Department of Energy
National Nuclear Security Administration
Washington, DC 20585

FEB 13 2004

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

In your letter of August 7, 2003, closing Recommendation 97-2, *Criticality Safety*, you established an annual reporting requirement. The report for Calendar Year 2003 is enclosed.

Overall, actions taken in response to Recommendation 97-2, DNFSB/TECH-29 (*Criticality Safety at Defense Nuclear Facilities)*, and your letter of July 20, 2001, have been effective and substantially improved the Department's criticality safety infrastructure and operational programs. Funding has been stabilized and the Nuclear Criticality Safety Program (NCSP) has been organized to maintain capability while addressing the most pressing operational criticality safety needs. Both the Los Alamos Critical Experiments Facility and the Oak Ridge Electron Linear Accelerator are recognized as important contributors to the NCSP and are being supported. Training and qualification programs have been established and are functioning. Pertinent criticality safety information is readily available on web sites supported by the NCSP, and feedback from the criticality safety community is being used to plan program work. Through implementation of the NCSP, a viable process for assessing needs and enhancing criticality safety has been institutionalized.

If you have any questions, please contact me directly, or have your staff contact Michael Thompson at 301-903-5648.

Sincerely,

David H. Crandall
Assistant Deputy Administrator
for Research, Development, and Simulation
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Enclosure
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STATUS OF THE DEPARTMENT OF ENERGY
NUCLEAR CRITICALITY SAFETY PROGRAM
FOR CALENDAR YEAR 2003

1. Introduction

In closing Recommendation 97-2, *Criticality Safety*, the Defense Nuclear Facilities Safety Board (DNFSB) established an annual reporting requirement and specified several specific areas of interest. In the body of the closure letter, the following was requested: "...the first annual report should include the results of a comprehensive review of the effectiveness of the actions that the Department of Energy (DOE) has taken to improve nuclear criticality safety in response to Recommendation 97-2, DNFSB/TECH-29, and the DNFSB letter of July 20, 2001, with particular attention to whether these improvements have been institutionalized within the Nuclear Criticality Safety Program." An enclosure to the DNFSB letter requested a status of the following:

- A copy of the Updated Nuclear Criticality Safety Program (NCSP) Five-Year Plan.
- NCSP Funding (actual and projected).
- Critical experiments status and Los Alamos National Laboratory (LANL) Technical Area (TA)-18 Relocation
- Program status.
- The status of contractor criticality safety engineer training and qualification programs.
- The status of Federal criticality safety engineer training and qualification programs.
- A summary of lessons learned from criticality safety program assessments.
- A summary of lessons learned from Criticality Safety Support Group (CSSG) reviews.
- A summary of the results of trending and analysis of reportable and non-reportable criticality safety occurrences.
- The status of open issues identified in the previous annual report.

This annual report is structured to address each of these areas in the order in which they appear in the DNFSB August 7, 2003 letter and its enclosure.

2. Effectiveness of actions DOE has taken in addressing Recommendation 97-2

The DOE began implementing DNFSB Recommendation 97-2 in January 1998 by addressing each of the 30 commitments made in the Implementation Plan and formally establishing the NCSP. The effectiveness of the DOE response to Recommendation 97-2 and a discussion of how actions have been institutionalized are presented in this section.

<u>Commitment 6.1 required the DOE to reexamine the experimental program in criticality research and provide a report.</u> This commitment was completed in March 1998, but the process established to meet

the commitment endures. Every year the list of priority experiments is re-evaluated and updated to ensure the most pressing programmatic needs are being met. New requirements are also considered as they arise. The Nuclear Data Advisory Group (NDAG) plays a key role in this process because of its unique perspective; it reviews programmatic needs for all nuclear data, differential and integral, and provides recommendations to the CSSG regarding data priorities. The CSSG recommends reprioritization of experimental needs to the NCSP Manager based on criticality safety community feedback and NDAG recommendations. Re-evaluation and prioritization of experimental needs have been institutionalized through the NCSP Five-Year Plan review and approval process, and NDAG/CSSG involvement ensures that the experimental program is responsive to the needs of the criticality safety community. During the past decade, significant progress has been made in performing the highest priority experiments and in providing quality benchmarks for those experiments to the community through the International Criticality Safety Benchmark Evaluation Project (ICSBEP) in a timely manner. Appendix F of the NCSP Five-Year Plan (attached) contains the schedule of integral experiments.

These actions effectively address the DNFSB sub-recommendation 1 of Recommendation 97-2 that the experimental program be structured to emphasize determination of bounding values for criticality of systems most important in the current programs at DOE facilities.

<u>Commitment 6.2.1 and its five sub-commitments required the DOE to perform a Criticality Safety Information Research Center (CSIRC) pilot program.</u> The five sub-commitments were completed by October 30, 1998. Letters dated February 2, 1998, and March 30, 1998, to Chairman Conway described the experiments conducted in 1968 and associated logbooks that were archived under this pilot program. A letter dated October 30, 1998, to Chairman Conway reported that data and calculations from these experiments have been published on the LANL web site (http://www.csirc.net). This pilot was effective in establishing the foundation for the CSIRC Program that is now institutionalized in the NCSP Five-Year Plan.

<u>Commitment 6.2.2 and its three sub-commitments required continuation of the CSIRC program.</u> This Program is continuing as a part of the NCSP. A February 23, 1999, letter to Chairman Conway reported completion of screening existing logbooks with original authors/experimenters. A May 26, 1999, letter to Chairman Conway provided the first CSIRC program plan to preserve primary documentation supporting criticality safety information and to make this information available for the benefit of the technical community. This information included not only experimenters logbooks, notes, drawings, photographs, and material descriptions from those sites at which critical experiments were conducted in the past, but also company reports and internal memoranda, which might be of benefit to future criticality safety engineers. The CSIRC program has proved to be very effective in preserving and archiving old experimental data. Criticality safety engineers from several sites have extracted relevant data from the CSIRC archive and used these data in preparation of more than 60 criticality safety benchmark evaluations for the ICSBEP.

Other important elements of the CSIRC Program are maintenance of the criticality safety accident report (LA-13638) and the Heritage Video Series. The latest edition of LA-13638 includes detailed analyses of 22 criticality accidents that occurred in the United States (7), the Russian Federation (13), the United Kingdom (1), and Japan (1). This document has become the definitive reference on criticality accidents and is used extensively in training. Regarding the Heritage Video Series, a number of criticality safety pioneers and experimenters have been videotaped at LANL and Oak Ridge National Laboratory as they recant the historical evolution of what have become accepted practices and in many cases regulatory norms. These video recordings have been made available in VHS and DVD formats and are being used primarily as training enrichment material. Preservation and dissemination of this information provides insights into the development of criticality safety culture as codified in the American National Standards Institute/American Nuclear Society (ANSI/ANS) 8 Series of standards. The CSIRC status and planned activities are contained in Section 7 of the NCSP Five-Year Plan (attached).

The continuing CSIRC program effectively addresses the DNFSB sub-recommendation 2 of Recommendation 97-2 that records of calculations and experiments be organized to ensure that past problems in criticality safety are not repeated and that information from past operations be accessible for similar future operations.

<u>Commitment 6.3 and its two sub-commitments required the DOE to continue and expand work on the Oak Ridge National Laboratory sensitivity methods development.</u> An October 30, 1998 letter to Chairman Conway provided the first program plan for the Applicable Ranges of Bounding Curves and Data (AROBCAD) Project and a May 26, 1999 letter provided details of the initiation of the AROBCAD program plan. The AROBCAD development effort is managed as part of the NCSP. The first formal issuance of AROBCAD production-software is scheduled for early calendar year 2004 with subsequent issuance of stand-alone software and usage guidance reports. This software will be institutionalized as part of the Standard Computer Analyses for Licensing Evaluation family of codes, and it is anticipated that it will prove to be an extremely useful new code. AROBCAD will improve the effectiveness of operational criticality safety programs by providing consistent and mathematically justifiable capabilities to rigorously quantify the following: criticality safety evaluations; computational and experimental uncertainties impacting criticality safety evaluations; applicability of critical experiment benchmarks for validating criticality computational methods for safety evaluations; confidence in safe margins of subcriticality for safety evaluations; appropriate additional subcritical margin penalties for lack of "full-coverage" with benchmarks relative to a safety evaluation; identification of experimental needs relative to production throughput; experimental design assistance to assure relevance of experiments for safety evaluations; and determination of safely bounding subcritical parameters for criticality safety. Those capabilities will allow a rational balance among process-designs and production throughput as they relate to the degree of subcriticality quality assurance for nuclear criticality safety. More detail on AROBCAD development is contained in Section 2 of the NCSP Five-Year Plan.

The continuing AROBCAD program effectively addresses sub-recommendation 3 of Recommendation 97-2 that a program be established to interpolate and extrapolate existing calculations and data as a function of physical circumstances that may be encountered in the future, so that useful guidance and bounding curves will result.

Commitment 6.4 required the DOE to make available evaluations, calculational studies, and data by establishing searchable databases accessible through a DOE Internet web site. The NCSP has institutionalized several criticality safety-related web sites. Hyperlinks between these sites and other related sites provide ease of access to a myriad of useful information that was only available in hard copy and difficult to obtain as little as a decade ago. An August 4, 1998, letter to Chairman Conway reported establishment of the DOE criticality safety web site managed by Lawrence Livermore National Laboratory and currently located at http://ncsp.llnl.gov/. This web site is monitored by the NCSP and routinely updated. LANL also has a criticality safety web site located at http://crit-safety.lanl.gov/ncs/index.htm. An October 30, 1998, letter to Chairman Conway reported that the database of Y-12 nuclear criticality safety evaluations is located on the Los Alamos criticality safety web site. The compilation of parameter studies into a database was accomplished by the Parameter Study Work Group and made available to the user community in 1995 on discs. The Parameter Study Working Group Database became known as the Hanford Database. A February 23, 1999, letter to Chairman Conway reported that this database was available on the NCSP web site as of December 1998. Funding for updating and improving the Hanford Database was reestablished in FY 2002. Finally, the ICSBEP website located at http://icsbep.inel.gov/ is maintained by the ICSBEP Project Manager at the Idaho National Engineering and Environmental Laboratory and funded by the NCSP. Based on criticality safety community feedback, these databases provide a very effective system for information preservation and dissemination and have enhanced operational criticality safety programs.

These actions effectively address sub-recommendation 4 of Recommendation 97-2 to collect and issue experimental and theoretical data as guidance for future activities.

Commitment 6.5.1 required the DOE to revise and reissue DOE-STD-3007-93. An October 30, 1998, letter to Chairman Conway reported that DOE-STD-3007-93 CN 1, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*, was revised in September 1998. The revision included examples of criticality safety evaluations emphasizing the use of hand calculations and comparative analysis to existing data.

Commitment 6.5.2 required the DOE to issue a guide for the review of criticality safety evaluations. A November 4, 1999 letter to Chairman Conway reported that the review guide was issued as DOE-STD-1134-99, *Review Guide for Criticality Safety Evaluations*.

Commitments 6.5.1 and 6.5.2 of the DOE Implementation Plan were developed to promulgate guidance and examples to promote the use of simple, bounding methods of analysis in place of detailed computational analysis, where possible, in setting criticality limits for processes. Both sets of guidance are captured in the DOE directive system as DOE-STD-3007-93 CN 1 and DOE-STD-1134-99. In addition, the standards for training and qualifying criticality safety engineers (contractor and DOE) require a working knowledge of DOE-STD-3007-91 CN 1. The training and qualification standards also explicitly require criticality safety engineers to demonstrate competence in the use of hand calculations as well as other computational methods. Therefore, the corrective actions have been institutionalized.

Regarding the effectiveness of these measures in enhancing operational criticality safety, the DOE performed several comprehensive reviews of various criticality safety programs (e.g., in response to the Tokai-mura criticality accident) since 1999. There have been no findings or concerns in any of the DOE Office of Environment, Safety and Health (EH)-led reviews related to over-reliance upon Monte Carlo methods or related to inefficiencies induced in the system by excessive analysis. The issue is no longer a concern because of multiple remedies [e.g., criticality safety engineers have become more experienced; DOE criticality safety staff have been trained and qualified and no longer demand so many complex calculations; the fissile systems being analyzed have become somewhat simpler over time as in the case of the Office of Environmental Management (EM) closure sites.] The actions taken to address the issue have been effective.

<u>Commitment 6.6.1 required the DOE to expand the existing five-day training course at the Los Alamos Critical Experiments Facility (LACEF).</u> A November 4, 1999 letter to Chairman Conway reported that the first expanded LACEF course was held the week of August 23, 1999. An improved course was held the week of February 14, 2000, that incorporated feedback from the initial course. This new five-day course, developed to supplement the existing five-day course, continues to be offered every year. During 2000 and 2001 demand for both five-day courses was high as Federal and contractor criticality safety engineers attended these courses to satisfy formal qualification requirements. During the past two years, attendance has declined because the initial qualification surge is over. Currently, each of the five-day courses is conducted only once annually and attendance for each of these courses is approximately 6-12 individuals. This level appears to be consistent with the number of individuals entering the criticality safety field annually. In addition to the five-day courses, LANL conducts four three-day criticality safety classes per year, one of which is reserved for individuals without clearances. These classes are geared towards fissile material handlers, operations managers, and more senior managers, who require a more general understanding of criticality safety to do their jobs. Approximately 30 to 50 individuals attend these three-day courses annually. Based on feedback from the criticality safety community, the hands-on training offered at LANL is extremely effective in supplementing criticality safety training conducted at the sites.

<u>Commitment 6.6.2 and its two sub-commitments required the DOE to survey existing curricula in criticality safety and initiate a program that addresses identified needs.</u> An August 4, 1998, letter to

Chairman Conway documented the results of an assessment that included a complete criticality safety practitioner job task analysis. Existing curricula in criticality safety (e.g., LANL courses, university courses, site-specific criticality safety curricula.) were surveyed to determine whether identified needs can be met though utilization of existing training or if development of new training is required. The assessment concluded that several available programs would be appropriate for general nuclear criticality safety personnel. These include courses at the University of New Mexico, the University of Tennessee, and the LANL hands-on nuclear criticality safety training courses. It was determined that many of the needs of the criticality safety community could be met with existing curricula and that gaps in specific areas could be addressed most efficiently through the development of Nuclear Criticality Safety Engineer Training (NCSET) modules. NCSET module development is institutionalized within the NCSP Five-Year Plan and funded by the NCSP to produce one or two modules per year. The 12 NCSET modules are available through the NCSP web site (http://ncsc.llnl.gov/) and remain the most downloaded items on the web site (several hundred downloads per year). The Training Development Working Group (subcommittee of the CSSG) oversees NCSET module development and makes recommendations to the CSSG on development of other training resources based on identified needs. Given the number of downloads from the Lawrence Livermore National Laboratory criticality safety web site and positive feedback from the criticality safety community, this activity has proved to be a very effective way to augment criticality safety training curricula.

Commitment 6.6.3 and its four sub-commitments required the DOE to survey existing contractor site-specific qualification programs, issue guidance for site-specific criticality safety training and qualification programs, and obtain commitments from contractors to implement criticality safety training and qualification programs. An August 4, 1998, letter to Chairman Conway contained the results of a survey that identified elements of existing site qualification programs. The purpose of the survey was to assist in determining elements essential to an adequate training program. A November 4, 1999, letter to Chairman Conway reported that guidance was issued as DOE-STD-1135-99, *Guidance for Nuclear Criticality Safety Engineer Training and Qualification*. A February 22, 2001, letter to Chairman Conway described the completion of a page change to DOE O 420.1, *Facility Safety*, that contains a new requirement to implement a training and qualification program for criticality safety staff. A May 14, 2001, letter to Chairman Conway reported the completion of this commitment. The requirement to train and qualify contractor criticality safety engineers is institutionalized.

Commitment 6.6.4 and its two sub-commitments required the DOE to develop a training and qualification program for Federal criticality safety personnel and formally qualify Federal staff directly performing criticality safety oversight. A May 26, 1999 letter to Chairman Conway described the Training and Qualification Program (TQP) developed for federal staff. A February 22, 2001, letter to Chairman Conway reported that at least one Federal employee at each site with a criticality safety program had been qualified to the DOE qualification standard. The requirement to train and qualify DOE criticality safety staff is institutionalized. The TQP was revised and reformatted into a new DOE Technical Standard in 2003. This revised and updated Criticality Safety Functional Area Qualification

Standard (DOE-STD-1173-2003) was issued in December 2003. This standard did not change the technical substance of the qualification program but represented fundamentally a format change. It did update some ancillary expectations that will be addressed by line management as appropriate under individual professional development plans at the site level. There is no need or intent to requalify individuals based upon issuing the TQP as a DOE technical standard. Further discussion of this topic is presented below in Section 9.

DOE actions taken in response to Commitments 6.6.1 through 6.6.4 effectively address sub-recommendation 6 of Recommendation 97-2 that a course of instruction in criticality and criticality safety serve as the foundation of a program of formal qualification of criticality engineers. The continuing actions have had a profound effect on training and qualification of Federal and contractor criticality safety personnel. Promulgation of DOE-STD-1135-99 and DOE-STD-1173-2003 provided necessary standardization as well as a sound foundation upon which to build criticality safety qualification programs. Sites have developed formal, documented criticality safety training and qualification programs in accordance with these standards and criticality safety personnel are being trained and qualified. An overarching goal of Recommendation 97-2 to establishing reliance on a group of formally trained and qualified criticality safety engineers at each site is being met.

Commitment 6.7 required the DOE to assess line ownership of criticality safety for each of its sites. This commitment was met in 1999. A February 23, 1999, letter to Chairman Conway provided details on the survey results. Individual site surveys were conducted to assess line ownership of criticality safety at Savannah River, Rocky Flats, Idaho, Chicago, Oak Ridge, and Richland. A letter dated May 26, 1999, to Chairman Conway reported that the Lawrence Livermore National Laboratory conducted a survey in conjunction with implementing Integrated Safety Management at Building 332 and that DOE Albuquerque staff completed surveys of line ownership of criticality safety at LANL, Sandia, and Pantex.

Line management ownership of criticality safety is demonstrated at several sites, in part, by their use of the criticality safety officer (CSO) function. These specially trained CSOs report directly to line supervision. They serve as the line's liaison with the nuclear criticality safety staff and usually perform such key functions as training operators on nuclear criticality safety limits, drafting criticality safety postings, attending pre-job briefings, performing criticality safety audits of operations, and responding to criticality safety deficiencies and infractions. The CSO function is implemented at Rocky Flats, LANL, Hanford, and Y-12.

