



Department of Energy

Washington, DC 20585

November 4, 1999

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:

The Implementation Plan (IP) for Defense Nuclear Facilities Safety Board Recommendation 97-2 requires a quarterly status report. Enclosed is the Department of Energy's quarterly status report for the fourth quarter, Fiscal Year 1999.

The Department has made significant progress in implementing Recommendation 97-2, thereby maintaining important criticality safety infrastructure. The following Recommendation 97-2 IP milestones were completed during the quarter:

- IP Commitment 6.5.2, Milestone 1: Develop a departmental guide for reviewing criticality safety evaluations;
- IP Commitment 6.6.1, Milestone 1: Expand the Los Alamos Critical Experiments Facility training course; and,
- IP Commitment 6.6.3, Milestone 2: Issue Guidance for site-specific criticality safety training and qualification programs.

The Department has completed the actions identified under Commitment 6.5.2 and Commitment 6.6.1, above, and proposes closure of these commitments.


The enclosed report outlines steady progress in each of the Nuclear Criticality Safety Program (NCSP) task areas. In addition, the Criticality Safety Support Group (CSSG) worked on a number of projects during the quarter including completion of its review of the Multi-Canister Overpack criticality safety evaluations for the Office of Environmental Management. Members of the CSSG also reviewed the Pilot Advanced 5-Day Criticality Training Course which was held at the Los Alamos National Laboratory in August 1999.



The IP contains 30 milestones, 27 of which have been completed. Of the three remaining milestones, two are overdue, and the remaining milestone, which is not yet due, will be delayed because of its connection to previously delayed milestones. A Recovery Plan, which was established to complete one of the milestones, was forwarded to the Board in the January-March 1999 Quarterly Report. It is included in Attachment B to this report to chronicle progress; all Recovery Plan milestones, with one minor exception, are being met on schedule. Recovery Plans for the two remaining overdue milestones will be forwarded to you when completed. The Management Team is working very hard to complete all remaining milestones and to continue implementing the NCSP Plan.

I will keep you informed as we continue to make progress on this important cross-cutting program.

Sincerely,


for Gilbert G. Weigand
Deputy Assistant Secretary
for Research, Development and Simulation
Defense Programs

Enclosure

cc (w/encl):
✓ M. Whitaker, S-3.1

QUARTERLY STATUS OF THE IMPLEMENTATION PLAN
FOR
DEFENSE NUCLEAR FACILITIES SAFETY BOARD RECOMMENDATION 97-2
FOURTH QUARTER FISCAL YEAR 1999

The Department of Energy (DOE) began implementing Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 97-2 in January 1998 by formally establishing the Nuclear Criticality Safety Program (NCSP). Each of the seven NCSP Tasks (Critical Experiments, Benchmarking, Analytical Methods, 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. Implementation of the NCSP is being accomplished according to the Five-Year NCSP Plan which was published in August 1999.

The Nuclear Criticality Safety Program Management Team (NCSPMT) and the Criticality Safety Support Group (CSSG) are performing their respective chartered functions in supporting the responsible Manager's execution of the Implementation Plan (IP). During the quarter, the NCSPMT and CSSG coordinated activities aimed at completing IP milestones and continued to provide justification necessary for maintaining funding support. The CSSG completed its review of the Multi-Canister Overpack criticality safety evaluations for the Office of Environmental Management (EM). Members of the CSSG also reviewed the Pilot Advanced 5-Day Criticality Training Course which was held at the Los Alamos National Laboratory (LANL) in August 1999.

This quarterly report provides a status of activities for each of the seven NCSP elements, as well as Recommendation 97-2 IP Milestones and Recovery Plans. Three IP milestones were completed during the quarter:

- IP Commitment 6.5.2, Milestone 1: Develop a departmental guide for reviewing criticality safety evaluations;
- IP Commitment 6.6.1, Milestone 1: Expand the Los Alamos Critical Experiments Facility (LACEF) training course; and,
- IP Commitment 6.6.3, Milestone 2: Issue Guidance for site-specific criticality safety training and qualification programs.

