental aspects of neutron chain reactions to advise on the above steps and assist in resolving future technical issues*”. Several charter members of the CSSG participated in writing the DOE Implementation Plan in response to 97-2. The current charter of the CSSG can be found on the NCSP website at <http://ncsp.llnl.gov/cssg/Revised-CSSG-Charter-August-2008.pdf>. Table I shows the 10 initial charter members of the DOE CSSG. The members were selected by DOE senior leadership to ensure that the group comprised a strong mix of those with theoretical, experimental and practical experience in the field of criticality safety. The CSSG membership policies and criteria, which are available at http://ncsp.llnl.gov/cssg/CSSG_Membership_Policy_Changes-06.pdf, requires at least 15 years of experience in the field of criticality safety, demonstrated leadership and expertise in nuclear criticality safety including in the ANS Nuclear Criticality Safety Division (NCSD) and participation in ANSI/ANS-8 standards development.

Table I. Charter Members of the CSSG in 1997

Name	Organization	Name	Organization
Adolf Garcia, Chair	DOE-NE	Jim Morman, Dep Chair	ANL
Mike Westfall*	ORNL	Robert Wilson	DOE-EM
Tom McLaughlin	LANL	Tom Reilly*	SRS
Calvin Hopper*	ORNL	Rick Anderson*	LANL
Jerry McKamy*^	DOE HQ	Hans Toffer*	Hanford

*currently Emeritus

^currently DOE NCSP Manager

2.2 CSSG Accomplishments

Over the last 15 years the CSSG has fulfilled its charter responsibilities in four specific areas: development of competency within the criticality safety discipline, driving consistency in regulation and the practice of criticality safety, technical support to criticality safety programs, and programmatic support. In addition the CSSG has been instrumental in guiding the advancement of analytical methods for criticality safety, preserving historical criticality safety data and documents, and in developing training materials for criticality safety practitioners.

The CSSG charter explains how the CSSG is tasked with specific activities by the NCSP Manager and how the CSSG responds to those Taskings with Responses. These Responses, starting in 2006, are available on the NCSP website at <http://ncsp.llnl.gov/cssgMain.html> and are noted in brackets in the following sections. Accomplishments in each of the specific areas are described below.

2.2.1 Increasing Competency in Criticality Safety

As was noted in the DNFSB Recommendation 93-2, one of the most important competencies that the NCSP can provide to the criticality safety engineer is experience with systems at or near the critical state. The CSSG was a strong advocate for the continuation of critical experiments activities at LANL and the re-establishment of critical experiments capabilities at the Device Assembly Facility (DAF) once DOE decided to close TA-18 at LANL. During the planning for the move of the experimental capability the CSSG reviewed the machine capabilities that would be established at the DAF [2005, Tasking not available]. The CSSG also reviewed the criticality safety evaluations for the critical experiments and reviewed the determination of the need for criticality safety accident alarms at the facility [2005-04].

Realizing that this experimental capability, while important for furthering criticality safety research, was also an important learning tool for the criticality safety engineer, the CSSG was also involved in the development of a training course that incorporated this national facility -now called the National Criticality Experiments Research Center (NCERC). The CSSG was integral in assessing the needs, developing the outline, reviewing the content and periodically auditing the NCSP two week hands on critical experiments class [2006-03, 2009-03].

The CSSG has also reviewed the DOE Standards related to DOE Federal Criticality Safety Qualifications (DOE-STD-1173) providing input on the necessary competencies and documentation to ensure federal personnel remain competent in providing oversight of the contractor programs [2009-05].

The CSSG also had a major hand in developing the first ever training and qualification standard for criticality safety engineers DOE-STD-1135-99 which was later superseded by ANSI/ANS-8.26.

2.2.2 Increasing Consistency in the Regulation and Practice of Criticality Safety

Many DOE Orders and Standards as well as consensus standards (e.g., ANSI/ANS-8 series) provide significant latitude in the way that they can be implemented in the field. While this often provides needed flexibility to match implementation to risk, it can also lead to significantly different interpretations of these Orders and Standards at the Site level. The CSSG has provided guidance that can be used to help create consistency in the implementation of DOE Orders and Standards (which in the past were often developed without significant input by the criticality safety community). Several examples of topical areas where the CSSG, often in collaboration with subject matter experts from other disciplines, has provided guidance are discussed below.