The actions taken under Commitment 6.7 of the Implementation Plan effectively address sub-recommendation 7 of Recommendation 97-2 that criticality safety be assigned a staff function assisting line management, with safety responsibility residing in line management.

Commitment 6.8 required the DOE to form a group of criticality safety experts. A February 2, 1998, letter to Chairman Conway provided the charter of the CSSG. The charter is reviewed periodically and updated as necessary. The CSSG is formally institutionalized within the DOE NCSP and consists of persons from DOE and contractor organizations having collective knowledge in a broad spectrum of criticality safety areas. It is functioning in accordance with its charter and actively supporting the NCSP Manager's continued implementation of the NCSP. Recently, at the request of the NCSP Manager, CSSG members began identifying young potential candidates for service on the CSSG in the future as current members retire. These individuals will begin shadowing their CSSG mentors and participating in all CSSG activities to gain experience prior to formal selection as members of the CSSG. The CSSG has been very effective in advising the NCSP Manager on NCSP implementation and in lending its expertise to address operational criticality safety issues upon request. Better leveraging CSSG expertise to assist line management is an issue that will require resolution and therefore will be carried forward as an open issue.

The formation and ongoing work of the CSSG effectively addresses sub-recommendation 8 of Recommendation 97-2 that a core group of criticality experts experienced in the theoretical and experimental aspects of neutron chain reactions be identified to advise and assist in resolving future technical issues.

Commitment 6.9 and its two sub-commitments required the DOE to charter an NCSP Management Team (NCSPMT) and develop an NCSP plan. The NCSPMT was chartered in 1998 and managed the NCSP until 2002, when Defense Programs decided to fully fund and manage the NCSP. At that time, the NCSPMT charter and function was assumed by an NCSP Manager in Defense Programs who reports directly to the program sponsor, the National Nuclear Security Administration (NNSA) Assistant Deputy Administrator for Research, Development and Simulation (NA-11), Defense Programs. Each of the seven NCSP Program Elements (Integral Experiments, Benchmarking, Analytical Methods Development and Code Maintenance, Nuclear Data, Training and Qualification, Information Preservation and Dissemination, and Applicable Ranges of Bounding Curves and Data) is dependent upon the others for a successful program. The NCSP is being conducted according to the NCSP Five-Year Plan, which is updated annually. A copy of the current Plan, dated November 2003 is attached. The NCSP has been institutionalized through integration with the Defense Programs' Readiness in Technical Base and Facilities budget. More detail on the budget situation is contained below in Section 6.

Management of the NCSP by the NNSA and establishment of formal funding plans within the NNSA budget effectively addresses sub-recommendation 9 of Recommendation 97-2 that the funding of the program be organized to improve its stability and to recognize the crosscutting importance of this activity.

3. Effectiveness of actions DOE has taken in addressing DNFSB/TECH-29

In response to DNFSB/TECH-29, the DOE took actions to enhance operational criticality safety programs. The effectiveness of the DOE response to DNFSB/TECH-29 and a description of how actions have been institutionalized are presented in this section.

The first suggested improvement in DNFSB/TECH-29 was to improve qualification of contractor and DOE criticality safety staff. The DOE issued a comprehensive training and qualification standard for contractor nuclear criticality safety staff, DOE-STD-1135-99, *Guidance for Nuclear Criticality Safety Engineer Training and Qualification*, and implementation of a training and qualification program was required by a subsequent revision to DOE O 420.1a. In December 2003, the Criticality Safety Functional Area Qualification Standard was revised and published as DOE-STD-1173-2003, *Criticality Safety Functional Area Qualification Standard*. The utilization of these qualification standards has institutionalized formal Federal and contractor criticality safety training and qualification processes within the DOE and served as an effective way to develop and maintain a cadre of criticality safety professionals. As stated in a previous section, DOE actions taken in response to Recommendation 97-2 in this area have had a profound effect on training and qualification of Federal and contractor criticality safety personnel. Promulgation of DOE-STD-1135-99 and DOE-STD-1173-2003 provided necessary standardization as well as a sound foundation upon which to build criticality safety qualification programs. An overarching goal of Recommendation 97-2 to establishing reliance on a group of formally trained and qualified criticality safety engineers at each site is being met. Sections 8 and 9 below provide a status of criticality safety qualification programs.

The second suggested improvement in DNFSB/TECH-29 was to increase criticality safety engineer time in operating areas. A workshop to share best practices for criticality safety engineer involvement in operations was held in Albuquerque on October 23-24, 2000. Ideas were developed for increasing nuclear criticality safety staff time on the floor and provided to the contractors at the workshop to include in their nuclear criticality safety improvement. Subsequent to the workshop, Field Office Managers were tasked to review the self-improvement plans of their contractors to ensure that these plans address the issue of criticality safety engineers spending an appropriate amount of time in operating areas. The DOE expectation that criticality safety engineers will spend an appreciable amount of time in operational areas is institutionalized in DOE-STD-1158-2002, *Self-Assessment Standard for Contractor Criticality Safety Programs.*

Two follow-up reviews (Savannah River Site and the Hanford Plutonium Finishing Plant) of site criticality safety programs indicate that the workshop was effective. The CSSG has concluded that DOE actions have been effective in increasing criticality safety engineer time in operating areas.

The third suggested improvement in DNFSB/TECH-29 was to decrease the over-reliance on procedural administrative controls over time. Institutionalization of this suggested improvement is achieved through contractor adherence to the following: DOE implementation guidance for 10 CFR 830, *Nuclear Safety Management*; DOE Order 420.1, *Facility Safety;* ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*; and DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs.* These documents reiterate the preference for engineered criticality safety controls over administrative controls in new nuclear facility designs and emphasize the need to design-in these controls rather than add them in after initial design and operation has begun. Examples of the effectiveness of this guidance are as follows: 1) the Pit Disassembly and Conversion Facility and its design rely primarily on engineered controls (active and passive) rather than administrative controls for criticality safety; 2) the design for the new storage vault at Y-12 relies heavily on the extensive use of fixed neutron absorbers; and, 3) operators of existing facilities at the Savannah River Site are being encouraged to identify possible engineered controls and formally disposition them as part of the routine criticality safety evaluation process.

<u>The fourth suggested improvement in DNFSB/TECH-29 was to define the relationship between criticality safety evaluations/controls and authorization basis documents</u>**.** This suggested improvement is institutionalized in10 CFR 830, *Nuclear Safety Management*, and the associated implementation guides. The CSSG provided input to EH on the implementation guides regarding this issue. EH met with the CSSG on three occasions to resolve the remaining open issues. After meeting with the CSSG at the New Orleans American Nuclear Society meeting, there are fundamentally only a few remaining issues. In January, 2004, the Energy Facilities Contractors Group (EFCOG) Safety Analysis Group, the DOE criticality safety community, and EH met in Albuquerque to continue discussions towards resolution. A path forward for resolving most of the issues was determined. The criticality safety community and EFCOG will issue their recommendations discussed in Albuquerque, in writing to EH, who will subsequently issue clarification guidance in a technical clarification memorandum containing the mutually agreed upon resolutions discussed at the meeting. EH plans to address the issue of selection of criticality controls for inclusion in the Documented Safety Analysis (DSA) and how to bridge between the existing criticality safety evaluations and the DSA by a revision or addendum to an appropriate DOE Standard, yet to be determined. Because this issue is not resolved, it will be carried forward as an open issue.

<u>The fifth suggested improvement in DNFSB/TECH-29 was to establish a robust process for vertically tracing criticality controls.</u> This suggested improvement is institutionalized in DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*. The lines of inquiry in this standard force the user to audit vertical traceability of criticality controls from criticality safety evaluation to procedures and postings. Clarity about the bases for controls helps ensure that they are interpreted accurately and appropriately maintained.

<u>The sixth suggested improvement in DNFSB/TECH-29 was to improve DOE Field oversight of contractor criticality safety programs.</u> This suggested improvement has been institutionalized

through the implementation of Federal criticality safety engineer qualification programs and DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*. In addition, the NCSP Manager is considering ways to leverage the expertise resident in the CSSG to assist line management at the sites. One area that may require additional resources is Federal oversight of criticality safety programs at LANL, Sandia National Laboratories, and Pantex. There is currently one qualified Federal employee located at the Albuquerque Service Center who oversees these programs in addition to a significant workload of other DOE duties. This situation may require additional surge support. Such support could be derived from other sites or the CSSG to conduct assessments or review documents. This is an issue that will require close monitoring and therefore, will be carried forward as an open issue.

<u>The seventh suggested improvement in DNFSB/TECH-29 was to enhance operator training and participation in the NCSP.</u> Operators must be involved in the process used to develop procedures and controls for their operations so they "own" them and understand the bases for them. The seventh suggested improvement in DNFSB/TECH-29 is institutionalized in DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*. The lines of inquiry in this standard force the user to audit the degree to which operations managers and operators are involved in development of controls so that 1) controls and their technical bases are understood; 2) there is rigorous adherence to procedures and controls; and, 3) a process exists for feedback and improvement.

<u>The eighth suggested improvement in DNFSB/TECH-29 was to formalize rigorous contractor self-assessments.</u> DOE Policy 450.5, *Line Environment, Safety and Health Oversight*, established expectations for contractor self-assessment programs. Promulgation of guidance in DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*, institutionalized a common framework upon which to base contractor criticality safety self-assessment programs. DOE Field elements are conducting formal assessments of contractor criticality safety programs, and the contractors are conducting self-assessments. Section 10 below contains more information regarding criticality safety program assessments.

<u>The ninth suggested improvement in DNFSB/TECH-29 was to enhance surveillance and configuration management of nuclear criticality safety-related design features.</u> Revisions to DOE O 420.1A in 2002 (sections 4.5.1.2 and 4.5.1.3) institutionalized the requirement to conduct periodic surveillance and configuration management of design features that provide protection from inadvertent criticality.

<u>The tenth and final suggested improvement in DNFSB/TECH-29 was to develop a robust, consistent method for reporting criticality safety infractions.</u> Sites have some form of graded infraction reporting program. These are similar in design and have reduced over-reporting. The Criticality Safety Coordinating Team (Federal criticality safety professionals at the Field Offices) monitors reportable and non-reportable criticality safety deficiencies and shares lessons learned. The Criticality Safety Coordinating Team (CSCT) is proactively improving its capability in the area of tracking and trending.

4. Effectiveness of actions DOE has taken in addressing DNFSB letter of July 20, 2001

In response to the DNFSB letter of July 20, 2001, the DOE took several actions to institutionalize the NCSP and enhance operational criticality safety programs. The effectiveness of the DOE response to the July 20, 2001, DNFSB letter and a description of how the actions have been institutionalized are presented in this section.

The first issue raised in the DNFSB Letter of July 20, 2001, involved stability of funding for the NCSP. The NCSP funding has been stabilized. Institutionalization of the NCSP funding requirements has been accomplished by including them as a separate line in the Readiness and Technical Base and Facilities portion of the NNSA annual budget request. More detail on the budget situation is contained below in Section 6.

The second issue raised in the DNFSB Letter of July 20, 2001, involved potential relocation of the LACEF. The DOE agrees that availability of an experimental criticality test facility is an important element of the DOE criticality safety program. The LACEF is located at LANL TA-18. Every effort is being made to carefully plan the relocation of LANL TA-18 to minimize operational impacts. More detail on the LANL TA-18 Mission Relocation Program (MRP) is provided below in Section 7.

The third issue raised in the DNFSB letter of July 20, 2001, involved the adequacy of contractor criticality safety qualification plans. As reported in a letter to Chairman Conway dated August 7, 2002, DOE reviewed contractor criticality safety qualification plans. Overall, contractor implementation of criticality safety qualification plans has been effective. More discussion of this topic is provided below in Section 8.

The fourth issue raised in the DNFSB Letter of July 20, 2001, involved the status of a CSSG review of the DOE's Implementation Guides for Title 10 of the Code of Federal Regulations, Part 830, *Nuclear Safety Management*. The CSSG provided input to EH on the implementation guides. EH met with the CSSG on three occasions to resolve the remaining open issues. After meeting with the CSSG at the New Orleans American Nuclear Society meeting, there are fundamentally only a few remaining issues. In January, 2004, the EFCOG Safety Analysis Group, the DOE criticality safety community, and EH met in Albuquerque to continue discussions towards resolution. A path forward for resolving most of the issues was determined. The criticality safety community and EFCOG will issue their recommendations that were discussed in Albuquerque, in writing to EH, who will subsequently issue clarification guidance in a technical clarification memorandum containing the mutually agreed-upon resolutions discussed at the meeting. Because this issue is not resolved, it will be carried forward as an open issue.

The fifth and final issue raised in the DNFSB Letter of July 20, 2001, involved the need to retain qualified Federal criticality safety personnel at DOE Field and Site Offices. Fully trained and qualified DOE nuclear criticality personnel are in place throughout the complex to provide line oversight for contractor criticality safety programs. Section 9 below provides more information on qualified Federal employees.

5. Current NCSP Five-Year Plan

The NCSP Five-Year Plan contains details on the NCSP structure, budget and scheduled activities. A copy of the latest version of the plan, dated November 2003, is attached.

6. NCSP funding

NCSP funding has never been more stable. Table ES-1 of the NCSP Five-Year Plan (attached) contains the planned funding levels for Fiscal Year (FY) 2004 through 2008. This level of funding is adequate for maintaining capability in all areas and addressing identified requirements. The NNSA commitment of $9.8 million in FY 2004 is firm, and all funds have been distributed according to the Work Authorization Statement text contained in Appendix B of the NCSP Five-Year Plan. The FY 2005 funding ($10.626 million) identified in Table ES-1 of the Five-Year Plan is in the President's FY 2005 budget request that will be submitted to Congress in February 2004.

Defense Programs is committed to continuing to provide adequate support for the NCSP. In the FY 2005 budget submission, NCSP funding was moved from the “Special Projects” category of the Readiness in Technical Base and Facilities Program budget to the “Program Readiness” category. This adjustment was made to reflect the broad technical support the NCSP provides to operations with special nuclear material throughout the DOE complex.

7. Critical experiments status and Los Alamos Technical Area 18 Relocation Program status

The critical experiments program at Los Alamos is making steady progress. By the end of Calendar Year 2003 all five critical assemblies were operational. Six critical experiments were completed and four benchmarks were published in the *International Handbook of Evaluated Criticality Safety Benchmark Experiments.* In FY 2004, plans include 10 experiments and publication of 6 benchmarks. More detailed information on the critical experiments program is contained in Section 6 and Appendix F of the NCSP Five-Year Plan.

As for the LANL TA-18 MRP, the conceptual design phase was completed during Calendar Year 2003 for moving the missions to the Device Assembly Facility (DAF) at the Nevada Test Site. The Critical Decision (CD)-1 package (Approve Preliminary Baseline) was delivered to Defense Programs on January 20, 2004. Preliminary Design is expected to begin in the spring of 2004. The DNFSB staff was provided with copies of the CD-1 package and is participating in design reviews. The TA-18 MRP Program Manager, Ms. Tracey Bishop (NA-117), is the Defense Programs point of contact for DNFSB interface for this activity.

Regarding the relocation of the critical experiments and criticality safety-training missions, high priority is being given to reduction of impacts to operations during transition from LANL to the Nevada Test Site. A detailed transition plan was submitted as part of the CD-1 package and will be carefully reviewed and improved throughout the design process. Transition is on the critical path for the TA-18 MRP. Both the NCSP Program Sponsor (NA-11) and the NCSP Manager are committed to maximize availability of critical experiments and training capabilities throughout the relocation of these important Defense Program missions. Phased transition of critical assemblies and associated special nuclear materials, detailed operational readiness review planning, table-top DAF operations exercises, comprehensive staff planning, and planned installation of a state-of-the-art high-speed secure video/data-acquisition system at the DAF with a link to LANL are examples of steps being taken to reduce transition time and risk and enhance operational safety and efficiency.

8. Status of contractor criticality safety engineer training and qualification programs

The DOE issued a comprehensive training and qualification standard for contractor nuclear criticality safety staff, DOE-STD-1135-99, *Guidance for Nuclear Criticality Safety Engineer Training and Qualification*, and implementation of a training and qualification program was required by a subsequent revision to DOE O 420.1a. Each site with criticality safety concerns has implemented a contractor criticality safety engineer training and qualification program that meets the intent of DOE-STD-1135-99.

Furthermore, most of the contractor criticality safety training and qualification programs were independently reviewed by EH. The EH review of contractor qualification programs at Savannah River, British Nuclear Fuels Limited Oak Ridge, Bechtel-Jacobs Oak Ridge, Hanford (Fluor, Bechtel, Pacific Northwest National Laboratory), BWXT Idaho, Argonne National Laboratory, Lawrence Livermore National Laboratory, BWXT Y-12, and Pantex concluded that their programs comply with the intent of DOE-STD-1135-99, with varying degrees of specificity. EH arranged for several presentations to be made on best practices in training and qualifying contractor criticality safety engineers at the November 2002 NCSP meeting held in conjunction with the Winter Meeting of the American Nuclear Society meeting. The purpose of these presentations was to foster more consistency and encourage implementation of best practices. The sites making presentations were Lawrence Livermore National Laboratory, Y-12 and the East Tennessee Technology Park (ETTP), Bechtel Jacobs Corporation (BJC).

Subsequently, qualified DOE Field personnel have reviewed criticality safety qualification plans for Rocky Flats, Pantex, Sandia National Laboratories, and LANL and judged their plans to be adequate as well.

The overarching goal of this effort to establish reliance for criticality safety at each site on a group of formally trained and qualified criticality safety engineers has been met and institutionalized.

One element of the qualification program has been particularly effective. It is essential that criticality safety engineers gain familiarity with operations they are analyzing prior to performing independent criticality safety evaluations. The qualification programs require that criticality safety engineers spend a specified amount of time in a facility, gaining familiarity with equipment, procedures, the facility itself, and operations as a prerequisite for performing independent evaluations. Reviews of the implementation of site programs show that only criticality safety engineers with familiarity with the facilities and operations are producing evaluations.

The numbers of qualified criticality safety engineers, the number of those in training, and open criticality safety positions for the site/contractors are shown below.

Argonne National Laboratory: 8 qualified and 2 in training
LLNL: 9 qualified and 1 open position to be filled.
Hanford (Fluor Hanford): 16 qualified and 1 in training
Idaho (BWXT): 8 qualified
LANL: 6 qualified
Sandia National Laboratories: 2 qualified
Pantex: 2 qualified
Rocky Flats: 3 qualified
Y-12 (BWX Technologies): 36 qualified and 3 in training (Note: There are 8 open positions to reduce reliance upon subcontractor support. A mix of recent graduates and experienced personnel will fill these positions. The current staffing level is adequate at Y-12; this effort is to adjust the mix of internal staff and subcontractors.)
ETTP (British Nuclear Fuels Limited): 5 qualified
ETTP/Portsmouth/Paducah (BJC and its major subcontractors): 24 qualified and 4 in training
Oak Ridge National Laboratory: 2 qualified and 1 in training
Savannah River (Westinghouse Safety Management Solutions): 27 qualified, 2 in training, and 1 open position expected to be filled in January.