There are two attachments to this report: Attachment A is a table depicting the status of all IP Deliverables and Milestones, and Attachment B contains Recovery Plans for the remaining milestones. The Department has made steady progress in implementing Recommendation 97-2 through execution of the NCSP. There is a significant amount of good work being done in each of the program element areas which not only maintains essential infrastructure, but provides information and tools that line criticality safety programs need. Accomplishments and key issues which arose during the period are as follows:

Critical Experiments

A status of experimental activities conducted during the period by critical assembly is as follows:

Flattop

In September, operations on Flattop were resumed following resolution of an unresolved safety question which was raised at the end of March. Formal fire and electrical inspections were performed on the machine, and later inspections documented the repairs and modifications. Following resumption of operations, a series of experiments measuring high multiplication systems ($k_{\text{eff}} > 0.99$) using both the U and Pu cores was performed.

Comet

Two initiatives aimed at enhancing resolution of critical experimental data acquired using the Comet machine were pursued during the quarter. The accident analysis for this machine has been re-evaluated using the measured temperature coefficient. The results of this analysis will allow addition of more excess reactivity so uncertainty in critical measurements can be reduced. In addition, work continued on a proton recoil detection system, which will be used to measure the neutron spectra for Comet critical assemblies. The detection system consists of three proton recoil detectors, with individual filling ratios of H₂, CH₄, and N₂ specifically selected to cover the "intermediate" neutron energy range, 1 eV to 1 MeV.

SHEBA

During July, several free-runs were performed to prepare for the SHEBA portion of the Advanced Criticality Safety Class, and SHEBA was then operated for the Advanced Criticality Class the last week of August 1999. Measurements were also taken on the SHEBA assembly during the week of August 2 using the same proton recoil detection system used on Comet. These measurements were taken in the experimental well with SHEBA in the pit. Leakage measurements were also taken at 3m with the machine out of the pit. The raw data looks promising, but is yet to be unfolded.

Godiva

The Godiva assembly was operated in burst mode on multiple occasions to support neutron dosimetry measurements and operator training. Sulfur pellet dosimetry [³²S(n,p)³²P] using Personnel Neutron Accident Dosimeters was used to characterize the absorbed dose from a 100°C Godiva burst starting at 10 cm and working out from the assembly. Both free air and phantom-reflected albedo absorbed doses were characterized.

Planet

During the past quarter, critical mass experiments involving uranium, polyethylene and matrix material such as SiO₂, Al, and MgO were performed on the Planet assembly. The results of these experiments were presented at the International Conference on Nuclear Criticality held in Versailles, France, and published in the conference proceedings.

Benchmarking

Publication of the 1999 version of the "International Handbook of Evaluated Criticality Safety Benchmark Experiments" took place during the fourth quarter of Fiscal Year (FY) 1999. Distribution of the Handbook began during the International Conference on Nuclear Criticality (ICNC-99) that was held September 18 - 19 in Versailles, France. Nearly 20 percent of the approximate 220 papers presented at this meeting referenced or focused on various aspects of the International Criticality Safety Benchmark Evaluation Program (ICSBEP) and the handbook. The 1999 version of the handbook contains 262 evaluations representing 2,151 critical configurations that can be used by criticality safety practitioners to validate their analytical methods.

ICSBEP personnel traveled to the Lawrence Livermore National Laboratory (LLNL) and reviewed experiments that were performed at LLNL, but which were classified or not well known. A member of the LLNL criticality safety group provided information on a relatively large series of 233U solution experiments that have H/U ratios in the range of 29-202 and some configurations with mean fission energies as large as 4eV. This series of experiments was classified; however, a declassification review was requested and the experiments were, in fact, declassified. The ICSBEP hopes to identify sufficient funding to evaluate this series of experiments during FY 2000.

Analytical Methods

Staff at the Oak Ridge National Laboratory (ORNL) and LANL continued to maintain KENO and MCNP software and assist the nuclear criticality safety community in the use of this software. At ORNL, this included continued testing of the software utilized by the new SCALE/CENTRM/KENO sequence. Test problems included mixtures of nuclides corresponding to light water reactor mixed oxide fuel. At LANL, further testing of the effect of the new unresolved resonance processing treatment in MCNP4XS on uranium and plutonium fueled benchmarks was performed. Also analyzed were some preliminary results from the new series of experiments (ZEUS) on the Comet critical assembly.