- Development of the NCSET Modules available on the NCSP website (1999-current) at <http://ncsp.llnl.gov/trainingMain.html>
- Guidance and content for the development of Nuclear Criticality Safety Evaluations via DOE-STD-3007 which was authored by the CSSG [2004-2005], and for the upcoming 2015 revision of DOE-STD-3007;
- The proper role of criticality safety in Facility Categorization and recommendations for changes to the DOE-STD-1020 [2010-02];
- The proper balance of risk between seismic design guidance and criticality safety and recommendations for changes to the DOE-STD-1027 [2010-01];
- The proper balance of risk between fire protection and criticality safety [2013-01];
- A process for uniform criticality incident categorization [2009-02]; and
- Guidance for uniform roles and responsibilities for Criticality Safety Committees [2009-01].

In addition the CSSG reviews all DOE Orders and standards involving or tangentially involving criticality safety. These have included:

- CSSG review and comment on DOE Order 420.1B/C [2004, 2011-01];
- CSSG review and comment on DOE-STD-1189 [2007-05];
- CSSG review and comment on DOE-STD-3009 [2011-02, 2013-03-01];
- CSSG review and comment on the NCS Good Practices Guide

2.2.3. Providing Technical Support to Criticality Safety Programs

There are sometimes specific topical areas that manifest themselves at a particular site which either have wide applicability to the rest of the DOE Enterprise, or whose failure could impact the mission accomplishment of DOE. In these cases the CSSG can be brought in to provide guidance and technical assistance. Access to CSSG support is available to any part of DOE/NNSA via request to, and approval from the NCSP Manager. Examples of this technical support are provided below.

- CSSG review of the criticality safety approach used for pre-closure of the Yucca Mountain Site as part of their license application [2006-07];
- CSSG review of WTP and Hanford Tank Farms in regard to plutonium solids issues [2009-06];
- CSSG assessment of the preliminary criticality safety approach for the UPF facility, including reviews of the interaction of criticality and seismic [2011-04];
- CSSG assessments and direct technical support for the LANL criticality safety program [2005-tasking not available, 2011-06, 2013-02, 2014-01]; and
- CSSG review of the approaches used by Y-12 to define the Immediate Evacuation Zone (IEZ) [2007-07].

2.2.4 Providing Programmatic Support to the NCSP

Since the inception of the NCSP and the CSSG, the CSSG has provided guidance to the NCSP in terms of the overall DOE approach to criticality safety. This is reflected by the CSSG review of the NCSP Mission and Vision as well as the NCSP 5 and 10-year plans available from <http://ncsp.llnl.gov/ncspMain.html> and <http://ncsp.llnl.gov/planMain.html>, respectively.

In addition the CSSG provides a yearly prioritization of tasks proposed to be performed under the NCSP budget. Each year the CSSG reviews all the current and proposed tasks and provides the NCSP Manager a prioritized list of activities for each of the elements within the NCSP. This prioritization is based on the collective CSSG perception of the best use of the limited funds available to furthering the competencies of the criticality safety discipline within DOE. The CSSG is charged with providing this perception while keeping a balance between experiments, data (new and historical), tools, and training such that the criticality safety professional is best prepared to perform their function.

2.3 CSSG Interfaces With Other Organizations

The CSSG, by design, is a transparent organization. As was noted in section 2.0 the available CSSG Taskings and responses (excluding those identified as OUO / Internal Use) as well as CSSG minutes from meetings (more to be added) are available on the NCSP website. However the CSSG does not just passively post information, it actively engages with other organizations in an effort to provide updates on activities as well as learning of new issues or areas of concern within the discipline.

As an integral part of the NCSP the CSSG has interfaces with all the elements of the NCSP program (nuclear data thru the Nuclear Data Advisory Group, analytical methods, bounding sensitivity and uncertainty, integral experiments, information preservation and training). Interfaces with the other elements of the NCSP occur during yearly meetings of the NCSP to plan upcoming work and report accomplishments (usually held in the Spring) and the yearly meeting to discuss execution of the projects

(usually held in the Fall). Some CSSG members are also engaged with, and in some cases are task managers for, activities in these other elements of the NCSP.

In addition the CSSG retains a close coordination with the DOE Criticality Safety Coordinating Team (CSCT) which is comprised of the Federal (Headquarters and Field) responsible entities at each of the DOE sites. This coordination is maintained via a cross pollination of the CSSG with several CSCT (DOE) members (see Table II) and an occasional joint meeting of the two groups. Typically the CSSG Chair or Deputy Chair attends the monthly CSCT teleconferences. This allows the CSSG to remain aware of issues that the individual Site federal oversight engineers may be facing.