DOE criticality safety staff who are in the field supporting line management monitor their contractors' staffing levels and budget requests. If they discover shortfalls, they appropriately advise DOE line management at the field/site office level.

9. Status of Federal criticality safety engineer training and qualification programs

The DOE has made tremendous strides in improving its criticality safety expertise in recent years. This has been accomplished by hiring additional, experienced criticality safety professionals and by ensuring that all DOE staff overseeing criticality safety are formally trained and qualified.

DOE has hired criticality safety staff with significant criticality safety experience as practitioners to improve its criticality safety expertise. Individuals with more than a decade of experience practicing criticality safety have been added to DOE's staff at EH, Rocky Flats, Idaho, Richland, and Oak Ridge over the past several years. In some cases, the individuals have several decades of criticality safety experience and are recognized nationally as experts in the field. These individuals fill GS-14 or Excepted Service level positions, which is indicative of the DOE's commitment to hire and retain exceptionally qualified staff.

The DOE issued comprehensive training and qualification standards for DOE staff. The DOE staff expectations were developed initially as a new Technical Qualification Program (TQP). Each site/area office has a criticality safety specialist qualified according to the TQP requirements. In several instances, oral examination boards made up of experts from the CSSG were held as part of the qualification process. A May 26, 1999, letter to Chairman Conway described the TQP developed for Federal staff. A February 22, 2001, letter to Chairman Conway reported that at least one Federal employee at each site with a criticality safety program had been qualified to the DOE qualification standard. The requirement to train and qualify DOE criticality safety staff is institutionalized. The TQP was revised and reformatted into a new DOE technical standard in 2003. This revised and updated Criticality Safety Functional Area Qualification Standard (DOE-STD-1173-2003) was issued in December 2003. This standard did not change the technical substance of the qualification program but represented a fundamental format change. It did update some ancillary expectations that will be addressed by line management as appropriate under individual professional development plans at the site level. There is no need or intent to requalify individuals based upon issuing the TQP as a DOE technical standard. These qualified Federal nuclear criticality safety personnel comprise the voluntary membership of the DOE CSCT that is chartered by the NCSP Manager.

The number of qualified Federal criticality safety engineers and the number of those in training are shown below:

Livermore Site Office: 1 qualified
Richland Operations Office: 1 qualified (Note: This individual provides criticality safety support to the Office of River Protection as well.)
Idaho Operations Office: 2 qualified and 1 in training
NNSA Service Center in Albuquerque(1): 1 qualified and ¼ full-time equivalent (FTE) in training
Los Alamos Site Office(1): 0 qualified and ¼ FTE in training

Sandia Site Office(1): 0 qualified
Amarillo Site Office(1): 0 qualified
Nevada Site Office(2): 0 qualified
Y-12 Site Office: 1 qualified and 1 FTE subcontractor support
Savannah River Operations Office: 2 qualified and 2 in training
Rocky Flats Field Office: 0 qualified (Note: 1 qualified DOE staff member is stationed at Rocky Flats but reports to EM Headquarters)
Oak Ridge Operations Office: 2 qualified
Chicago Regional Office: 1 qualified
Office of Environment, Safety and Health: 1 qualified
Office of Independent Oversight: 1 qualified

Notes:

(1) There is currently one qualified Federal employee located at the Albuquerque Service Center who provides oversight of the criticality safety programs at LANL, Sandia National Laboratories, and Pantex, in addition to a significant workload of other DOE duties. This situation may require additional surge support. Such support could be derived from other sites or the CSSG to conduct assessments or review documents. This is an issue that will require will require close monitoring and therefore will be carried forward as an open issue.

(2) Currently there is no requirement for qualified Federal staff at the Nevada Site Office. If the decision is made to relocate TA-18 to the Nevada Test Site, this situation will be re-evaluated and a determination will be made about Federal criticality safety oversight prior to the relocation.

10. Lessons learned from criticality safety program assessments

The mandatory ANSI/ANS-8 standards for criticality safety require criticality safety audits and self-assessments. In particular, every fissile material operation must be reviewed frequently, at least annually. Generally speaking, some sort of contractor self-assessment, either by operations staff or the nuclear criticality safety staff, occurs monthly in some portion of any given plant. The requirement to review every fissile material operation is usually met by performing a systematic schedule of assessments over a small portion of the facility/site monthly, with the roll-up covering all areas in a year. Most site contractors utilize criticality safety committees in addition to line operations and nuclear criticality safety staff audits/assessments. The nuclear criticality safety committees often include external expertise to advise contractor management. Finally, it is a common practice for contractors to perform biennial or triennial comprehensive criticality safety program reviews by teams comprised of some mix of internal and external expertise. Standard practice at the sites is to capture findings from all these types of self-assessments in a site-specific corrective action-tracking database that contractor management uses as tool to ensure that improvements occur.

It is important to differentiate self-assessments findings and observations from criticality safety deficiencies/infractions. The former are often programmatic or reflect deviations from expected policy or practice that do not involve specific criticality safety limits and controls. The latter explicitly arise from deviations from approved criticality safety limits, controls, and procedures as derived from criticality safety evaluations.

Site DOE criticality safety staff ensures that contractors have programs and procedures in place for performing the required self-assessments. This assurance is gained by conducting DOE line criticality safety assessments/reviews on an ongoing basis. These assessments examine program documentation, spot-checking self-assessment and corrective action-tracking reports, and frequently examining individual criticality safety evaluations and limits. DOE site criticality safety staff periodically tour fissile material facilities and operations, usually as a team with Facility Representatives. Site DOE criticality safety staff do not, in general, review every report of every audit/self-assessment performed by the contractor. DOE site line management holds its contractor management responsible for maintaining awareness of criticality safety issues and concerns based on feedback from all assessments and implementing corrective actions as needed.

If contractor self-assessments do identify criticality safety deficiencies/infractions, these are reported to contractor management and to the site DOE criticality safety staff. The site DOE criticality safety staff, collaborating with the CSCT, will then track and trend all criticality safety deficiencies/infractions.

The DOE issued a formal technical standard, DOE-STD-1158-2002, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*, as an aid to establish consistent, high-quality self-assessments. This standard was written with the intent of the entire scope being covered at a site approximately every three years. Properly implemented, such a systematic self-assessment program will maintain best practices consistent with the expectation of the mandatory standard ANSI/ANS-8.19.

Most DOE contractors have incorporated DOE-STD-1158-2002 in some fashion as part of their ongoing self-assessment program. Some use it as part of their criticality safety committee protocol, some use it as part of their monthly self-assessment programs, and others utilize it for their biennial/triennial reviews. Typically, when site DOE offices conduct assessments of their contractor's criticality safety programs, the lines of inquiry from this standard are utilized.

In addition to these ongoing systems of line management self-assessments at the DOE site and contractor management level, DOE recently baselined its criticality safety programs. In 1999-2000 the DOE required each site to perform comprehensive self-assessments to what is now the DOE-STD-1158-2002 criteria. These self-assessments were forwarded to EH and independently reviewed by

EH, who was chartered with the mission of following up on sites pending the results of the review. EH began this task in 2000 with a follow-up review at the ETTP. In addition, EH was tasked by the Deputy Secretary with conducting an independent review of five major sites and reported the results to the Secretary in 2000. To date, every site, except BJC operations at ETTP, has been shown to meet the expectations of ANSI/ANS-8.19 through assessments to criteria now embodied in DOE-STD-1158-2002. The DOE Oak Ridge Site Office is conducting a comprehensive review of the BJC program at ETTP in January 2004. If this review shows the BJC program is adequate, then every site with potential criticality hazards will have been reviewed and shown to meet the requirements of DOE-STD-1158-2002 and ANSI/ANS-8.19 which forms the basis for the DOE self-assessment standard.

Finally, four major DOE site self-assessments were conducted during Calendar Year 2003. These are listed below along with summarized results.

- January 2003: Review of British Nuclear Fuels Limited (BNFL) ETTP Criticality Safety Program by the Oak Ridge Operations Office.

  Results: The BNFL criticality safety program met the intent of the required ANSI/ANS standards and was adequate to support planned decontamination and decommissioning operations at ETTP. There were no significant findings.

- January 2003: Review of the LANL Criticality Safety Program by NNSA Service Center.

  Results: The LANL training and qualification program still needed approval; a program to track criticality safety findings/deficiencies was needed; and additional work was needed to track non-reportable deficiencies. The LANL nuclear criticality safety committee is functioning. The contractor is using the equivalent of DOE-STD-1158-2002 as its self-assessment criteria in the form of the ANSI/ANS-8.19 criteria directly.

- August 2003: Review of the Fluor Hanford Portable Non-Destructive Assay (NDA) Program Supporting decontamination and decommissioning by the Richland Operations Office.

  Results: Additional management attention is needed in the near term to establish a properly staffed, qualified, and accurate NDA program with the capabilities of supporting accelerated decontamination and decommissioning. The contractor has developed a corrective action plan. The Richland Operations Office is tracking the plan.

- October 2003: Review of the Fluor Hanford Plutonium Finishing Plant (PFP) Criticality Safety Program by the EM Headquarters (EM-5).

Results: The review of the Fluor Hanford PFP revealed no significant findings against the criticality safety program. The Richland Operations Office is tracking the improvement actions that Fluor Hanford committed to as a result of the review.

In summary, the DOE site offices and their contractors are performing self-assessments. No imminent criticality safety concerns were found in 2003. Self-assessment processes are in place to allow site line management to maintain criticality safety programs that meet the expectations of the ANSI/ANS-8 standards.

11. Lessons learned from CSSG reviews

The CSSG is chartered to advise management on operational criticality safety, provide the technical basis for supporting all activities within the NCSP, and review DOE orders, standards, and rules. The CSSG has performed some specific reviews at the request of DOE Program Managers [e.g., the Hanford Multi-Canister Overpack, the Paducah Criticality Accident Alarm System, Waste Isolation Pilot Project (WIPP) criticality safety limits, and the preliminary design of the Pit Disassembly and Conversion Facility] through taskings initiated by the NCSP Manager. In some cases, the feedback has been formal and written (e.g., Hanford Multi-Canister Overpack andWIPP criticality safety limits). In other cases, the CSSG feedback has been informal and verbal (e.g., the Pit Disassembly and Conversion Facility). In any case, aside from reports generated by the CSSG, lessons learned from their reviews have several avenues for dissemination: NCSP web site; CSCT monthly teleconferences; and discussions with the End Users Group at the bi-annual NCSP meetings held in conjunction with the American Nuclear Society meetings.

Finally, the NCSP Manager is considering establishing a process whereby the expertise resident in the CSSG is leveraged to assist site office management in assessing the state of criticality safety programs periodically at the sites. One proposal under consideration is to use a subset of CSSG members to visit a site and provide feedback directly to the site manager. This proposal will continue to be developed in conjunction with corrective actions resulting from the internal NNSA review of the Columbia Accident Investigation Board report. If the site office managers consider the proposal useful, a pilot site visit would be scheduled later in calendar year 2004. If the pilot is successful, more visits would be scheduled. In addition, a way to promulgate lessons learned during CSSG reviews would be developed. Optimizing the use of CSSG expertise to assist site office and contractor line management and developing a system for sharing lessons learned are issues that will require resolution and therefore will be carried forward as open issues.

12. Trending and analysis of reportable and non-reportable criticality safety occurrences

The DOE CSCT meets via teleconference each month to discuss new initiatives in criticality safety, major criticality safety reviews/assessments, and reportable and non-reportable criticality safety infractions/deficiencies. In 2003 the CSCT added the informal discussion of all criticality safety infractions/deficiencies to the monthly agenda in order to share lessons learned informally.

The one theme that emerged from the informal discussions of criticality safety-related events is the need for accurate NDA with well-characterized uncertainties to support decontamination and decommissioning activities within the DOE. Several sites experienced criticality safety-related issues related to decontamination and decommissioning activities throughout the year (i.e., Rocky, Hanford, Paducah, and ETTP). DOE field offices are taking action to improve the quality of NDA through appropriate corrective action plans developed by the contractors at the site level.

In late 2003, the CSCT worked to improve its ability to characterize deficiencies and infractions to better deduce lessons learned, share the information across sites more efficiently, and develop effective corrective actions. The CSCT undertook the development of a web-based database for tracking/trending reportable and non-reportable criticality safety deficiencies and infractions. The data that will be used to populate this database is already collected by the contractors as part of their requirements to comply with ANSI/ANS-8.1 and 8.19. The CSCT plans to analyze the occurrences and upload the data monthly. The database became operational in January 2004 and is accessible only by CSCT members, in order to protect the integrity of the data. The information used by the CSCT for this purpose is input into the database in the format shown below. The CSCT will track/trend deficiencies/infractions monthly using this protocol, beginning in 2004 and will work to improve the system as experience is gained in this effort.

<u>CSCT Infraction Reporting/Tracking Format</u>

Date:
Site:
Building/Facility and Contractor:
Reporting CSCT Member:
Discovered by (Contractor/DOE; Criticality Safety/Operations):
ORPS Reportable (Y/N):
Brief Description of Operation:
Brief Description of Infraction/Deficiency:
Infraction/Deficiency Category (List all that apply):

- Mass
- Volume
- Concentration
- Spacing/Interaction
- Labeling
- Unauthorized/Improper Transfer or Location

- Unauthorized/Improper Fissile Material Type/Form
- Improper/Inadequate Criticality Safety Posting
- Unauthorized/Improper Containers
- Unauthorized/Unanalyzed Operation
- Operation without Criticality Safety Posting/Limits
- Moderation/Flooding/Wetting
- Criticality Safety Alarm System Failure
- Limiting Condition for Operations Violation
- Technical Safety Requirement Violation
- Other (Describe)

Causal Factors (List all that apply):

- Less Than Adequate (LTA) Work Planning/Hazards Analysis
- LTA Pre-Job Walk-Down
- LTA Pre-Job Brief
- LTA Fissile Handling/Operational Procedures
- LTA Policies or Program Procedures
- LTA Training
- Failure to Follow Operational Procedures
- Failure to Follow Policies/Program Procedures
- Equipment Failure/Error
- Discovery of Pre-Existing Condition
- LTA Criticality Safety Evaluation
- Software Failure/Error
- Surveillance Failure
- LTA Assay of Material
- LTA Materials Control and Accountability
- Other (Describe)

13. Open issues identified in the previous annual report

Although this is the first report and no open issues have been previously identified, several unresolved issues have been identified in this report and will be carried forward as open issues. These are:

- Optimizing the use of CSSG expertise to assist site office and contractor line management and developing a system for sharing lessons learned;
- Resolution of issues surrounding the relationship between criticality safety evaluations/controls and authorization basis documents;

- Resolution of issues regarding the way criticality safety is addressed in the DOE Implementation Guides for Title 10 of the Code of Federal Regulations, Part 830, *Nuclear Safety Management*;
- The potential relocation of LACEF activities conducted at LANL TA-18; and
- Federal oversight of LANL, Sandia National Laboratories, and Pantex criticality safety programs.

14. Conclusion

Overall, actions taken in response to Recommendation 97-2, DNFSB/TECH-29, and the DNFSB letter of July 20, 2001, have been very effective and substantially improved the DOE criticality safety infrastructure and operational programs. Funding has been stabilized and the NCSP has been organized to maintain capability while addressing the most pressing operational criticality safety needs. Both the LACEF and the Oak Ridge Electron Linear Accelerator are recognized as important contributors to the NCSP and are being supported. Training and qualification programs have been established and are functioning. Pertinent criticality safety information is readily available on web sites supported by the NCSP, and feedback from the criticality safety community is being used to plan program work. Through implementation of the NCSP, a viable process for assessing needs and enhancing criticality safety has been institutionalized.

United States Department of Energy

Nuclear Criticality Safety Program

Five-Year Plan

November 2003

Nuclear Criticality Safety Program Five-Year Plan, November 2003

Reviewed: 12-06-03

Adolf Garcia
Chairman, Criticality Safety Support Group

Recommend Approval: 1/5/04

Michael Thompson, Director ~~(Acting)~~
Office of Facilities Management
And Environment, Safety and Health
Defense Programs
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LIST OF ACRONYMS

AMPX	Nuclear cross-section processing computer code
ANL	Argonne National Laboratory
ANS	American Nuclear Society
ANSI	American National Standards Institute
ARH	Atlantic Richfield Hanford
AROBCAD	Applicable Ranges of Bounding Curves and Data
BNL	Brookhaven National Laboratory
CENTRM	Discrete Ordinates Transport Computer Code
COG (1)	Lawrence Livermore National Laboratory Monte Carlo Computer Code
CSCT	Criticality Safety Coordinating Team
CSEWG	Cross Section Evaluation Working Group
CSIRC	Criticality Safety Information Resource Center
CSSG	Criticality Safety Support Group
DICE	Database for the International Criticality Safety Benchmark Evaluation Project
DOE	United States Department of Energy
EH	Office of Environment, Safety and Health
EM	Office of Environmental Management
ENDF	Evaluated Nuclear Data File
FFTF	Fast Flux Test Reactor
FTE	Full-Time Equivalent
FY	Fiscal Year
GLLSM	Generalized Linear Least Squares Method
GNASH(2)	A statistical nuclear model computer code
HCTLTR	High Core Temperature Lattice Test Reactor
HEU	Highly Enriched Uranium
ICNC	International Conference on Nuclear Criticality
ICSBEP	International Criticality Safety Benchmark Evaluation Project
INEEL	Idaho National Engineering and Environmental Laboratory
KENO(3)	Monte Carlo criticality computer code
LACEF	Los Alamos Critical Experiments Facility

LANL	Los Alamos National Laboratory
LEU	Low Enriched Uranium
LLNL	Lawrence Livermore National Laboratory
LWBR	Light Water Breeder Reactor
MCNP	Monte Carlo N Particle (N currently equals 3) Computer Code
MOX	Mixed Oxide Fuel
MURR	Missouri University Research Reactor
NA-11	Assistant Deputy Administrator for Research, Development and Simulation
NA-117	Office of Facilities Management and Environment, Safety and Health
NASA	National Aeronautics and Space Administration
NE	Office of Nuclear Energy, Science and Technology
NNSA	National Nuclear Security Administration
NCSET	Nuclear Criticality Safety Engineer Training
NCSP	Nuclear Criticality Safety Program
NDAG	Nuclear Data Advisory Group
OECD-NEA	Organization for Economic Cooperation and Development - Nuclear Energy Agency
ORELA	Oak Ridge Electron Linear Accelerator
ORNL	Oak Ridge National Laboratory
PCTR	Physical Constants Test Reactor
PNNL	Pacific Northwest National Laboratory
PRTR	Plutonium Recycle Test Reactor
RL	Richland Operations Office
RSICC	Radiation Safety Information Computational Center
RW	Office of Civilian Radioactive Waste Management
SAMMY[(4)]	A nuclear model computer code
S/U	Sensitivity and Uncertainty
SCALE[(5)]	Standardized Computer Analyses for Licensing Evaluation
SRS	Savannah River Site
VIM	Vastly Improved Monte Carlo Computer Code
USNRC	United States Nuclear Regulatory Commission
WINCO	Westinghouse Idaho Nuclear Company

WSMS	Westinghouse Safety Management Solutions
ZPPR	Zero Power Physics Reactor
ZPR	Zero Power Reactor

(1) COG was originally developed to solve deep penetration problems in support of underground nuclear testing. Variance reduction techniques are very important to these problems and hence the name COG was chosen as in "to cog the dice" or cheat by weighting.
(2) GNASH is a pre-equilibrium, statistical nuclear model code based on Hauser-Feshbach theory (and additional models) for the calculation of cross sections and emission spectra, primarily in the epithermal and fast neutron energy ranges.
(3) KENO is a family of Monte Carlo criticality codes whose name came from an observation of the KENO game in which small spheres, under air levitation, arbitrarily move about in a fixed geometry.
(4) SAMMY is a nuclear model code, which applies R-Matrix theory to measured data and produces resolved and un-resolved resonance parameters in Reich-Moore and other formalisms. The name SAMMY was a personal choice of the author.
(5) SCALE is a system of well-established codes and data for performing nuclear safety (criticality, shielding, burn up-radiation sources) and heat transfer analyses.