At Argonne National Laboratory (ANL), the stratified sampling effort with the VIM code included the investigation of four proposed benchmarks which represent realistic nuclear systems and test fission source convergence algorithms. The source convergence issue was presented to the OECD/NEA Nuclear Science Committee Working Party on Criticality Safety at a Working Party meeting. Finally, a web site for VIM is undergoing publication clearance review. The user community will be able to access the site through the DOE Criticality Safety program web site.

Substantial administrative assistance was performed for the NCSP under this task during this quarter. Presentations on the status and enhancement of all three code systems were made at the ICNC'99 meeting in September. These included the studies of the Uranium/Iron Intermediate Spectrum Benchmark which demonstrated the value of two, independent, rigorous analog physics analyses and the needs for capability enhancements in the energy multigroup approach. The LANL compendium of analytical benchmarks for verifying transport methods was presented at ICNC'99 and also at the Math & Computation'99 meeting which was held in Madrid the week after ICNC'99. The CSSG Methods Advisory Group recommended priorities on future methods work being proposed under the current revision of the NCSP Five Year Plan. As part of their mission under DOE/EH sponsorship, ORNL staff conducted and participated in writing group meetings for the development of national and international consensus standards on nuclear criticality safety.

Nuclear Data

Oak Ridge National Laboratory

Significant feedback on nuclear data needs/deficiencies was received from an e-mail request sent in July to the criticality safety community. There were no suggestions to remove nuclides from the current NCSP list. Additional nuclides, materials, and applications were cited in the new responses.

Cross Section Measurements at the ORNL Oak Ridge Electron Linear Accelerator for Si capture and Cl transmission measurements were performed and data reduction was begun.

Cross section evaluation activity during the quarter is as follows. Resonance evaluation of the ^{233}U cross section up to 600 eV continues. Multigroup covariance data for Si-28, Si-29, and Si-30 were generated with the computer code SAMMY up to 1.8 MeV and 199-group versions delivered to the AROBCAD Project for use in their applications in criticality safety. Evaluation of the U235 neutron cross section in the unresolved resonance range continued using all the options of the new SAMMY/URR, resulting in considerably improved values compared to ENDF/B-VI. Generation of covariance data for Al-27 continues. Comparison between the covariance files obtained from the three different options show that SAMMY gives the expected results. A resonance parameter O-16 evaluation is now available in ENDF/B-VI format and a 199-group form and results for L-series benchmark calculations show very good results. Additional benchmark studies are under way.

Argonne National Laboratory

Two reports on a unified resonance theory were completed and distributed in this quarter: "Critical Examinations of Commonly Used Numerical Methods for Broadening of Cross Sections" by R. N. Hwang (ANL-NT-72) and "Generalized Pole Representation and Interpolation of Cross Sections at Any Temperature" by C. Jammes and R. N. Hwang (ANL-NT-101). A simple methodology was used to generate covariance files and 44-group covariance data for a number of

materials, and these were provided to the Applicable Ranges of Bounding Curves and Data Task. The report, "A Method to Construct Covariance Files in ENDF/B Format for Criticality Safety Applications" by D. G. Naberejnev and D. L. Smith (ANL/NDM-148) documenting the work was published.

Los Alamos National Laboratory

Substantial progress was made during the quarter on the development of two new MCNP nuclear-data libraries: ENDF65, a continuous-energy Monte Carlo neutron library based upon evaluations from ENDF/B-VI Release 5 and a thermal S (alpha, beta) library. Design documents detailing the creation, QA, validation, documentation, and distribution plans are nearly complete. Our target date for completion of both new libraries is the end of the first quarter of FY 2000. Both libraries should be distributed to the Radiation Shielding Information and Computational Center during the second quarter of FY 2000.

Training and Qualification

This program element includes three sub-elements: (1) hands-on criticality safety training at LACEF; (2) training development; and, (3) criticality safety qualification program development.