Table II. Current Members of the CSSG

Name	Organization	Name	Organization
Fitz Trumble, Chair	URS	David Erickson, Dep Chair	SRNS
Adolf Garcia	DOE-ID	Robert Wilson	DOE-EM
Tom McLaughlin	LANL	Jim Morman	ANL
David Hayes	LANL	Kevin Kimball	Y-12
Dave Heinrichs	LLNL	Mikey Brady-Rapp	PNL

The CSSG also maintains close coordination with the Energy Facility Contractors Owner Group (EFCOG) criticality safety sub-group. This group is comprised of “end-users” of the criticality safety data, tools and training prepared by the NCSP and is made up of NCS managers and engineers from the various DOE Sites. Coordination with this group is via attendance at the EFCOG subgroup teleconferences (monthly) by the CSSG Chair or Deputy Chair as well as attendance at selected EFCOG technical meetings.

As was noted in section 2.1 the CSSG members are also closely involved with the ANS NCSD and are or have been active in the program, executive, education committees as well as serving on a number of the ANS-8 standards writing groups. This engagement with NCSD helps ensure that the CSSG members are aware of the perspectives and approaches used outside of the DOE Enterprise. It also facilitates sharing of information between the CSSG and the non-DOE criticality safety community.

2.4 Impact Attributable to the CSSG

Over the past 15 years, the CSSG has worked closely with the NCSP to develop, maintain, and enhance the practice of criticality safety within DOE by providing guidance on the data, tools, and training used by the criticality safety engineer. The CSSG strives to present information and guidance related to the prevention of criticality accidents in a balanced risk perspective, ensuring that regulations promulgated by the DOE are respectful of the limited resources available to the accomplishment of mission and are providing real improvements to safety. During this first 15 year period of the CSSG, the group has been a strong advocate for “doing the right thing” and not allowing political considerations to outweigh technical considerations. This has resulted in a much stronger application of the graded approach to criticality safety which is one of the fundamental underpinnings of the ANSI/ANS series 8 standards.

The CSSG has also championed the approach that criticality safety differs in no intrinsic way from other safety disciplines. While a criticality safety accident clearly can cause a fatality in a nearby worker, there are very few instances where a criticality accident would cause serious damage to a facility, or would impact co-located workers or the public. By putting criticality accident risk into perspective the CSSG continues to advocate for the regulation of criticality safety to follow rules based primarily on consequence and not political perception.

The CSSG also ensures that the current almost 40 year period (see Figure 1) without a process criticality accident in the United States does not develop into a sense of complacency within the DOE community.

2.5 Future of the CSSG

The CSSG has proven itself an important and integral part of the NCSP over the last 15 years. As the CSSG looks forward it has the staffing, expertise and mission to continue in that role. The CSSG membership criteria help ensure that the CSSG remains the most authoritative body on criticality safety within the DOE Enterprise. The CSSG has multiple Taskings underway in 2015 and these Taskings impact all four of the CSSG service areas. Table II provides the current membership of the CSSG supplemented by the Emeritus members noted in Table I. The Emeritus members continue to provide invaluable advice to the current CSSG members although they are no longer directly funded by the NCSP.

In 2014 the CSSG developed a strategic plan for the organization that is designed to ensure that the group's capabilities and impacts are well known in the DOE leadership, technical programs, and regulatory writing bodies. The strategic plan is also intended to ensure that the work the CSSG performs is timely and focused on the most pressing needs of the DOE Enterprise.

As new and revised DOE policy and regulation relating to criticality safety or criticality safety's interaction with other safety and operational disciplines is developed, the CSSG stands by ready to provide guidance and direction. The CSSG is also ready to address new technical issues that may arise in the DOE Enterprise as the future unfolds. A request for access to the CSSG capabilities is available thru contact with the NCSP Manager (Dr. Jerry McKamy) or any member of the CSSG.

3. CONCLUSIONS

Born during a time of concern over the ability of the Department of Energy to maintain capability in the field of criticality safety, the CSSG has provided crucial information, guidance and direction to the NCSP and the DOE Enterprise. The NCSP, with CSSG guidance, has been successful in stabilizing the loss of, and reinvigorating, criticality expertise and capability within the United States and has provided new data, tools, and training that directly support and enhance the practice of criticality accident prevention. The CSSG has helped ensure that the operations within the DOE Enterprise have been conducted safely and has pointed out where the potential for over-regulation could cause resources to be wasted without a commensurate reduction in risk. As the single most authoritative body on criticality safety within the DOE Enterprise, the CSSG is well positioned to continue that support role into the future and plans to continue its interactions with other criticality safety practitioners to ensure two way information flow. For over 15 years, the CSSG has delivered on the expectations of the group set by the DNFSB Recommendations 93-2 and 97-2 and plans to continue to do so into the future as long as the need remains.

ACKNOWLEDGMENTS

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REFERENCES

1. DNFSB Recommendation 93-2
2. DNFSB Recommendation 97-2
3. Nuclear Criticality Safety Program 2014 Mission and Vision