United States Department of Energy
Nuclear Criticality Safety Program Five-Year Plan

EXECUTIVE SUMMARY

The primary objective of the DOE Nuclear Criticality Safety Program (NCSP) is to maintain fundamental infrastructure that supports operational criticality safety programs. This infrastructure includes key calculative tools, differential and integral data measurement capability, training resources, and web based systems to enhance information preservation and dissemination. Another important function of the NCSP is to solicit feedback from the operational criticality safety community so that the infrastructure remains responsive to evolving needs. The objective of operational nuclear criticality safety is to ensure that fissile material is handled in such a way that it remains subcritical under both normal and credible abnormal conditions to protect workers, the public, and the environment. A robust operational criticality safety program requires knowledgeable people and technical resources. The NCSP maintains these two key elements so the Department of Energy (DOE) can continue to do work safely with fissile materials.

The NCSP is funded by the Assistant Deputy Administrator for Research Development, and Simulation (NA-11), Defense Programs, National Nuclear Security Administration (NNSA)[1]. Mr. Mike Thompson, from the Office of Facilities Management and Environment, Safety and Health (NA-117) is the NCSP Manager. He is supported by the Criticality Safety Support Group (CSSG) regarding technical matters and by the Criticality Safety Coordinating Team (CSCT), consisting of Federal Criticality Safety Practitioners at the sites, and the End Users Group (DOE Contractor Criticality Safety Representatives) regarding DOE Field criticality safety issues.

The NCSP includes the following seven technical program elements:

Applicable Ranges of Bounding Curves and Data: develop method(s) to interpolate and extrapolate from existing criticality safety data.

Analytical Methods Development and Code Maintenance: support and enhance numerical processing codes used in criticality safety analyses.

International Criticality Safety Benchmark Evaluation Project: identify, evaluate and make available benchmarked data to support validation of criticality safety analyses.

Nuclear Data: provide nuclear cross section data required for codes to accurately model fissionable systems encountered by operational criticality safety programs.

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[1] In addition to the funding provided by NA-11, the DOE Office of Science is committed to maintain the Oak Ridge Electron Linear Accelerator in an operational state to support nuclear cross section data acquisition. Also, the Office of Nuclear Energy's Idaho Office has agreed to support Mr. Adolf Garcia's activities associated with his chairmanship of the CSSG.

Integral Experiments: provide integral experimental data for the validation of the calculation methods used to support criticality safety analyses.

Information Preservation and Dissemination: collect, preserve and make readily available criticality safety information.

Training and Qualification: maintain and improve training resources and qualification standards for criticality safety practitioners.

Each of these areas is interdependent on the others and together form a complete criticality safety infrastructure. If any of these program elements is eliminated, the ability of the Department's criticality safety engineers to perform their work will be substantially diminished. In addition to the seven technical program elements, two important facilities are required for successful execution of the NCSP: the Los Alamos Critical Experiments Facility (LACEF) and the Oak Ridge Electron Linear Accelerator (ORELA). Figure ES-1 contains a flow chart that shows how the NCSP works and Figure ES-2 contains a NCSP organizational chart.

Figure ES-1 How the Nuclear Criticality Safety Program Works

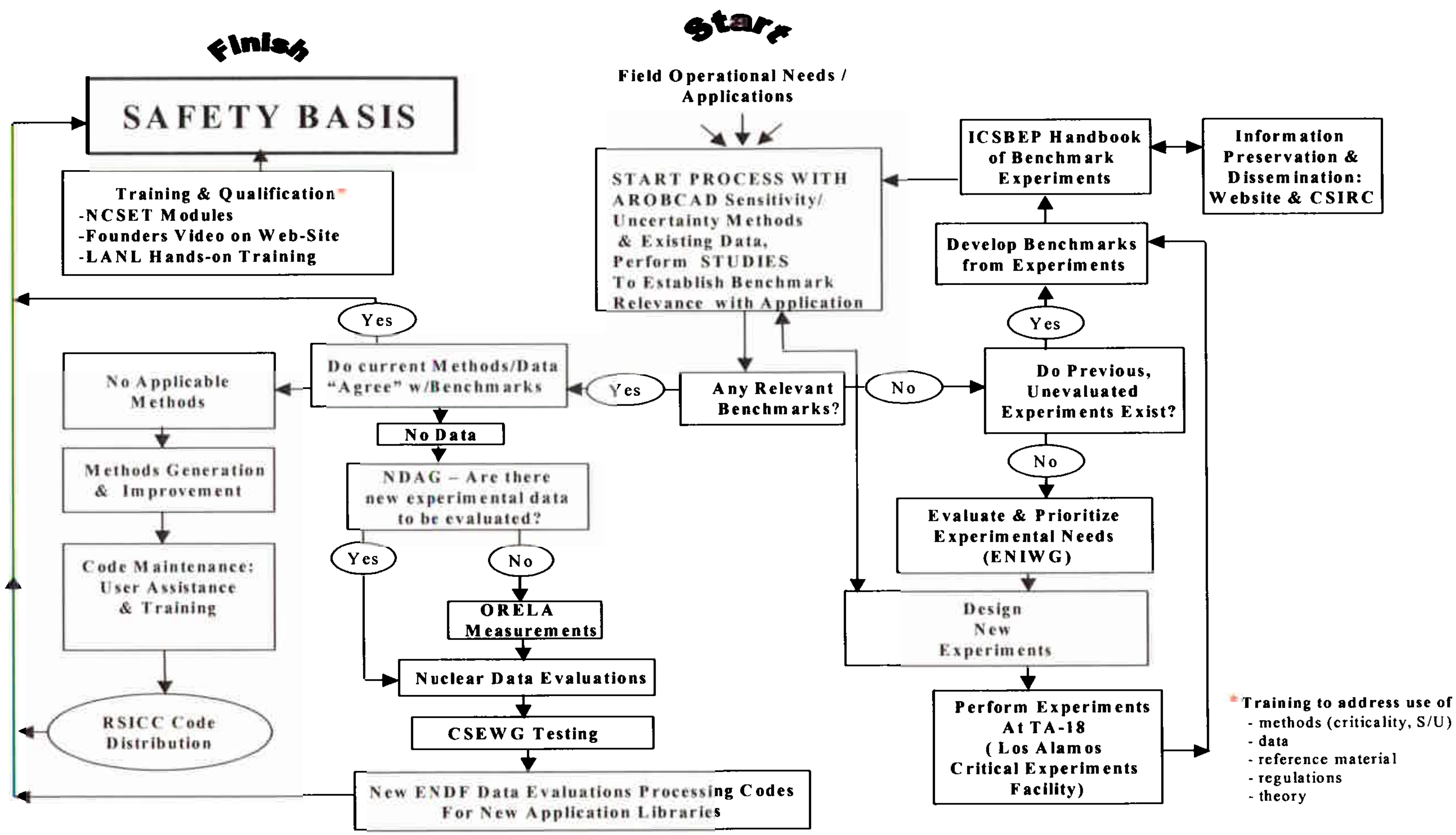
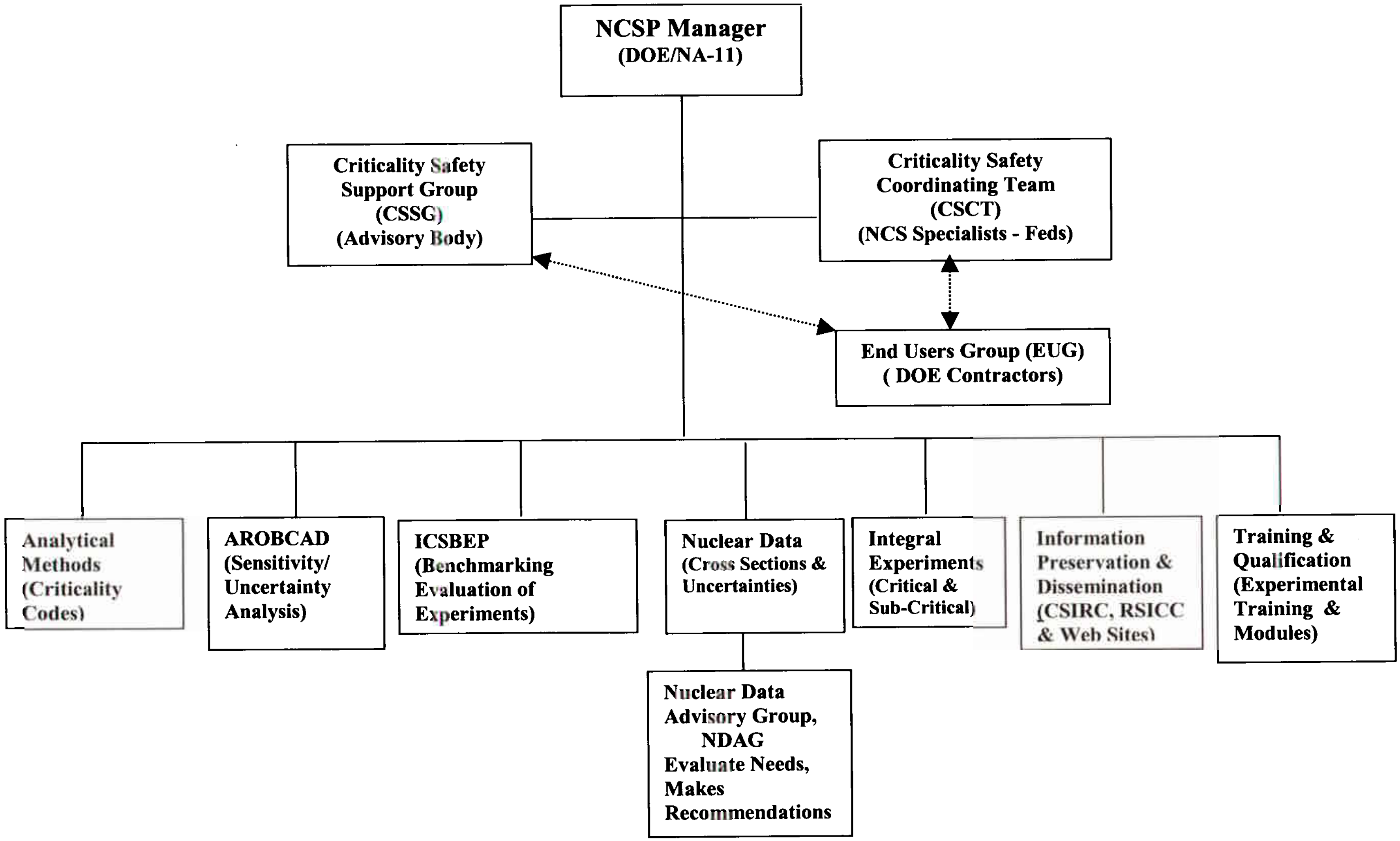


Figure 1-2: Nuclear Criticality Safety Program Organization



The infrastructure maintenance portion of the NCSP Budget is requirements based. Requirements for preservation of capability in each of the seven technical program elements are provided in this five year plan along with budget, schedule, and customers/Departmental missions supported by each of the program elements. A budget summary for the NCSP is contained in Table ES-1.

Table ES-1: Nuclear Criticality Safety Program Base Funding, Fiscal Years 2004 – 2008

	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
Applicable Ranges of Bounding Curves and Data	784	800	700	400	400
Analytical Methods Development and Code Maintenance	2,036	2,500	2,600	2,650	2,650
International Criticality Safety Benchmark Evaluation Project	1,760	1,900	2,000	2,100	2100
Nuclear Data	3,155	3,300	3,400	3,450	3,450
Integral Experiments	1,372	1,400	1,450	1,700	1,800
Information Preservation and Dissemination	263	270	270	270	270
Training and Qualification	225	230	230	230	230
Criticality Safety Support Group	205	226	200	200	300
TOTAL	9,800	10,626	10,850	11,000	11,200

The NCSP is primarily a capability maintenance program aimed at preserving a unique skill set and associated infrastructural assets for the Nation. Skills and infrastructure are preserved and maintained by doing mission related work in each of the program elements. The results of this work significantly enhances criticality safety throughout the Department. In addition to maintaining the infrastructure or "base program", NCSP resources are routinely employed to solve Departmental problems. Such program specific applications are coordinated by the NCSP Manager and costs are recovered wherever appropriate. The program specific application section of this plan contains detailed information about scheduled and proposed work.

United States Department of Energy
Nuclear Criticality Safety Program
Five-Year Plan

1. Nuclear Criticality Safety Program Purpose and Scope

The primary objective of the DOE Nuclear Criticality Safety Program (NCSP) is to maintain fundamental infrastructure that supports operational criticality safety programs. This infrastructure includes key calculative tools, differential and integral data measurement capability, training resources, and web based systems to enhance information preservation and dissemination. Another important function of the NCSP is to solicit feedback from the operational criticality safety community so that the infrastructure remains responsive to evolving needs. The objective of operational nuclear criticality safety is to ensure that fissile material is handled in such a way that it remains subcritical under both normal and credible abnormal conditions to protect workers, the public, and the environment. A robust operational criticality safety program requires knowledgeable people and technical resources. The NCSP maintains these two key elements so the Department of Energy (DOE) can continue to do work safely with fissile materials.

The NCSP is funded by the Assistant Deputy Administrator for Research Development, and Simulation (NA-11), Defense Programs, National Nuclear Security Administration (NNSA)[1]. Mr. Mike Thompson, from the Office of Facilities Management and Environment Safety and Health (NA-117) is the NCSP Manager. He is supported by the Criticality Safety Support Group (CSSG) regarding technical matters and by the Criticality Safety Coordinating Team (CSCT), consisting of Federal Criticality Safety Practitioners at the sites, and the End Users Group (DOE Contractor Criticality Safety Representatives) regarding DOE Field criticality safety issues.

The NCSP includes the following seven technical program elements:

> Applicable Ranges of Bounding Curves and Data: develop method(s) to interpolate and extrapolate from existing criticality safety data.
>
> Analytical Methods Development and Code Maintenance: support and enhance numerical processing codes used in criticality safety analyses.

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[1] In addition to the funding provided by NA-11, the DOE Office of Science is committed to maintain the Oak Ridge Electron Linear Accelerator in an operational state to support nuclear cross section data acquisition. Also, the Office of Nuclear Energy's Idaho Office has agreed to support Mr. Adolf Garcia's activities associated with his chairmanship of the CSSG.

International Criticality Safety Benchmark Evaluation Project: identify, evaluate and make available benchmarked data to support validation of criticality safety analyses.

Nuclear Data: provide nuclear cross section data required for codes to accurately model fissionable systems encountered by operational criticality safety programs.

Integral Experiments: provide integral experimental data for the validation of the calculation methods used to support criticality safety analyses.

Information Preservation and Dissemination: collect, preserve and make readily available criticality safety information.

Training and Qualification: maintain and improve training resources and qualification standards for criticality safety practitioners.

Each of these areas is interdependent on the others and together form a complete criticality safety infrastructure. If any of these program elements is eliminated, the ability of the Department's criticality safety engineers to perform their work will be substantially diminished. In addition to the seven technical program elements, two important facilities are required for successful execution of the NCSP: the Los Alamos Critical Experiments Facility (LACEF) and the Oak Ridge Electron Linear Accelerator (ORELA). Figure ES-1 contains a flow chart that shows how the NCSP works and Figure ES-2 contains a NCSP organizational chart.

The infrastructure maintenance portion of the NCSP Budget is requirements based. Requirements for preservation of capability in each of the seven technical program elements are provided in this five year plan along with budget, schedule, and customers/Departmental missions supported by each of the program elements. A budget summary for the NCSP is contained in Table ES-1.

The NCSP is primarily a capability maintenance program aimed at preserving a unique skill set and associated infrastructural assets for the Nation. Skills and infrastructure are preserved and maintained by doing mission related work in each of the program elements. The results of this work significantly enhances criticality safety throughout the Department. In addition to maintaining the infrastructure or "base program", NCSP resources are routinely employed to solve Departmental problems. Such program specific applications are coordinated by the NCSP Manager and costs are recovered wherever appropriate. The program specific application section of this plan contains detailed information about scheduled and proposed work.