Hands-on criticality safety training has resumed at LANL. A 3-Day Nuclear Criticality Safety class was offered in July, and the Advanced 5-Day Nuclear Criticality Safety course was piloted in August. Piloting of the new advanced 5-day course completes IP Commitment 6.6.1, Milestone 1. This advanced pilot course was peer reviewed by several CSSG members, criticality safety professionals from the Pacific Northwest National Laboratory and ORNL, and a DNFSB staff member. Following the course, a training development working group was established to work with LANL to address comments from the peer review and enhance this course prior to its fielding in December 1999. Five additional training courses are scheduled for the remainder of Calendar Year 1999.

Training development activities continued at a somewhat reduced level this quarter. Two additional training modules have been reviewed and reformatted for the World Wide Web, and additional exercises were added to each. The two modules added to the NCSP web site are: Module 4 - Neutron Scattering and Module 5 - Criticality Safety Limits. Module 6, Diffusion Theory, has been reformatted and will be added to the web site as soon as the exercise solutions are verified.

All comments have been received and dispositioned or incorporated as appropriate, on DOE-STD-1135-99, "Guidance for Nuclear Criticality Safety Engineer Training and Qualification." Commenters, including the DNFSB staff, concurred with the handling of their comments. The Standard has been issued as a formal directive on the Department's web-page. This completes IP Commitment 6.6.3, Milestone 2. Hard copy distribution of the standard will follow during the next quarter.

Information Preservation and Dissemination

This program element currently contains three sub-elements: (1) the Criticality Safety Information Resource Center (CSIRC); (2) web page development; and, (3) standards and guides development.

Progress has been made during this quarter in a number of CSIRC task areas. LA-10860 compact disks have been made and are available for distribution upon request. A CSIRC presentation was made by Tom McLaughlin at ICNC'99 in Versailles, France, on September 21, 1999, and the paper was included in the conference proceedings. This was a significant presentation to the international criticality safety community.

Regarding web site development, the NCSP web site at <http://ncsc.llnl.gov:8080/> is being maintained and improved by LLNL. This web site provides technical information and serves as a pointer to other web sites which are important to the NCSP. During the third quarter, FY 1999, web site improvements included:

- (1) Five Nuclear Criticality Safety Engineer Training Modules were added to the web pages. The training modules are "Introductory Nuclear Criticality Physics," "Neutron Interactions," "The Fission Chain Reaction," "Neutron Scattering and Moderation," and "Criticality Safety Limits."
- (2) An "Other Codes" web page was constructed.
- (3) The NCSP Five Year Plan was added to the web site.
- (4) The End Users Group roster was updated to include Chuck Voldness, WSRC; Davis Reed, ORNL; and Chad Pope, ANL-West.
- (5) The nuclear criticality safety Basic Reference Set was replaced with the Contractor Qualification Standard list.
- (6) A CSIRC link was added to the Site Map Other Internet Resource web page.
- (7) A New MCNP4XS software announcement web page was created.
- (8) Ten more people were added to NCSP Registration Database.
- (9) The NCSP Registration Database was sorted in alphabetical order by people's last name, thus providing an easy reference e-mail directory for the people who use the web pages.

Progress has been made in another area related to information preservation and dissemination. All comments have been received and dispositioned or incorporated as appropriate, on DOE STD-1134-99, "Review Guide for Criticality Safety Evaluations." Commenters, including the

DNFSB staff, concurred with the handling of their comments. The Standard has been issued as a formal directive on the Department's web-page. This completes IP Commitment 6.5.2, Milestone 1. Hard copy distribution of the standard will follow during the next quarter.

Applicable Ranges of Bounding Curves and Data

The objective of the Applicable Ranges of Bounding Curves and Data (AROBCAD) program element is to provide the criticality safety practitioner with information, tools, and guidance that will assist in establishing and using applicable bounding values. The AROBCAD program develops a technically justifiable methodology for validating calculations in areas where benchmark data is unavailable or excessively sparse. In conjunction with validation efforts, the methodology will also aid in the selection of appropriate benchmarks, thereby providing greater confidence in the calculational validation.