2. Applicable Ranges of Bounding Curves and Data

Program Element Description

The Applicable Ranges of Bounding Curves and Data (AROBCAD) Program Element involves adapting and extending the use of optimization, sensitivity/uncertainty (S/U), and statistical methods into useable software tools; applying these tools in studies of technology issues and/or DOE programmatic applications; and then providing training and guidance in the use of these tools. The overall objective is the establishment of safe and efficient margins of sub-criticality. Planned activities are being performed through five technical subtasks and one program administration subtask. These subtasks, including interim results, which lead to the completion of the two end products (AROBCAD software and guidance), are:

1. Implementation of optimization techniques for establishing bounding values;

2. Investigation of the means to resolve or incorporate anomaly and discrepancy effects into bounding values;

3. Implementation of the use of S/U and statistical methods for identifying experimental needs (i.e., critical or near critical and cross-sections);

4. Development and publication of guidance and provision of education/training for interpolating and extrapolating bounding values;

5. Development and publication of guidance and provision of education/training for establishing bounding margins of subcriticality, and

6. Planning, administration, and reporting.

Preservation of AROBCAD Capability

This work element requires support from two to three full time equivalent (FTE) personnel at Oak Ridge National Laboratory (ORNL) to perform the five technical subtasks. Methodology resources draw heavily from resident ORNL staff expertise in criticality safety analyses, as well as sensitivity/uncertainty and statistical theories. Additionally, the optimization methodology incorporates and extends work performed by the University of California, Berkeley. The AROBCAD development effort is focused on demonstrating the AROBCAD software tools, evaluating specialized and novel problems, designing differential and integral experiments, and completing the software transition to code maintenance and training (Nuclear Criticality Safety Engineer Training (NCSET) Module) by 2008. The level of effort drops significantly with subtask completion in FY 2007 and FY 2008, and the software developed under this program element will be transitioned to the Analytical Methods program element for maintenance and user support in FY 2009.

Table 2-1: AROBCAD Budget, Fiscal Years 2004 – 2008

Subtasks	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
1) Optimization	175	160	120	90	60
2) Examine Anomalous & Discrepant Effects	110	90	70	0	90
3) Implement S/U & Statistical Methods	119	220	170	140	90
4) Develop Guidance for Bounding Value Applications	90	100	120	0	0
5) Develop Guidance for Subcritical Margins Applications	234	130	120	60	70
6) Administration	56	100	100	110	90
TOTALS	784	800	700	400	400

AROBCAD is a Key Element of the NCSP

Along with the other NCSP technical work elements, in conjunction with staff training and qualification, the products of AROBCAD provide validated methods for performing criticality safety analyses. This is a very exciting development effort because it will allow for extension of existing integral data into areas where little benchmark data exists and provide the criticality safety engineer with a method for quantifying the uncertainty of derived safety margins. In addition, AROBCAD will help illuminate discrepancies in integral and differential data so that scarce research dollars can be focused on the highest priority problems. This activity has the potential to significantly enhance operational safety and efficiency.

Customers

The customers for these activities are all DOE fissionable material operations requiring criticality safety analyses. Generally, these include all operations with more than 700 grams of fissile material, with the exception of those operations in which the aggregation of this material into a critical mass can be shown to be impossible. Additionally, under certain circumstances, criticality safety analyses are required for operations involving fissionable but not fissile material, e.g. Plutonium-238. DOE fissionable material operations are performed by the various elements of the National Nuclear Security Administration (NNSA), as well the offices of Environmental Management (EM), Civilian Radioactive Waste (RW), and Nuclear Energy, Science and Technology (NE).

A good example of the utilization of AROBCAD technology in DOE program specific applications was initiated in fiscal year 2003 for EM's Office of Environment, Safety and Health. Sensitivity/uncertainty studies will be performed for EM operations at Savannah

River Site (SRS), the Idaho National Engineering and Environmental Laboratory (INEEL), and the Richland Operations Office (RL) to demonstrate capabilities for improvements in determining safe margins of subcriticality, as well as increased efficiencies in EM operations. The three studies will be performed collaboratively with analytical specialists at the three sites. Concurrent effort will expedite the completion the new Standardized Computer Analyses for Licensing Evaluation (SCALE) System 5.0, for packaging and distribution to the nuclear criticality safety community. The combined efforts will demonstrate the AROBCAD capabilities, make them generally available for use in criticality safety evaluations, and provide the initial training to the user community. Other potential program specific applications include the NE's effort to design and evaluate the new Generation-IV reactor and associated fuel-cycle concepts.

Other programs that could benefit from the utilization of AROBCAD analytical methods include: 1) the evaluation of data uncertainties in the design of subcritical experiments; 2) the importance of data uncertainties in Uranium-238/ weapons-grade Mixed Oxide (MOX) disposition; 3) the validation of Uranium-233 applications in the intermediate energy range, and, 4) the National Aeronautics and Space Administration's (NASA) new space reactor design program.

3. Analytical Methods Development and Code Maintenance

Program Element Description:

Since 1997, the NCSP methods (codes and processed data) have been utilized in a redundant, corroborative manner, along with the technology provided by the other NCSP work elements, to perform two primary functions:

1. Establish Critical Experiment Benchmarks (MCNP and VIM software along with the International Criticality Safety Benchmark Evaluation Project (ICSBEP), Nuclear Data, and Critical Experiments).

2. Perform Criticality Safety Analyses (SCALE/KENO, MCNP, and COG software along with established ICSBEP Benchmarks, Validated Nuclear Data, and Critical Experiments and with future utilization of AROBCAD Sensitivity/Uncertainty Methods).

Currently, the work under the Analytical Methods Development and Code Maintenance NCSP Element includes seven ongoing subtasks:

1. Capability maintenance, training and user assistance and needed improvements are performed on the SCALE/KENO software by ORNL (Lead-Lester Petrie).

2. Capability maintenance, training and user assistance and needed improvements are performed on the MCNP code and related software by Los Alamos National Laboratory (LANL), with associated management support (Lead-Bob Little).

3. Capability maintenance, training and user assistance and needed improvements are performed on the VIM code and related software by Argonne National Laboratory (ANL), with associated management support (Lead-Roger Blomquist).

4. Capability maintenance, training and user assistance and needed improvements are performed on the COG code and related software by Lawrence Livermore National Laboratory (LLNL), with associated management support (Lead-Dave Heinrichs).

5. Cross Section Processing Code support is performed at ORNL, LANL, LLNL and ANL (Leads: ORNL-Maurice Greene, LANL-Bob MacFarlane, LLNL-Red Cullen and ANL-Dick McKnight).

6. The Radiation Safety Information Computational Center (RSICC, Lead-Hamilton Hunter) at ORNL performs the functions of collecting, packaging, and disseminating the software (codes and data libraries).

7. As Contractor Project Manager, Mike Westfall, assisted by Bob Little, Dick McKnight, Dave Heinrichs, and Hamilton Hunter, perform the functions of planning, administration and reporting for this NCSP work element.

Preservation of Analytical Methods Development and Code Maintenance Capability

This program element requires between 0.5 and 2 FTEs at each of the four laboratories to perform the seven ongoing subtasks and maintain capability. In the time frame of FY 2004 through FY 2006, the following major code enhancements are scheduled:

ORNL: Additional continuous-energy kinematics in the CENTRM discrete-ordinates transport code; implementation of continuous energy Monte Carlo into the SCALE system; development of three-dimensional discrete ordinates with variable irregular mesh and time and frequency-dependent transport capabilities.

LANL: Implementation of automatic fission source generation and geometry testing, ICSBEP spectral parameters, and advanced graphics into MCNP; generation of new MCNP cross section libraries based on new evaluated Nuclear Data File (ENDF)/B data; and demonstration of these new capabilities on advanced super computers.

LLNL: Implementation and testing of ENDFB/VI (Release 8) cross-section data in COG. Processing and testing of new nuclear data evaluations proposed for incorporation into ENDF/B-VII (Release 0).

ANL: Develop a graphical user interface for VIM and energy and temperature interpolation capability of the data, and perform upgraded data processing of VIM libraries.

Table 3-1: Analytical Methods Development and Code Maintenance Budget, Fiscal Years 2004 – 2008

Subtask	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
1. SCALE/KENO Support	606	750	730	720	720
2. MCNP Support	447	550	520	520	520
3. VIM Support	343	420	430	410	410
4. COG Support	40	180	270	350	350
5. Cross Section Processing Code Support	300	300	300	300	300
6. RSICC Support	240	240	280	280	280
7. Administration	60	60	70	70	70
TOTAL	2,036	2500	2,600	2,650	2,650

Analytical Methods Development and Code Maintenance is a Key Element of the NCSP

This program element is an essential part of the criticality safety infrastructure because the maintenance, user assistance, improvements, and continued support for these codes enables calculations by criticality safety professionals that are necessary to conduct criticality safety analyses that assure the safety of workers and the public.

Customers

The customers for these activities are all DOE fissionable material operations requiring criticality safety analyses. Generally, these include all operations with more than 700 grams of fissile material, with the exception of those operations in which the aggregation of this material into a critical mass can be shown to be impossible. Additionally, under certain circumstances, criticality safety analyses are required for operations involving fissionable but not fissile material, e.g. Plutonium-238. DOE fissionable material operations are performed by the various elements of NNSA, as well the offices of EM, RW, and NE.

A good example how this program element supports customers in the Field is the one cited in the previous AROBCAD section of this Plan. Analytical Methods developed and maintained as a part of this program element are complementary to AROBCAD as it is applied to the ongoing program specific application that was initiated in Fiscal Year 2003 for EM's Office of Environment, Safety and Health.

Other programs that could benefit from the utilization of Analytical Methods include: 1) the evaluation of data uncertainties in the design of subcritical experiments; 2) the importance of data uncertainties in Uranium-238/Mixed Oxide (MOX) disposition; 3) the validation of Uranium-233 applications in the intermediate energy range, and, 4) NASA's new space reactor design program.

4. International Criticality Safety Benchmark Evaluation Project

Program Element Description:

The primary focus of the International Criticality Safety Benchmark Evaluation Project (ICSBEP) is to: consolidate and preserve the information base that already exists in the United States, identify areas where more data are needed, draw upon the resources of the international criticality safety community to help fill identified needs, and identify discrepancies between calculations and experiments. This program represents a tremendous capability. It preserves a valuable national asset and provides the United States with access to the global database of experimental benchmarks to validate calculative methods that simulate the neutronic behavior of fissile systems.

Preservation of ICSBEP Capability:

The ICSBEP is a national, as well as an international effort that requires participation from several different DOE Laboratories and Facilities. Base capability is maintained by involving criticality safety experts from the INEEL, LANL, LLNL, ANL, ORNL, SRS and Hanford as well as representatives from 14 other countries. The project is managed through the INEEL and requires about 1 FTE for evaluation work at each of the above named sites. Independent reviews, participation by the Russian Federation, spectra data calculations, partial database support, project administration, graphic arts, and publication are also provided primarily by the INEEL and / or INEEL subcontractors.

The ICSBEP has one major product: the annual publication of the "International Handbook of Evaluated Criticality Safety Benchmark Experiments". This Handbook has been published annually (typically in September) since the first publication in 1995. Approximately 20 to 25 new evaluations representing 200 to 300 configurations are completed each year. The ICSBEP also collaborates with the Organization for Economic Cooperation and Development - Nuclear Energy Agency (OECD-NEA) in the production, improvement, and maintenance of a database and user interface, DICE, which enables users to more easily identify data that fills their validation needs. DICE is also updated and published annually with the Handbook.

The ICSBEP has only one intermediate product milestone: the annual Working Group Meeting. This meeting is typically held in May or June of each year. Evaluations that are scheduled for publication in September are reviewed and approved or deferred at this meeting. (Special circumstances may warrant two meetings during one fiscal year.)

ICSBEP Budget

Over the next 5 years, for the funding depicted below, the ICSBEP will continue to evaluate and compile (1) Critical Benchmark Data, (2) Criticality-Alarm/Shielding Benchmark Data, (3) Subcritical Benchmark Data, and (4) Relevant Fundamental Physics Measurements. Specific evaluations that are planned for the next 5 years by United States participants are provided in Appendix D. The content and priority of the planned evaluations may change frequently with the changing needs of the criticality safety community. Special requests will also be made of foreign participants and the United States will be expected to respond to special requests from foreign participants.

Table 4-1: ICSBEP Budget, Fiscal Years 2004 – 2008

Subtask	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
1. INEEL	760	850	875	900	900
2. Other Participants	1,000	1,050	1,125	1,200	1,200
TOTAL	1,760	1,900	2,000	2,100	2,100

The ICSBEP is a Key Part of the NCSP

The objectives of the ICSBEP are to systematically consolidate and preserve the benchmark information base that already exists in the United States and expand it by drawing upon the resources of the international criticality safety community. By meeting these objectives, a large portion of the tedious and redundant research and processing of critical experiment data is eliminated. The necessary step in criticality safety analyses of validating computer codes with benchmark critical data is greatly streamlined, and valuable criticality safety experimental data are preserved. The work of the ICSBEP highlights gaps in data, retrieves lost data, and helps to identify limiting assumptions in cross section processing and neutronics codes and deficiencies in nuclear data.

Coordination / integration with other NCSP program elements is accomplished by including NCSP Program element Leaders (or their designate) from the Analytical Methods Development and Code Maintenance, AROBCAD, Integral Experiments, and Nuclear Data Program Elements as well as criticality safety practitioners at various DOE facilities as members of the ICSBEP Working Group. Coordination / Integration also takes place through the Nuclear Data Advisory Group. Electronic coordination resources include the NCSP Web Site, maintained by LLNL and the ICSBEP Web Site (http://icsbep.inel.gov/icsbep). Both sites are linked to one another.

Customers

The ICSBEP customer base includes criticality safety practitioners at DOE National Laboratories, support facilities, and subcontractors; the United States Nuclear Regulatory Commission (USNRC); U.S. Military (Army, Air Force, and Navy); Defense Threat Reduction Agency; commercial fuel enrichment and fabrication facilities; utilities; universities, and similar agencies in 56 different countries.

The work of the ICSBEP impacts all DOE Missions involving fissile material. Cost savings in terms of time saved during required validation efforts for each fissile material operation has been estimated to exceed a million dollars annually. Savings as a result of international participation and contribution of data are of the order of several tens of millions.

5. Nuclear Data

Program Element Description:

The Nuclear Data Program Element of the NCSP includes the measurement, evaluation and testing of neutron cross-section data for nuclides of high importance to nuclear criticality safety analyses. New measurements are performed at the Oak Ridge Electron Linear Accelerator (ORELA) Facility. Evaluation and data testing are performed under the auspices of the DOE-sponsored Cross Section Evaluation Working Group (CSEWG). The low and intermediate energy (eV, keV) evaluations are performed at ORNL with the SAMMY software. The high-energy evaluations (MeV) are performed primarily at LANL with the GNASH software. Cross section processing methods are being maintained and improved and the need for data-uncertainty covariance files has been recognized.

During FY 2002 a new initiative was undertaken to coordinate nuclear data activities better and establish a strong collaborative effort among all of our national resources in this highly technical area. The objective is to solve the highest priority nuclear data problems relevant to criticality safety in a timelier manner. Accordingly, the deputy director of the National Nuclear Data Center at Brookhaven National Laboratory (BNL) is being retained as an NCSP consultant and a Nuclear Data Advisory Group (NDAG) was established. The NDAG meets twice a year and has made significant progress in addressing its three-fold mission of identifying data needs, involving the other NCSP work elements in addressing these needs, and shepherding each of the nuclear data tasks to completion.

The Nuclear Data Program Element includes three subtasks:

1. ORNL - data measurement, evaluation, testing, evaluation method development, covariance development, and CSEWG and international interactions. As Contractor Project Manager, Mike Westfall (ORNL), assisted by Luiz Leal (ORNL), Bob little (LANL) and Dick McKnight (ANL),

perform the functions of planning, administration and reporting for this NCSP Program Element. Coordinate the development of data uncertainties into covariance matrices for the performance of S/U studies on program specific applications.

2. LANL - evaluation, testing, evaluation method development, covariance development, and CSEWG and international interactions. Coordinate the development of data uncertainties into covariance matrices for the performance of S/U studies on program specific applications.

3. LLNL – nuclear data processing using PREPRO and subsequent data testing. Participate in CSEWG and IAEA/NDS activities.

4. ANL - testing, covariance development, and CSEWG and international interactions. Coordinate the development of data uncertainties into covariance matrices for the performance of S/U studies on program specific applications.

Preservation of Nuclear Data Capability

For the FY 2004 budget, staff level requirements for this work element are eight FTEs. The six ORNL positions include two experimentalists, one nuclear model code specialist and three evaluators. One FTE at LANL and one FTE at ANL are required for subtasks 2 and 3 and NDAG activities. The ORELA Material/Equipment budget includes experimental costs ($80k-electricity, $100k-target samples & special equipment) and $620 thousand to the ORNL Physics Division for ORELA administration and operation (the DOE Office of Science adds ~$250k to maintain ORELA in an operational state to support data acquisition).

In FY 2004 through FY 2006, there is a one to two FTE base program increase to bring in and mentor young technologists in anticipation of NCSP staff retirements. Two post doctoral positions have been established at ORNL to mentor nuclear modeling and data evaluation roles. A new NCSP work element is being initiated in FY 2004 to develop a stronger basis for neutron fission/capture theory. This will be a multi-Lab effort with ties into the academic community. A graduate-study-level intern position is also being developed in the area of data measurements with ORELA. In FY 2004, an effort will be initiated to establish understudy positions for the operator/engineer/technician positions on the ORELA staff. At LANL, a staff addition was made involving the lead Japanese specialist in developing covariance files. In addition, substantial progress continues in re-evaluating the high-energy reaction types (inelastic, elastic, fission, etc) in the uranium isotopes. At ANL, two retirees who are internationally recognized experts in the fields of resonance modeling and data evaluation are continuing to contribute to ANL NCSP activities. Finally, Dick McKnight continues to serve as the NDAG Chairperson.

Table 5-1: Nuclear Data Budget, Fiscal Years 2004 – 2008

Subtask	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
1. ORNL	2,648	2,800	2,840	2,860	2,860
2. LANL	272	280	320	330	330
3. ANL	235	220	240	260	260
TOTAL	3,155	3,300	3,400	3,450	3,450

Nuclear Data are a Key Part of the NCSP

This program element is absolutely essential for the NCSP because it provides the nuclear cross section data that are necessary input for the modeling codes used by all criticality safety practitioners in performing criticality safety analyses.

Customers

In addition to the performance of criticality safety evaluations utilizing improved nuclear data, the covariance files generated by this NCSP work element will be utilized in AROBCAD sensitivity/uncertainty analyses. The customers for these activities are the same as stated above in the AROBCAD and Analytical Methods Development and Code Maintenance sections of this Plan.

A good example how this program element supports customers in the Field is the one cited in the previous AROBCAD section of this Plan. Nuclear Data developed and maintained as a part of this program element are complementary to all Analytical Methods and AROBCAD as these tools are applied to the ongoing program specific application that was initiated in fiscal year 2003 for EM's Office of Environment, Safety and Health.

Other programs that could benefit from the utilization of Analytical Methods include: 1) the evaluation of data uncertainties in the design of sub critical experiments; 2) the importance of data uncertainties in Uranium-238/Mixed Oxide (MOX) disposition; 3) the validation of Uranium-233 applications in the intermediate energy range, and, 4) NASA's new space reactor design program.

6. Integral Experiments

Program Element Description

The Integral Experiments program element of the NCSP maintains a fundamental capability for the DOE/NNSA to be able to perform critical measurements, and within the limits of is resources, to address specific site needs on a prioritized basis. This program element also supports maintaining a fundamental nuclear materials handling capability by providing support for the hands-on nuclear criticality safety training programs at the Los Alamos Critical Experiments Facility (LACEF). In addition, and beyond the scope of the NCSP, infrastructure maintained by the Integral Experiments program element also supports specific program requirements in the stockpile stewardship program, emergency response and counter terrorism program, and the non-proliferation and arms control program.

Preservation of Integral Experiments Capability

Personnel, equipment, and facilities are the keys elements required to maintain this capability. The NCSP program provides funding for approximately five full-time personnel. The facilities and the nuclear material itself are the other essential elements at LACEF. LACEF is the last operational general-purpose critical experiments facility in the United States.

The philosophy of the NCSP is to maintain capability by doing meaningful work. For an experiment to meet the definition of meaningful work, it either needs to be listed in LA-UR-99-2083, or meet an emerging need. (LA-UR-99-2083 contains the results of the1998 review of LA-12683, *Forecast of Criticality Experiments and Experimental Programs Needed to Support Nuclear Operations In The United States of America: 1994 - 1999*, originally published in July, 1994). Although, the principal goal of the Integral Experiments Program Element is to maintain capability, there are specific deliverables associated with each proposed experiment. Appendix F lists the individual experiments that are planned under the NCSP Integral Experiments Program Element for fiscal years 2004 through 2008. Appendix D lists the associated ICSBEP evaluation deliverables that LANL is committing to provide.

In addition to the planned integral experiments, a collaborative effort between LANL and ORNL to perform subcritical measurements continues. These subcritical measurements will be performed at LACEF and will be evaluated and submitted to the ICSBEP. Together with existing critical measurements, these subcritical measurements will help solidify the methodology for making and evaluating these types of measurements and will provide excellent data to the criticality safety community.

Table 6-1: Integral Experiments Budget, Fiscal Years 2004 – 2008

Subtask	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
Integral Experiments	1372	1400	1450	1700	1800

Integral Experiments are a Key Part of the NCSP

Of primary importance to the NCSP is the ability to establish or estimate the calculative bias in computer codes when performing criticality safety evaluations. This is essential to effectively implement an appropriate level of conservatism in the safety controls and is one of the key requirements of American National Standards Institute (ANSI) / American Nuclear Society (ANS) Standard 8.1.

By maintaining an operating critical experiments program, DOE is in a position to respond quickly to site-specific questions as criticality safety branches into non-traditional areas such as long-term geological waste storage and remediation of legacy materials. The conduct of a credible Integral Experiments program, including the publication of scientific results and benchmarks, is essential to maintain expertise and the capability to properly address the nuclear criticality safety issues associated with the conduct of current DOE programs.

The Integral Experiments Program Element of the NCSP interfaces at some level with all of the NCSP program elements, but its primary contact is with the Criticality Safety Training and ICSBEP groups. The Nuclear Data and Analytical Methods Development and Code Maintenance groups work with the Experimental Needs Identification Working Group, which is part of the Integral Experiments program element, to establish the basic list of experimental needs and place some priority on the experiments to be performed.

Customers

The customers are the same as those listed in the AROBCAD section above, with a few exceptions. The USNRC and certain agencies within the Department of Defense have also submitted requests for experiments and criticality safety training. Also, NASA has approached LACEF with a request for critical experiments designed to evaluate the cross sections of certain exotic materials currently planned for use in space nuclear-electric propulsion systems.

7. Information Preservation and Dissemination

Program Element Description

The Information Preservation and Dissemination Program Element of the NCSP was established to preserve primary documentation supporting criticality safety and to make this information available for the benefit of the technical community. There are two major sub elements within this program element:

1. The Criticality Safety Information Resource Center (CSIRC), which is tasked with collecting and preserving documents directly related to critical experiments and criticality safety as well as generating new documents such as the revised criticality accident report and the Heritage video series; and

2. The NCSP World Wide Web Internet site, which is the central focal point for access to criticality safety information collected under the NCSP sub element, and the gateway to a comprehensive set of hyperlinks to others sites containing criticality safety information resources.

Preservation of Information Preservation and Dissemination Capability

The pace of some of CSIRC work has significant urgency. As the pioneers and original experimenters dwindle in numbers and the memories of those remaining fade, irrecoverable losses occur. Thus, the allocation of funds to support the review of logbooks by original experimenters, where practical, and the videotaping of pioneers recanting the historical evolution of what have become accepted practices and in many cases regulatory norms will be given priority. This activity requires approximately one half of a FTE per year and is centered at LANL. Specific ongoing activities include videotaping of pioneers and original experimenters and editing/distributing the resultant videotapes, indexing scanned logbooks and papers to allow for electronic searches, scanning of Zero Power Physics Reactor (ZPPR) logbooks at ANL-West, and updating various criticality safety information data bases maintained by the NCSP.

An important part of information preservation and dissemination is updating, correcting, and maintaining criticality safety handbooks. Atlantic Richfield Hanford (ARH)-600, an extensively used criticality safety handbook requires revision, correction, and reissue as an electronic handbook. Detailed activities under this task include identification of sections that need close review, correction of any inconsistencies, recalculation of graphic presentation with validated analysis codes, and presentation of information in electronic form for improved retrieval and presentation. Activities in FY 2004 will encompass structuring the task, selection of validation tools, creation of the electronic version framework and processing the most urgently needed test cases. Additional needed revision of ARH-600 will continue during the out-years at a level commensurate with available funds.

The primary goals of the NCSP Web Site are to (1) provide a forum where the information concerning the NCSP and other information of interest to the criticality safety community can be posted; (2) through hyper links to other related web sites, point to original data sources to ensure accuracy and access to the latest versions; and (3) provide training aids such as the NCSET Modules, basic reference information, and several bibliographical and topical data bases to assist newcomers to the criticality safety field. The NCSP web site utilizes the platform of a Sun Ultra 10 workstation with 10 Mb/s connection speed to Internet. The web site is equipped with security software to protect against unauthorized intrusions. The server is physically located in a room with double locked doors for access control.

Web site and data base maintenance activities require approximately one third of an FTE and are centered at LLNL. The web site has the following features:

1. Links to all major nuclear criticality safety related web sites including, DOE Orders, USNRC, ANS, Defense Nuclear Facilities Safety Board, and other national laboratories;
2. General help for new criticality safety practitioners;
3. A discussion of computational methods and links to computer code centers;

4. Two bibliographical references with literature search engine;
5. An interactive question and answer forum for the criticality safety community; and
6. Training modules to assist criticality safety engineers

From time to time, new development work is planned to enhance the web site. Specific improvements are formulated in response to the input from the users community and implemented under the direction of the CSSG and the NCSP Manager. For the next five years, the following activities are planned:

1. Enhance web site design to facilitate navigation utilizing a cascade menu design;
2. Setup Internet Mail Lists (i.e. Majordomo service) for NCSP management to send out criticality safety related announcements;
3. Procure new web server hardware and software to replace existing old hardware to prevent catastrophic failure;
4. Create online training with multi-media streaming capabilities; and
5. Provide dedicated searching capability of relevant DOE Orders and Standards related to nuclear criticality safety.

Table 7-1: Information Preservation and Dissemination Budget, Fiscal Years 2004 – 2008

Sub element	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
1. CSIRC	107(1)	90	90	90	90
2. Web Site	156	160	160	160	160
TOTAL	263	270	270	270	270

Note: (1) Includes $33k sent to ANL to complete scanning of ZPPR Logbooks.

Information Preservation and Dissemination Activities are a Key Part of the NCSP

Mining the stockpile of experimental data before it is lost is extremely important. Recreation of many of these experiments in the current regulatory environment would be cost prohibitive. The CSIRC activities have already preserved data that has been documented as part of the ICSBEP and there is no reason to think that this will not continue. At a cost of ~$300 thousand and up for a single critical experiment, it makes sense to strive to make use of all existing data.

Regarding web site activities and maintenance of associated databases, it is important that criticality safety information and data be distributed to the criticality safety community as rapidly as possible. With user-friendly tools to access and search the Internet, a central web site to coordinate information at numerous DOE criticality safety sites offers great advantage in the dissemination of criticality safety information to a wide audience. The NCSP web site is designed not to duplicate the information held at other sites, but only to present the reader with a structured set of links to those sites. This avoids duplication and maintenance of superceded versions of documents, and leads the reader, whenever possible, to the original source of the information. The web site also provides a central clearinghouse for resources beneficial to criticality safety engineers who are new comers to this field.

Customers

The customers are the same as those listed in the AROBCAD section, above.

8. Training and Qualification

Program Element Description

The Training Development and Qualification program element has two subtasks:

1. Continue to offer hands-on training courses at LANL as needed by DOE; and
2. Identify training needs and develop new resources in areas where no suitable materials exist.

The goal of this program element is to maintain the technical capabilities of criticality safety professionals and provide for the training and qualification of people entering the criticality safety discipline from related scientific fields.

Preserving Training and Qualification Capability

As experienced criticality safety practitioners leave the field, there are fewer opportunities for entry-level staff to participate in long-term mentor programs to gain first-hand knowledge of practical criticality safety. Also, the number of experimental facilities where criticality safety experts can gain first-hand knowledge about the behavior of systems at or near the critical state has been drastically reduced. Both hands-on and classroom training are essential to maintaining the level of expertise needed to function as a criticality safety engineer. The Training Development and Qualification program element of the NCSP addresses these requirements by:

1) providing hands-on training courses where students actively participate in approach-to-critical experiments and see first-hand the effects of material interactions on the reactivity of various configurations;

2) identifying training resources, promoting the development of new training materials to supplement existing curricula and working with other organizations to quickly respond to training needs as new programs apply criticality safety to areas requiring new information.

Training and Qualification Budget and Cost Recovery

The funding for hands-on training at Los Alamos represents a subsidy for a base level of courses consisting of 4 Three-Day Courses, 1 Five-Day Basic Course, and 1 Five-Day Advanced Course. Partial cost recovery is achieved through collection of tuition from each student ($600 for a three-day course and $1000 for a five-day course). Although needs are currently projected to be flat, additional courses can be added in the out-years to accommodate additional needs should they arise.

In the area of training development, Nuclear Criticality Safety Engineer Training (NCSET) modules will continue to be developed at a rate of one to two modules per year based on needs expressed by the criticality safety community. In FY 2004 the potential for development of a criticality safety simulator will be addressed, starting with an evaluation of past simulator work and development of an appropriate work scope for a new-generation criticality safety simulator.

Table 8-1: Training and Qualification Budget, Fiscal Years 2004 – 2008

Subtask	FY 2004 ($k)	FY 2005 ($k)	FY 2006 ($k)	FY 2007 ($k)	FY 2008 ($k)
1. Hands-on Training at LANL	175	180	180	180	180
2. Training Development	50	50	50	50	50
TOTAL	225	230	230	230	230

Training and Qualification Activities are a Key Part of the NCSP

The benefits to the DOE from having comprehensive criticality safety programs with well-trained staff members are significant. One benefit is an immediate increase in the efficiency of operations involving fissile materials. When doing evaluations to support the handling, storage and transportation of fissile materials, a well-trained staff will know the proper analysis techniques to use for a given situation. By learning that a thorough understanding of operations is necessary, and how to properly interface with the operations staff, criticality safety evaluations of those operations can support efficiency as well as safety. Above all, the proper training will instill the correct philosophy of criticality safety that will allow the practitioner to know what factors are important to criticality safety and how to develop the proper controls without being overly conservative to the point of restricting operations with no added safety benefits.

Customers

The products of this element are the hands-on courses offered at LANL, and the NCSET training modules that are made available on the NCSP web site. Customers for the products of the Training and Qualification element of the NCSP are all persons who manage criticality safety programs or facilities with fissile material operations and all persons whose job functions include criticality safety responsibilities, including criticality safety engineers and criticality safety officers.

9. Criticality Safety Support Group Activities

The Criticality Safety Support Group (CSSG) is comprised of recognized criticality safety experts from DOE offices and contractor organizations (see Appendix A for CSSG members). The primary function of the CSSG is to provide operational and technical expertise to the Nuclear Criticality Safety Program Manager, who has the responsibility for the implementation and execution of the coherent, efficient criticality safety program that is responsive to the criticality safety needs of DOE missions. The CSSG is also tasked to provide, to the NCSP manager, technical reviews of orders, standards, rules and guides issued by DOE related to criticality safety. In its support role, the CSSG also responds to requests from the NCSP Manager for information, reviews and evaluations of criticality safety issues throughout the complex. As a nationally recognized expert group, the CSSG has extended its role to helping DOE with technical reviews of criticality safety documents and issues. These reviews will generally be limited to high-level issues that have the potential to impact multiple DOE sites. These activities are coordinated through the NCSP manager, and are funded by the organizations requesting the reviews. Another important activity that the CSSG is pursuing is a strategy for assuring criticality safety infrastructural critical skill needs are being met. In FY 2003, the CSSG submitted two proposals to the NA-11 Critical Skills program for consideration and will continue to submit such proposals in the future. Finally, the CSSG continues to provide important input for the annual report to the Defense Nuclear Facilities Safety Board on NCSP activities and effectiveness.

10. Program Specific Applications

Integral Experiments

The weapons program at LANL uses Godiva about 10 times per year and pay as they go. This involves measuring emissions and developing radiochemistry techniques. This will probably continue this year for a total of about $200k. The weapons program also plans to fund some experiments on Comet this year. Details are classified. NASA is interested in some benchmark experiments for their proposed space reactor to power the Jupiter Icy Moons Orbiter. If this is supported, it could provide as much as $400k. The USNRC has expressed interest in conducting critical experiments with the MOX fuel rods. However, to date, no firm commitment exists.

ICSBEP

Program specific application is typically merged with the annual ICSBEP Working Group Meeting or publication schedule. When necessary, extra effort is made to advance program specific application through the independent review process and make the unofficial information available to the customer prior to formal publication. This information is subject to revision after the international review and approval process is completed. The following activities have been proposed and will be accomplished if the additional funding, delineated below, is provided:

1. A collaborative effort between LANL and LLNL has been proposed to evaluate the LLNL pulsed sphere experiments. This work is also funded by NNSA. The first evaluation is scheduled to be completed by FY 2004 and others will be completed over the next several years. Re-evaluation of these measurements will provide data that are needed for code and neutron validation.

2. ICSBEP participation of scientists from up to 5 weapons related institutes in the Russian Federation has been proposed to NNSA's office of Nuclear Non-Proliferation (NN) at a cost of $300 thousand per year. Scientists from the Russian Federation joined the ICSBEP in 1994 and are the second largest contributor; however the level of their participation has declined significantly since 1997 because of lack of funding. Inclusion of these scientists in the ICSBEP naturally supports the DOE Office of Nuclear Nonproliferation mission in that it provides meaningful safety related work for former weapons scientists from Russia and Kazakhstan. In addition, DOE receives high quality criticality safety related data and the expertise developed in the Russian Federation.

3. Continued analysis of existing data on Light Water Breeder Reactor (LWBR) Cores with ^{233}U and thorium has been proposed by INEEL. This work is important because there are significant amounts of thorium in the ^{233}U fuels stored at the INEEL, however, there are very little ^{233}U and thorium data available. Completion of this work is contingent upon EM funding.

AROBCAD

The potential exists for significant customer benefits from additional funding. The following tasks with their associated deliverables have been funded by the Office of Environmental Management (EM-5):

1. Delivery of a prototypical SCALE sequence with uncertainty analysis capability using the Generalized Linear Least Squares Method (GLLSM): Completed August 2004; $150k.
2. Training on AROBCAD tools for the SRS, the INEEL, and the Hanford criticality safety operational groups: Scheduled to be completed by June 2004; $125k.
3. Three SRS, INEEL and Hanford AROBCAD studies (guidance, training, and sample cases) to be interactively defined & developed during FY 2003 and FY 2004; $50k/study x 3 studies = $150k.

In addition to the support from EM, a NASA effort to utilize the AROBCAD tools in evaluating methods and nuclear data for establishing the criticality safety aspects of space nuclear power reactor concepts was initiated in FY 2003 at a funding level of $225k. The follow-on work in FY 2004 will involve the qualification of these tools, including the design of pertinent critical experiments. This work is being performed as a cooperative effort between NASA and DOE.

Analytical Methods Development and Code Maintenance

The potential exists for significant customer benefits from modest levels of supplemental funding. The following tasks with their associated deliverables were funded by EM-5 beginning in June, 2003:

1. Release of SCALE 5.0: Scheduled for release in January, 2004; $300 k.
2. Completion of the production version of AMPX and preparation of the AMPX/ Evaluated Nuclear Data File, ENDF/B-VI Reference Library in FY 2004. A subtask involves modifying the PUFF covariance-file software for consistency with current formats on cross-section uncertainties.($150 k).

Nuclear Data

An additional $300k from EM-5 has been provided to fund the development of covariance files for nuclides of high importance in EM fissionable material operations. This effort will be made on an incremental basis with recommendations made by the NDAG after reviewing results of special studies on EM applications. The initial effort addresses the isotopes of gadolinium.