Though substantial progress was made during the quarter in each of the AROBCAD Technical Program Plan (TPP) Task areas, a significant shortfall in productivity is being experienced resulting from the death of a key contributing staff member, Mr. Jim Mincey. This loss primarily impacts TPP Task 5 and secondarily impacts TPP Task 3 due to realignment of available staff efforts. Mr. Mincey, who will be greatly missed, was a key contributor to this and many other criticality safety related activities.

TPP Task 1 - Implement use of optimization techniques for establishing bounding values.

The prototypic SWAN-SCALE one-dimensional material-optimization code has been completed and incorporated into an ORNL SCALE driver system. The user manual has been reviewed by ORNL staff, revised accordingly by University of California Berkeley staff. It is anticipated that the final draft report/user manual will be completed for editorial review and approval for printing by October 31, 1999, though the issuance of the codes may not occur before the release of SCALE Version 5.

TPP Task 2 - Investigate means to resolve or incorporate anomaly and discrepancy effects into bounding values.

LANL has supplied ORNL with the historic computational input decks for the National Institutes of Standards and Technology (NIST) experiments for re-evaluation/comparison with ORNL 1-D models and documentation. Completion of the draft technical report on the investigation of discrepancies in the NIST experiments is on track to be issued the second quarter of FY 2000. LANL has completed a re-evaluation of the NIST experiments, and their study results are being provided for consolidation with the ORNL re-evaluation. Additionally, LANL is publishing the results in an independent LANL report entitled, "Spectral Measurements in Critical Assemblies: MCNP Specifications and Calculated Results" by Stephanie C. Frankle and Judith F. Briesmeister.

TPP Task 3 - Investigate utilization of S/U and statistical methods for identifying experimental needs.

Sensitivity and uncertainty (S/U) studies were performed on a previously proposed sludge transfer from the Hanford K-Basin to Tanks. The studies included the S/U analyses of critical experiment benchmarks and key safety evaluations. Also, S/U studies were performed on potential National Spent Nuclear Fuel (SNF) disposal parameters as compared to a suite of approximately 400 benchmarks. The draft reports of results for both the Hanford and the SNF sensitivity and uncertainty analyses are behind schedule (scheduled completion date of September 30, 1999) but are expected to be completed by mid-November 1999.

ANL has provided covariance data files to ORNL for 8 of the 19 various elements or isotopes of potential importance to DOE safety evaluations. These files are for 233-U, 236-U, Zr, Mg, Gd, Hf, 235-U, and 238-U. ANL is reconsidering the need to provide covariance data for the remaining elements or isotopes of potential importance that include 239-Pu, 240-Pu, 241-Pu, Fe, H, C, N, O, Al, Si, and B considering there is new data from ENDF/B-VI or other international sources or experiments. Comparison assessments using existing and ANL supplied covariance data files will be provided in the second quarter of FY 2000.

TPP Task 4 - Develop guidance for interpolating and extrapolating bounding values.

Effort on this subtask was initiated by an ORNL statistician review of the various methods used for evaluating computational biases and uncertainties due to cross section and experimental benchmark measurements (i.e., c_k , $D_{n,c,s}$, $E_{n,c,s}$, and Generalized Linear Least Squares Method - GLLSM). This subtask will progress as further relevant information is generated and evaluated using the AROBCAD tools of TPP Task 3 and the results from TPP Task 5.

TPP Task 5 - Develop guidance for establishing bounding margins of subcriticality.

ORNL statisticians have performed follow-up inquiries of the US nuclear criticality safety community, commercial and contractor, to resolve questions regarding technicalities of their approaches for establishing bounding margins of subcriticality for safety. The draft assessment report of these findings will be provided in November 1999.

ATTACHMENT A: IP COMMITMENT AND DELIVERABLE/MILESTONE STATUS

Commitment	Deliverable/Milestone	Due Date	Status
6.1 Assess critical experiments program	1. Assessment report of criticality research program	March 1998	Completed
6.2.1 Perform CSIRC pilot program	1. Identify an experiment to archive	November 1997	Completed
	2. Archive logbook(s) and calculation(s) for that experiment	December 1997	Completed
	3. Videotape original experimenters	January 1998	Completed
	4. Digitize data and calculations	February 1998	Completed
	5. Publish data and calculations	April 1998	Completed
6.2.2 Continue to implement the CSIRC program	1. Collocate logbooks (copies or originals) from all U.S. critical mass laboratories	December 1998	Completed
	2. Screen existing logbooks with original author/experimenter	December 1998	Completed
	3. CSIRC program plan	December 1998	Completed
6.3 Continue and expand work on ORNL sensitivity methods development	1. Technical program plan	July 1998	Completed
	2. Document initiation of priority tasks from the program plan in the quarterly report to the Board	January 1999	Completed
6.4 Make available evaluations, calculational studies, and data by establishing searchable databases accessible through a DOE Internet web site	1. DOE criticality safety web site	March 1998	Completed
	2. Y-12 evaluations on DOE web site	June 1998	Completed
	3. Calculations compiled by the Parameter Study Work Group on DOE web site	September 1998	Completed
	4. Nuclear Criticality Information System Database on DOE web site	March 1999	Completed
6.5.1 Revise and reissue DOE-STD-3007-93	1. Revise DOE-STD-3007-93	September 1998	Completed
6.5.2 Issue a guide for the review of criticality safety evaluations	1. Departmental guide for reviewing criticality safety evaluations	May 1999	Completed *

Commitment	Deliverable/Milestone	Due Date	Status
6.6.1 Expand training course at LACEF	1. Expanded LACEF training course	July 1998	Completed *
6.6.2 Investigate existing additional curricula in criticality safety	1. Assessment of additional training needs and review of available supplementary curricula	June 1998	Completed
	2. Initiate a program which addresses identified needs	December 1998	Completed
6.6.3 Survey existing contractor site-specific qualification programs	1. Report on the review of site qualification programs	June 1998	Completed
	2. Guidance for site-specific criticality safety training and qualification programs	September 1998	Completed *
	3. Guidance to procurement officials specifying qualification criteria for contractor criticality safety practitioners	September 1998	Overdue: Recovery Plan to be submitted when completed.
	4. DOE Field will provide line management dates upon which contractors will have implemented guidance in Deliverable #2, above	March 1999	Overdue: Recovery Plan to be submitted when completed
6.6.4 Federal staff directly performing criticality safety oversight will be qualified	1. Qualification program for Departmental criticality safety personnel	December 1998	Completed
	2. DOE criticality safety personnel qualified	December 1999	Expected completion date is December 2000 - See Recovery Plan in Attachment B
6.7 Each site will conduct surveys to assess line ownership of criticality safety	1. Individual sites issue report of findings	June 1998	Completed
6.8 The Department will form a group of criticality safety experts	1. Charter for Criticality Safety Support Group approved by the NCSPMT	January 1998	Completed
6.9 Create NCSPMT charter and program plan	1. NCSPMT charter	January 1998	Completed
	2. NCSPMT program plan	June 1998	Completed

* Indicates change from previous quarterly report dated August 19, 1999.

ATTACHMENT B: RECOVERY PLANS FOR OVERDUE AND DELAYED MILESTONES

OVERDUE MILESTONES

Recovery Plan for IP Milestone 6.6.3.3: Guidance to procurement officials specifying qualification criteria for contractor criticality safety practitioners (was due in September 1998).

Will be provided upon issuance of a page change to DOE O 420.1 requiring contractors to develop site-specific criticality safety qualification programs.

Recovery Plan for IP Milestone 6.6.3.4: DOE Field will provide line management dates upon which contractors will have implemented guidance in Milestone 6.6.3.2 (was due in March 1999).

Will be provided upon issuance of a page change to DOE O 420.1 requiring contractors to develop site-specific criticality safety qualification programs.

DELAYED MILESTONE

Recovery Plan for IP Milestone 6.6.4.2: DOE criticality safety personnel qualified (due by the end of December 1999).

<u>Action</u>	<u>To Be Completed By</u>	<u>Responsibility</u>
1. DP will inform the Field Management Counsel (FMC) about Fed Qual Program	June 30, 1999	Completed
2. Lead Program Secretarial Officers (LPSOs) Task Field Managers	September 30, 1999	Expected completion date is 11/99
3. Fed Qual Plans Submitted to LPSOs	December 31, 1999	FMC
4. All Federal employees qualified	December 31, 2000	Field