Appendix A

Points of Contact for the Seven Technical NCSP Elements and CSSG Members

NCSP Program Element Points of Contact

AROBCAD

Contractor Project Manager:	Calvin Hopper Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, TN 37831-6370 Telephone: 865-576-8617 Facsimile: 865-576-3513 E-Mail: hoppercm@ornl.gov

Analytical Methods Development and Code Maintenance

Contractor Project Manager:	R. Michael Westfall Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, TN 37831-6370 Telephone: 865-574-5267 Facsimile: 865-574-3527 E-Mail: rwe@ornl.gov

ICSBEP

DOE-ID Program Monitor:	Adolf Garcia United States Department of Energy Idaho Operations Office Idaho Falls, ID 83401-1226 Telephone: 208-526-4420 Facsimile: 208-526-7245 E-Mail: garciaas@id.doe.gov
Contractor Project Manager:	J. Blair Briggs Idaho National Engineering & Environmental Laboratory 2525 N. Fremont P. O. Box 1625 Idaho Falls, ID 83415-3860 Telephone: 208-526-7628 Facsimile: 208-526-2930 E-Mail: bbb@inel.gov

Nuclear Data

Contractor Project Manager:

R. Michael Westfall
Oak Ridge National Laboratory
P.O. Box 2008
Oak Ridge, TN 37831-6370
Telephone: 865-574-5267
Facsimile: 865-574-3527
E-Mail: rwe@ornl.gov

Integral Experiments

Contractor Project Manager:

Charlene Cappiello
Los Alamos National Laboratory
P.O. Box 1663, MS J562
Los Alamos, New Mexico 87545
Telephone: 505-667-7724
Facsimile: 505-665-1758
E-Mail: ccappiello@lanl.gov

Information Preservation and Dissemination

Contractor Project Managers:

CSIRC
Tom McLaughlin
Los Alamos National Laboratory
P.O. Box 1663, MS F691
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Facsimile: 505-665-4970
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Lawrence Livermore National Laboratory
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7000 East Ave, Livermore, CA
94550-9234
Telephone: 925-422-6516
Facsimile: 925-423-8204
E-Mail: huang3@.llnl.gov

Training and Qualification

Contractor Project Managers:	Hands-On Training Tom McLaughlin Los Alamos National Laboratory P.O. Box 1663, MS F691 Los Alamos, NM 87545 Telephone: 505-667-7628 Facsimile: 505-665-4970 E-Mail: tpm@lanl.gov
	Training Development Jim Morman Argonne National Laboratory 9700 S. Cass Ave. Argonne, IL 60439 Telephone: 630-252-6076 Facsimile: 630-252-4500 E-Mail: jamorman@anl.gov
Federal Qualification Program Manager	Dr. Jerry McKamy U.S. Department of Energy EH-24/270CC/Rm5142 1000 Independence Ave., SW Washington, DC 20585 Telephone: 301-903-8031 Facsimile: 301-903-4120 E-Mail: jerry.mckamy@eh.doe.gov

CSSG Members

NAME	PHONE	E-MAIL ADDRESS
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Jerry McKamy	3o1-903-8031	jerry.mckamy@eh.doe.gov
Thomas P. McLaughlin	505-667-7628	tpm@lanl.gov
James A. Morman	630-252-6076	jamorman@anl.gov

Thomas A. Reilly	803-952-3562	thomas.reilly@srs.gov
Robert M. Westfall	423-574-5267	rwe@ornl.gov
Robert E. Wilson	303-966-9681	robert.wilson@rf.doe.gov
Hans Toffer	509-376-5230	hans_toffer@rl.gov
Ivon Fergus	301-903-6364	ivon.Fergus@eh.doe.gov

Appendix B

<u>Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year (FY 2004) Provided to NA-11 Budget Office in September 2003.</u>

Tasks: Nuclear Data, Analytical Methods Development and Code Maintenance, Applicable Ranges of Bounding Curves and Data, and Criticality Safety Support Group
Oak Ridge National Laboratory (ORNL): $4,360k

Funds are provided to ORNL to conduct Criticality Safety related nuclear data acquisition, evaluation, testing, and publication; to maintain Criticality Safety Codes and RSICC; and to conduct the Applicable Ranges of Bounding Curves and Data (AROBCAD) Program, in accordance with the schedule and milestones set forth in the Nuclear Criticality Safety Program Five-Year Plan, dated September 2002, or as directed by the Nuclear Criticality Safety Program Manager. Funds are also provided to ORNL for CSSG technical support to the NCSP Manager regarding planning and execution of the DOE Nuclear Criticality Safety Program (NCSP). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations. Provide quarterly reports at the end of each fiscal calendar quarter on the status of all tasks to the Nuclear Criticality Safety Program Manager.

ORNL POC: Mike Westfall (865-574-5267) and Calvin Hopper (865-576-8617)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: International Criticality Safety Benchmark Evaluation Project
Idaho National Engineering and Environmental Laboratory (INEEL): $1,760k

Funds are provided to the INEEL to conduct the International Criticality Safety Benchmark Evaluation Project (ICSBEP) as delineated in the Nuclear Criticality Safety Program Five-Year Plan, dated September 2002, or as directed by the Nuclear Criticality Safety Program Manager. Provide quarterly reports at the end of each fiscal calendar quarter on ICSBEP activities to the Nuclear Criticality Safety Program Manager.

INEEL POC: Blair Briggs (208-526-7628)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Integral Experiments, Hands-On Training, Criticality Safety Information Resource Center, Analytical Methods Development and Code Maintenance, and Nuclear Data Support
Los Alamos National Laboratory (LANL): $2,450k

Conduct nuclear criticality integral experiments, hands-on criticality safety training, Criticality Safety Information Resource Center activities, MCNP support, and Nuclear Data support as delineated in the Nuclear Criticality Safety Program Five-Year Plan, dated September 2002, or as directed by the Nuclear Criticality Safety Program Manager. Re-validate experiment priorities based on input from the criticality safety community and publish an updated Nuclear Criticality Experiments Priority list in July 2004. Provide quarterly reports at the end of each fiscal calendar quarter on the status of all tasks to the Nuclear Criticality Safety Program Manager.

LANL POC: Steve Clement (505-665-3129), Tom McLaughlin (505-667-7628), and Robert Little (505-665-3487)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Analytical Methods Development and Code Maintenance, Nuclear Data Support, Training Development, Preservation of Argonne National Laboratory (West) Zero Power Reactor critical experiments documentation, and Criticality Safety Support Group Support
Argonne National Laboratory (ANL): $810k

Funds are provided to ANL to continue VIM support and Nuclear Data support as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan, dated September 2002, or as directed by the Nuclear Criticality Safety Program Manager. Funds are also provided to continue development of Nuclear Criticality Safety Engineer Training materials and continue the criticality safety simulator scoping study; to continue preservation, in electronic form, documents describing numerous critical experiments from past programs that are useful to the criticality safety community as benchmark experiments. Electronic copies of scanned documents should be forwarded to Tom McLaughlin, Criticality Safety Information Resource Center, Los Alamos National Laboratory. Funds are also provided for Criticality Safety Support Group (CSSG) technical support to the NCSP Manager regarding planning and execution of the NCSP. With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations. Provide quarterly reports at the end of each fiscal calendar quarter on the status of all tasks to the Nuclear Criticality Safety Program Manager.

ANL POC: Richard McKnight (630-252-6088) and Jim Morman (630-252-6076)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Nuclear Criticality Safety Web Site, COG Maintenance, and Updating of the Hanford Database
Lawrence Livermore National Laboratory (LLNL): $285k

Funds are provided to LLNL to maintain the DOE Nuclear Criticality Safety Web Site; to maintain COG; and to update the Hanford Database as delineated in the Nuclear

Criticality Safety Program Five-Year Plan, dated July 2002, or as directed by the Nuclear Criticality Safety Program Manager. Provide quarterly reports at the end of each fiscal calendar quarter on the status of all tasks to the Nuclear Criticality Safety Program Manager.

Task: Criticality Safety Support Group (CSSG) support
Westinghouse Safety Management Solutions (WSMS): $25k

Funds are provided to WSMS for CSSG technical support to the NCSP Manager regarding planning and execution of the DOE Nuclear Criticality Safety Program (NCSP). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations.

WSMS POC: Tom Reilly (803-952-3562)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Criticality Safety Support Group (CSSG) support
Fluor Hanford: $25k

Funds are provided to Fluor Hanford for CSSG technical support to the NCSP Manager regarding planning and execution of the DOE Nuclear Criticality Safety Program (NCSP). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations.

Fluor Hanford POC: Hans Toffer (509-376-5230)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Criticality Safety Support Group (CSSG) support
Brookhaven National Laboratory (BNL): $85k

Funds are provided to BNL for technical consultation to the CSSG regarding all aspects of nuclear data relevant to criticality safety. Support will include shepherding new data evaluations through the Cross Section Evaluation Working Group process and subsequent publication of these data in the United States Evaluated Nuclear Data File.

BNL POC: Charles Dunford (631-344-2804)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year (FY 2004) Provided to NA-11 Budget Office in October 2003.

Tasks: Neutron Fission / Capture Theory Development
Oak Ridge National Laboratory (ORNL): $90k

Funds are provided to ORNL to support a research professor to develop nuclear theory for ORELA measurements for the Joint Institute for Heavy Ion Reactions in accordance with the schedule and milestones set forth in the Nuclear Criticality Safety Program Five-Year Plan, dated October 2003, or as directed by the Nuclear Criticality Safety Program Manager. Provide quarterly reports at the end of each fiscal calendar quarter on the status of all tasks to the Nuclear Criticality Safety Program Manager.

ORNL POC: Mike Westfall (865-574-5267)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Analytical Methods Development and Code Maintenance
Los Alamos National Laboratory (LANL): -$30k

Funds are withdrawn because the universal graphical user interface workshop has been deferred to the out-years.

LANL POC: Robert Little (505-665-3487)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Analytical Methods Development and Code Maintenance
Argonne National Laboratory (ANL): -$30k

Funds are withdrawn because the universal graphical user interface workshop has been deferred to the out-years.

ANL POC: Richard McKnight (630-252-6088)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: COG Maintenance, Updating the Hanford Database, and Universal Graphical User Interface Workshop

Lawrence Livermore National Laboratory (LLNL): -120$k

Funds are withdrawn because the universal graphical user interface workshop and COG maintenance have been deferred to the out-years. Also, funding for updating the Hanford Data Base is being sent directly to Hanford.

LLNL POC: Song Huang (925-422-6516)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Criticality Safety Support Group (CSSG) support

Westinghouse Safety Management Solutions (WSMS): $25k

Funds are provided to WSMS for CSSG technical support to the NCSP Manager regarding planning and execution of the DOE Nuclear Criticality Safety Program (NCSP). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations.

WSMS POC: Tom Reilly (803-952-3562)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Task: Updating the Hanford Database, Updating ARH-600, and Criticality Safety Support

Group (CSSG) support

Fluor Hanford: $115k

Funds are provided to Fluor Hanford for updating the Hanford Data Base and ARH-600, and providing CSSG technical support to the NCSP Manager regarding planning and execution of the DOE Nuclear Criticality Safety Program (NCSP). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other DOE and DOE Contractor organizations.

Fluor Hanford POC: Hans Toffer (509-376-5230)
DOE POC: Mike Thompson, NNSA (301-903-5648)

Appendix C

Summary of Cost Recovery Activities

This section remains a work in progress. Aside from tuition charged for students who attend the hands-on training at Los Alamos, and funded program specific applications as described in Section 10, above, there is general agreement among CSSG and NCSP Task Managers that few additional cost recovery opportunities exist. However, some areas are still being evaluated. For example, the CSSG is developing policy for setting reasonable rates for time they spend reviewing and rendering opinions on issues of interest to DOE Field customers.

For the record, Los Alamos hands-on training tuition collection (at a rate of $200/day/student) should bring in anywhere from $55,000 to $65,000 in FY 2004 depending on enrollment.

Appendix D

International Criticality Safety Benchmark Evaluation Project Planned Benchmarks

ICSBEP FIVE-YEAR PLAN	
ARGONNE NATIONAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
HEU-COMP-FAST-005	ZPPR-20 Phase C: Space Reactor Mockup with Water Immersion Simulation
HEU-COMP-FAST-006	ZPPR-20 Phase E: Space Reactor Mockup with Earth Burial Simulation
HEU-MET-FAST-070	ZPR-9 Assemblies 7, 8 and 9: HEU (93% ^{235}U) Cylindrical Cores with Tungsten, Aluminum, and Al Oxide Diluent with a Dense Aluminum Reflector
IEU-COMP-FAST-001	ZPR-6 Assembly 6A: A Large, Clean, Cylindrical UO_2 Core with Sodium Cooling Surrounded by a Depleted Uranium Reflector
IEU-MET-FAST-011	ZPR6-1 All Aluminum - 14% Enriched
IEU-MET-FAST-013	ZPR-9 Assembly 1: A Clean Cylindrical U (11% ^{235}U) Metal Fuel Core with a Dense Aluminum Reflector
FY-2005	
HEU-COMP-FAST-004	ZPR-3 Assembly 14: A Clean HEU (93% ^{235}U) Carbide Core Reflected by Depleted Uranium
IEU-MET-FAST-015	ZPR-3 Assembly 6F: A Clean Cylindrical Core with a ^{235}U-to-^{238}U Ratio of 1, Reflected by Depleted Uranium
MIX-COMP-FAST-002	ZPR-9 Assembly 29: Normal and Flooded Configurations of Mixed (Pu/U)-fueled GCFR Assembly
FY-2006	
PU-COMP-FAST-003	ZPR-9 Assembly 31: The Plutonium Carbide Benchmark Assembly Reflected by Depleted Uranium
IEU-COMP-FAST-003	ZPR-6 Assembly 5: A Large, Clean, Cylindrical Uranium Carbide Benchmark Assembly Reflected by Depleted Uranium
IEU-COMP-FAST-004	ZPR-3 Assembly 12: A Large, Clean, Cylindrical Uranium (21% ^{235}U)Carbide Bench`mark Assembly Reflected by Depleted Uranium
FY-2007	
PU-COMP-FAST-004	ZPR-3 Assembly 48: A Clean Cylindrical Pu Carbide Core, Reflected by Depleted Uranium
IEU-COMP-FAST-005	ZPR-3 Assembly 11: A Large, Clean, Cylindrical Uranium (12% ^{235}U) Carbide Benchmark Assembly Reflected by Depleted Uranium
IEU-COMP-FAST-006	ZPR-3 Assembly 25:A Large, Clean, Cylindrical Uranium (9% ^{235}U) Carbide Benchmark Assembly Reflected by Depleted Uranium
FY-2008	
	To Be Determined

ICSBEP FIVE-YEAR PLAN	
FLOUR HANFORD / PNNL	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
SUB-LEU-MET-THERM-001	Subcritical Spent Fuel for LEU Metal Tubular Fuel
FY-2005	
LEU-COMP-THERM-072	Max k_∞ for UO_3 in Water for 1.0 $^w/o$ ^{235}U Enrichment
LEU-COMP-THERM-073	Max k_∞ for UNH for 2.1 $^w/o$ ^{235}U Enrichment
SUB-LEU-MET-THERM-002	Subcritical 2.1 $^w/o$ Enriched Uranium Rods in Water Intermixed with Cd
SUB-MIX-COMP-THERM-001	Subcritical Waste Drums Measurements
FY-2006	
LEU-COMP-THERM-074	Max k_∞ for UF_4 Paraffin for 2.0 $^w/o$ ^{235}U Enrichment
SUB-LEU-MET-THERM-003	Subcritical LEU Metal Rods in Water for 3.0 w/o ^{235}U Enrichment
SUB-LEU-MET-THERM-004	Subcritical LEU Metal Tubes in Water with 1.25 $^w/o$ ^{235}U Enrichment
SUB-LEU-MET-THERM-005	Subcritical LEU Metal Tubes in Water with 0.95 w/o ^{235}U Enrichment
HEU-MET-THERM-023	Uranium, Chromium, Water Mixtures - Measurements Needed
HEU-MET-THERM-024	Uranium, Cerium, Water Mixtures - Measurements Needed
FY-2007	
PU-MET-THERM-005	PRTR Plutonium Rods in Water
LEU-MET-THERM-010	PCTR Experiments -- Graphite Moderated 2.1 w/o Enriched LEU with Li Targets
SUB-LEU-MET-THERM-006	Subcritical LEU Metal Tube-Rod in Water
MIX-COMP-THERM-017	FFTF Fuel Criticals in Water
MIX-COMP-FAST-004	FFTF Fuel Approach to Critical in Liquid Na Critical
FY-2008	
PU-COMP-THERM-003	PCTR Graphite Moderated Pu-Al Fuel Rods
PU-MET-THERM-006	PRTR Pu Rods in Water and PuO_2 / MgO
LEU-MET-THERM-011	HCTLTR Experiments
LEU-MET-THERM-012	PCTR Experiments with Graphite and LEU
HEU-COMP-THERM-020	Uranium Carbide Experiments
FY-2009	
SUB-LEU-MET-THERM-007	Subcritical 1.44 w/o Enriched LEU Tubes in Water
MIX-COMP-FAST-005	FFTF Core Demonstration Experiment
LEU-MET-THERM-013	Graphite Moderated, Air-Cooled 305 Test Pile
LEU-MET-THERM-014	PCTR U-Th Supercells in Graphite Moderator

ICSBEP FIVE-YEAR PLAN	
IDAHO NATIONAL ENGINEERING AND ENVIONMENTAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
HEU-SOL-THERM-026	Aqueous Solutions of ^{235}U Poisoned With Raschig Rings
HEU-SOL-THERM-049	Highly Enriched Uranyl Nitrate Solution Containing Soluble Cadmium
LEU-COMP-THERM-056	Critical Experiments with BORAX-V Boiling Fuel Assemblies
U233-COMP-THERM-002	LWBR $^{233}UO_2$-ThO_2 Detailed Cell Experiments -- Work For Others
MIX-SOL-THERM-007	U + Pu Nitrate Solution Containing Gadolinium
FY-2005	
HEU-COMP-THERM-019	Critical Experiments with BORAX-V Superheater Fuel Assemblies
HEU-MET-THERM-022	Advance Test Reactor – Water Moderated High Enriched Uranium Metal Serpentine Core of Plate-Type Fuel Assemblies Reflected by Beryllium
IEU-COMP-THERM-006	Critical Experiments with BORAX-V Boiling and Superheater Fuel Assemblies
U233-COMP-THERM-003	LWBR $^{233}UO_2$-ThO_2 BMU Experiments -- Work For Others
FY-2006	
PU-MET-FAST-042	Plutonium Hemishells in Oil - Part II
PU-MET-FAST-043	Plutonium Hemishells in Oil - Part III
MIX-SOL-THERM-008	U + Pu Nitrate Solution in a Raschig-ring-filled Tank
MIX-MISC-THERM-005	UO_2 + PuO_2 Fuel Pins in U + Pu Nitrate Solution Containing Boron and Gadolinium
FY-2007	
IEU-COMP-THERM-007	Power Burst Facility – Water Moderated 18.5% Enriched Uranium Ternary Oxide Fuel Pin Lattice
	Others To Be Determined
FY-2008	
LEU-COMP-THERM-071	Loss of Fluid Test Reactor – Water Moderated Array of 4% Enriched Uranium PWR Fuel Assemblies
	Others To Be Determined

ICSBEP FIVE-YEAR PLAN	
LOS ALAMOS NATIONAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
HEU-MET-INTER-011	SM1, Special Moderator HEU/Graphite
HEU-MET-FAST-063	Critical Experiments Performed using HEU Plates Reflected by LI-6D and LID
HEU-MET-FAST-072	Z005/Z006 ZEUS (HEU) Intermediate Energy Spectrum with Iron (Fe)
HEU-MET-THERM-012	P009, Planet Waste Matrix HEU/Al/Poly (2x2 array)
HEU-MET-THERM-015	P007/P008, Planet Waste Matrix HEU-Fe (2x2 array) 15-mil thick iron plates
SUB-SPEC-MET-FAST-001	SUB2, Bare and Cu-reflected Np-237 Spheres
FY-2005	
SPEC-MET-FAST-009	NP001/NP002 Neptunium/HEU Critical (natural uranium reflected)
HEU-MET-INTER-010	Z007/Z008 ZEUS (HEU) Intermediate Energy Spectrum with Aluminum (Al)
SPEC-MET-FAST-014	NP007, Neptunium/HEU Reflected with Steel
HEU-MET-THERM-017	P012, Waste Matrices HEU / Ca / Poly
HEU-MET-THERM-018	P015, Waste Matrices HEU / Concrete / Poly
MIX-MET-FAST-013	P011, Bare Pu(α) / HEU
FY-2006	
HEU-MET-INTER-012	SM2 Special Moderator HEU/D_2O
HEU-MET-INTER-009	ZEUS (HEU) Intermediate Energy Spectrum with Ni-Cr-Mo-Gd Alloy
PU-MET-FAST-038	BRP Ball Experiments Pu/Be
HEU-MET-THERM-019	PO13, Waste Matrices HEU / Zr / Poly (1x1)
SPEC-MET-FAST-010	NP003, Neptunium/HEU/Be Reflected
FY-2007	
PU-MET-INTER-003	SM4/SM6, Pu Reflected with Graphite and Beryllium
HEU-MET-INTER-013	Z013/Z014, ZEUS (HEU) Intermediate Energy Spectrum with SiO_2
HEU-MET-INTER-014	SM3, HEU Reflected by Beryllium
HEU-MET-THERM-020	P016, HEU / Concrete / Poly (2x2)
HEU-MET-THERM-021	P017/P018, HEU / Al_2O_3 / Poly (1x1 and 2x2)
SPEC-MET-FAST-011	NP004, Neptunium/HEU Reflected with Poly
FY-2008	
PU-MET-INTER-004	SM5, Pu Reflected with D_2O
MIX-MET-FAST-014	P019, Pu(δ) /HEU
SPEC-MET-FAST-012	NP006, Neptunium Reflected with Tungsten
PU-MET-THERM-002	P022, Pu / Si / Poly (2x2)
PU-MET-THERM-003	P023, Pu / Al / Poly
SPEC-MET-FAST-013	NP005, Neptunium/HEU Reflected with Beryllium
FY-2009	
PU-MET-THERM-004	P024 / P025, Pu / MnO / Poly (1x1 and 2x2)
	Others May Include the Following Existing Experiments
SPEC-MET-FAST-005	Replacement Measurements Performed with Am-241
SPEC-MET-FAST-006	Replacement Measurements Performed with Am-243

ICSBEP FIVE-YEAR PLAN	
LAWRENCE LIVERMORE NATIONAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
	FY-2004
PU-SOL-THERM-019 (Joint IRSN/LLNL)	Proserpine Experiments: Part I. Aqueous Plutonium Solutions Reflected by Beryllium Oxide and Graphite
HEU-MET-FAST-057	Lead Reflected Oy Systems (Mark Lee)
HEU-MET-FAST-059	SPADE Experiments: Part I. BeO Moderated Oy ("Clean" Configurations)
Neutron-Time-of-Flight	LLNL Pulsed Spheres: Part I. Plutonium (Luisa Hansen)
TBD	Nimbus: Part II. *Requires help with declassification of original materials.
	FY-2005
HEU-SOL-THERM-046 (Joint IRSN/LLNL)	Proserpine Experiments: Part II. Aqueous Uranium Solutions Reflected by Beryllium Oxide and Graphite
HEU-MET-FAST-059 Rev 1	SPADE Experiments: Part II. BeO Moderated Oy with Interstitial Materials
Neutron-Time-of-Flight	LLNL Pulsed Spheres: Part II. Beryllium.
	Note: If Proserpine goes well it may be possible to move some of the IEU evaluations forward.
	FY-2006
Neutron-Time-of-Flight	LLNL Pulsed Spheres: Part III. TBD
Neutron Transmission	LLNL (Bramblett & Czirr) U-235 and Pu-239 Plate Transmission Measurements
IEU-COMP-MIXED-001	U(30.14)O2 & Paraffin Wax: H/X=8, 16.3, 39.5, & 81.6 (35 Configurations)
IEU-MET-FAST-016	U(37.5) -- 0.125 Al Metal Parallelepipeds (13 Configurations)
IEU-SOL-THERM-002	British Spheres: U(30.45)O_2F_2 Aqueous Solutions Systems
IEU-SOL-THERM-003	British 8",12" and 16" Cylinders: U(30.45)O_2F_2 Aqueous Solutions Systems
	FY-2007
	To Be Determined
	FY-2008
	To Be Determined
HEU-MET-FAST-056	Graphite – Oy – D2O System (C/U: 500 – 35000)

ICSBEP FIVE-YEAR PLAN	
OAK RIDGE NATIONAL LABORATORY	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
PU-SOL-THERM-018	Cooperative Analysis of Pu-Gd Solution With WSMS, EM Work For Others Effort
HEU-MET-FAST-071	Graphite-reflected HEU Metal Cylinders - Parkey
HEU-SOL-THERM-047	HEU Uranyl Nitrate Solution in 60.92 and 107.7 cm diameter cylinders H/X=2000
U233-COMP-THERM-004	Bettis U233-Th Lattice Physics Experiments, Judd Hardy, et.al.
LEU-COMP-THERM-066	Plexiglas and Concrete-Reflected U(4.46)3O8 with H/U=0.77 and HEU drivers
LEU-MET-THERM-007	Libby Johnson U(4.89) Metal Rods in Water or Uranyl Fluoride Solution
FY-2005	
IEU-SOL-THERM-006	Cronin UF4-CF2 from 0.2 to 37.5% U-235 (ORNL-2968)
LEU-COMP-THERM-067	Cronin Sterotex U(4.89) Blocks, H/U from 0 to 37, ORNL-2986
LEU-COMP-THERM-068	Plexiglas, Concrete, and Steel-reflected U(4.46)3O8 with H/U=1.25
LEU-COMP-THERM-069	Plexiglas and Concrete-Reflected U(4.46)3O8 with H/U=2.05
U233-SOL-THERM-016	Bare and Water-Reflected Solutions of 233UO2(NO3)2 in Cylinders-Parkey
U233-SOL-THERM-009	U233 Uranyl Nitrate Solutions in 60.92 in Cylinder and 48 in. Sphere H/X=1835
SUB-HEU-MET-THERM-001	Research Reactor Fuel Assemblies (MURR fuel)
FY-2006	
IEU-MET-THERM-001	Cronin U(37.5) Metal Experiments, Recently Unclassified
LEU-MET-THERM-008	Libby Johnson U(4.89) Metal Rods, Various Interstitial Absorbers
U233-MET-INTER-001	Critical Measurements on the U233 ZPPR Plates in the LANL ZEUS Assembly
MIX-COMP-INTER-004	Cooperative Analysis of U238-MOX Experiment with LANL
SUB-HEU-SOL-THERM-002	WINCO Slab Tanks with HEU Uranyl Nitrate Solution
FY-2007	
HEU-SOL-THERM-048	HEU Uranyl Fluoride Solution (82 g U/l) in Slab Arrays (ORNL/CF-56-7-148)
LEU-MET-THERM-009	Libby Johnson U(3.85) Annular Metal Billets (7.62 cm OD)
FY-2008	
	Critical assemblies pertinent to reactor design & fuel cycle materials processing associated with the Generation-IV reactor concepts for nuclear energy generation, the advanced high temperature reactor concepts for hydrogen production and the space applications of nuclear energy. In this historical period, critical experiments pertinent to these applications were performed in Oak Ridge and elsewhere.

ICSBEP FIVE-YEAR PLAN	
SAVANNAH RIVER (WESTINGHOUSE SAFETY MANAGEMENT SOLUTIONS)	
IDENTIFIER	***DRAFT TITLE***
FY-2004	
IEU-SOL-THERM-004	Water Boiler Experiments: Be-Reflected Spheres Containing Uranyl (14.7) Sulfate Solution
MIX-COMP-FAST-003	Reflected Polystyrene Moderated, Mixed Oxide Cubes
MIX-COMP-THERM-014	Reflected Polystyrene Moderated, Mixed Oxide Cubes with Fixed Poisons (Cu, Al, Cu-Cd)
MIX-COMP-THERM-015	Reflected Polystyrene Moderated, Mixed Oxide Cubes with Fixed Poisons (SS, Borated SS, dep-U, Boral, Cd, Pb)
HEU-COMP-INTER-007	HEU/Be Space Reactor
FY-2005	
PU-MET-FAST-044	Pu Metal Sphere with Different Metal+Polyethylene Reflectors (Table IIIA2 of LA-30067-MS)
MIX-COMP-THERM-013	PuO_2-UO_2 Polystyrene Compact with Poison Plates
	TBD
FY-2006	
SUB-HEU-MET-THERM-002	Subcritical (Exponential) SRS Fuel Assemblies (Mk XVIB and Mk XIIA)[pending permission to release data]
	Others To Be Determined
FY-2007	
	To Be Determined
FY-2008	
	To Be Determined

Appendix E

Nuclear Data Schedule

Organization Key: A=ANL, B=BNL, L=LANL, N=NDAG, O=ORNL
Isotope Key: U5=U-235, U3=U233, O6=O-16, Al=Al-27, Si8=Si-28, Si9=Si-29, Si0=Si-30, Cl5=Cl-35, Cl7=Cl-37, F9= F-19, K9=K-39, K1=K-41, Gd5=Gd-155, Gd7=Gd-157, H=H, N4=N-14, Be9=Be-9, U8=U-238, Mn5=Mn-55, Pu9=Pu-239, Pu0=Pu-240, Pu1=Pu-241, Pu2=Pu-242, Re5=Re-185, Re7=Re-187, Fe, Ni, Cr, Cu, Ce, Ca, 2005 nuclides, 2006 nuclides?

Activity	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
1. NDAG Review, Data Needs and Status	Fe, Ni, Cr, Cu, Ce, Ca, Hf, Zr, Th, Nb, Er, Am, Np, N4, Be9, Re5, Re7, Nb ?	Cs, Eu, Ag, Nd, Rh, Ru Sm, Tc, Ti,Mo He, P, S, V,Hg ?	?	?	?
2. Measurement	Mn5(O)	?	?	?	?
3. Evaluation	K9,K1, Re5, Re7, Nb, (O,L,A), ?	Mn5, (O,L)	?	?	?
4.Covariance Generation	F9(O,L), K9, K1(O,L,A), B, C, Na, Mg, Ga, Pb, Re5, Re7, Nb?	Fe, Ni, Cr, Cu, Ce, Ca, Hf, Er, Th, N4,(O, L, A) ?	Am, Np, Mn5, (O, L, A) ?	?	?
5. Beta Test Libraries (RSICC)	Pu9, Pu0, Pu1, Pu2, Gd5,Gd6, Gd7,Gd8, U8, Zr (O,N)	F9, K9, K1, Re5, Re7, Nb, N4,(O, N), ?	Hf, Er, Th, Cu, Ce, Ca, Mn5, ?	?	?
6. CSEWG Testing	Cl5(B), Cl7(B), U8, Zr	F9, K9, K1, Pu9,Pu0,Pu1,Pu2, Gd5,Gd6,Gd7,Gd 8,N4,Be9, Fe, Ni, Cr, Mn5(B)	Re5,Re7,N b, Cu, Ce, Ca, (B) ?	?	?
7. ENDF/B Release	Si8, Si9 Si0, Cl5, Cl7, U8, Zr,(B)	F9, K9, K1, Mn5,Gd5, Gd6,Gd7,Gd8, Ni, Fe, Cr (B)	N4, Be9, Pu9,Pu0, Pu1,Pu2,(B),?	Cu, Ce, Ca, (B),	?

Note: NDAG Recommendations may change priorities based on programmatic needs

Appendix F

Planned Integral Experiments

Integral Experiments Planned for FY 2004 through FY 2008

FY 2004 ($k) 1350	FY 2005 ($k) 1400	FY 2006 ($k) 1450	FY 2007 ($k) 1700	FY 2008 (k$) 1800
Z007 Comet/Zeus, Al^1/HEU/Al^1	Z008 Comet/Zeus, Al^2/HEU/Al^2	Z010 Initiate ^{239}Pu intermediate energy experiment (if ^{239}Pu available) $Graphite^1$/Pu/$Graphite^1$	Z016 $SiO_2^{\ 2}$/Pu/$SiO_2^{\ 2}$	P026 HEU bare
Z006 Comet/Zeus, Fe^1/HEU/Fe^1	Z009 HEU/Gd Alloy (if Gd Alloy becomes available)	Z011 $Graphite^2$/Pu/$Graphite^2$	Z017 $SiO_2^{\ 3}$/Pu/$SiO_2^{\ 3}$	P027 HEU Reflected NU
NP002 Continue ^{237}Np critical mass experiment Np/HEU/NU reflected	Z013 $SiO_2^{\ 1}$/HEU/$SiO_2^{\ 1}$	Z012 Initiate ^{233}U intermediate energy experiment (if ^{233}U available)	Z018 Fe^1/Pu/Fe^1	P028 HEU Reflected W
NP003 Np/HEU/Be	NP004 Np/HEU/Poly	Z015 $SiO_2^{\ 1}$/Pu/$SiO_2^{\ 1}$	P022 2x2 Pu/SiO_2/Poly	Z019 Fe^2/Pu/Fe^2
NP007 Np/HEU/Steel	SM2 HEU/D_2O	Z014 $SiO_2^{\ 2}$/HEU/$SiO_2^{\ 2}$	P023 2x2 Pu/Al/Poly	Z020 Fe^3/Pu/Fe^3
SM1 HEU/Graphite	SM3 HEU/Be	P019 Pu(δ)/HEU	NP005 Np/HEU/Be	P024 1x1 Pu/MgO/Poly
P012 1x1 HEU/CaO/Poly	SM4 Pu Reflected Graphite	SM5 Pu Reflected D_2O	NP006 Np/HEU/W	P025 2x2 Pu/MgO/Poly
P013 1x1 HEU/Zr/Poly	SM6 Pu Reflected Be	P020 1x1 Pu/SiO_2/Poly		
P014 Component Benchmark	P016 2x2 Concrete/HEU/Poly	P021 1x1 Pu/Al/Poly		
P015 1x1 Concrete/HEU/Poly	P017 1x1 HEU/Al_2O_3/Poly			
SUB2 ^{237}Np Bare and Reflected by Cu and HEU	P018 2x2 HEU/Al_2O_3/Poly			

Completed
Initiated/ongoing
Experiments that will require change to AB and nuclear material not currently available at LANL.
Additional capital funding will be required.
Superscript numbers^{1,2,3} indicate first, second, and third configurations respectively. Actual configurations are unknown

Appendix G

Foreign Travel Requests

Applicable Ranges of Bounding Curves and Data

The AROBCAD Program Element will require one attendee at the annual OECD/NEA Nuclear Criticality Safety Working Group on Bounding Critical Systems meeting on an annual basis. Additionally, between two and three technical presentations from this work element (S/U software tools, S/U studies, guidance on safe margins) will be made at the ICNC conducted in FY 2004 and FY 2008, requiring attendance of 2-3 individuals. The AROBCAD Contractor Program Manager serves as the Convener of ISO TC-85, SC-5, WG-8. This is the writing group for the development of international standards for nuclear criticality safety. This NCSP work element should support his participation and leadership of the annual WG-8 meetings. The work program for these standards includes a number of NCS topics in which the NCSP could supply subject matter experts (fission yield estimates, Mixed Oxide Fuel (MOX) Processing, Criticality Accident Alarm System qualification, etc.). The NCSP should support the participation of two United States subject matter experts in the annual WG-8 meetings. This will assure the inclusion of the United States expertise in the development of these important standards.

Analytical Methods Development and Code Maintenance

The Analytical Methods Development and Code Maintenance Program Element will require four attendees at the annual OECD/NEA Nuclear Criticality Safety Working Group meetings on an annual basis. From the three Labs, this includes two United States Representatives to the Nuclear Criticality Safety Working Party and membership on the Fission-Source Convergence, Criticality Excursions Analysis, and Experimental Needs Working Groups. Additionally, between four and six technical presentations (improved neutronics software, improved cross-section processing software, methods validation) from this work element would be made at the ICNC conducted in FY 2004 and FY 2008, requiring attendance of 4-6 individuals.

International Criticality Safety Benchmark Evaluation Project

The ICSBEP is an international program involving 12 different countries and the OECD NEA. As such, annual project Working Group meetings are held outside the United States every other year. Approximately 15 participants from the United States (including Working Group Members, evaluators, independent reviewers, and administrative support) are required to travel to these meetings. ICSBEP Meetings to be held outside the United States during the next five years will occur in 2004 (Madrid, Spain), 2006, and 2008. In addition, the ICSBEP Element should support one attendee at the OECD/NEA Working Party on Nuclear Criticality Safety meeting on an annual basis where a report on ICSBEP activities is made. Additionally, between four and six technical presentations from this work element should be made at the ICNC 2003 (Tokai, Japan) and 2007 (St. Petersburg, Russia). Periodically, data are identified in nonparticipating countries and these countries are invited to contribute their data. In some cases, an information/training meeting in the new participating country is deemed appropriate. For example, China was invited to participate in 2004 and a meeting was held in Beijing. Other current nonparticipating countries who may contribute data in the future include Germany, Canada, Poland, Australia, and South Africa.

Nuclear Data

The Nuclear Data Program Element will require three attendees at the annual OECD/NEA Working Party on Evaluation and Cooperation meetings on an annual basis. This is the major activity involving international cooperation on the development and evaluation of nuclear data. Also, there is a need for two to three nuclear data presentations at the International Conferences on Nuclear Criticality in FY 2004 and FY 2008, requiring attendance of 2-3 individuals. The international forum for presentations on nuclear data is the annual series of PHYSOR reactor physics meetings. This Program Element should support the participation by two nuclear data specialists on an annual basis. Again, these are three laboratory activities.

Integral Experiments

The Integral Experiments Program Element will require about 5 foreign trips per year for the next five years. Annual requirements include 2 persons to the ICNC in FY 2004 and FY 2008; 2 persons every other year to the ICSBEP meeting; 1 person per year to a technical conference on integral experiments; and 2 persons per year to participate in International Standards Development activities.

Information Preservation and Dissemination

The Web Site portion of this Program Element projects 1 person traveling to the 7th ICNC in early FY 2004 and 1 person traveling to the 8th ICNC in FY 2008.

Training and Qualification

No projected foreign travel.