CSSG TASKING 2016-01
Date Issued: 12/22/2015

Task Title:

Review of US DOE NCSP T&EP Hands-On Training and Education Course for Criticality Safety Professionals

Background:

It has been nearly six years since the first US DOE Nuclear Criticality Safety Program (NCSP) Training and Education Program (T&EP) Hands-On Training and Education Course for Criticality Safety Professionals was conducted. The T&EP provides classroom presentations and is followed by hands-on subcritical and critical measurements at the US DOE Sandia National Laboratory (SNL) and the Nevada Test Site Device Assembly Facility (currently the National Criticality Experiments Research Center (NCERC)). The class originally included tours of process operations at the Los Alamos National Laboratory. The class is based upon criteria developed by the US DOE Criticality Safety Support Group (CSSG) in October 2009 and subsequently accepted for implementation by the US DOE NCSP Manager.

Task Statement:

The CSSG is directed to provide a Subgroup review of the US DOE NCSP T&EP Hands-On Training and Education Course for Criticality Safety Professionals. The review is to consider not only the effectiveness of presentations and balance of the course material and content but also the degree and appropriateness of any course content creep relative to the CSSG Response to Tasking 2009-03: Recommendations for the Future DOE NCSP Training and Education Infrastructure Program (see extract in Attachment 1). Additionally, the review is to evaluate the consistency of the course with the 2014 – 2023 NCSP Mission and Vision (see extract in Attachment 2). The CSSG Subgroup reviewers are to consider not only the previously developed criteria but also to consider realistic circumstances that are, or may reasonably become, prevalent regarding necessary resources to address the course criteria (e.g., availability of facilities, training materials, personnel, fiscal support, calendar dates, student support/schedules).

Period of Performance:

The course review is to be conducted February1-5, 2016 at the US DOE Nevada Field Office for the classroom portion of the course and February 8-12, 2016 at the SNL TA-V facility and NCERC for hands-on subcritical and critical measurements portion of the course. The CSSG shall provide a written report with their results by March 25, 2016.

Resources:

CSSG Task 2016-01 Team Members:

- Calvin Hopper (CSSG Emeritus, Team Lead)
- Mikey Brady Raap (CSSG)
- Kevin Kimball (CSSG)
- Fitz Trumble (CSSG)

CSSG members of the review team will use their FY16 NCSP CSSG support funding.

Task Deliverables:

1. The review team will review the course materials in advance of the course.
2. Hopper and Brady Raap will review and evaluate the February 1-5, 2016 Nevada Field Office classroom portion of the course. Provide an informal out-brief to the Training Coordinating Team on February 5, 2016.
3. Brady Raap and Kimball will review and evaluate February8-12, 2016 NCERC hands-on portion of the course. Provide an informal out-brief to the Training Coordinating Team on February 12, 2016.
4. Hopper and Trumble will review and evaluate February 8-12, 2016 SNL hands-on portion of the course. Provide an informal out-brief to the Training Coordinating Team on February 12, 2016.
5. The review team will draft a summary review report to be provided by February 19, 2016 for one week duration factual accuracy review.
6. The review team will address all factual accuracy comments and provide a draft to the entire CSSG by March 4, 2016 for their review/comments.
7. The entire CSSG is to provide comments to the writing team by March 11, 2016.
8. The review team is to address all CSSG comments and to incorporate into the final report any comments that are accepted and to provide the final report to the CSSG Chair for transmittal to the NCSP Manager by March 25, 2016.

Task Completion Date: March 25, 2016

Signed: JN McKamy

Dr. Jerry N. McKamy, Manager US DOE NCSP
Office of the Chief of Defense Nuclear Safety, NA-511

Attachment 1
CSSG Response to Tasking 2009-03
Recommendations for the Future DOE NCSP Training and Education Infrastructure Program

CSSG Response to Tasking 2009-03

Recommendations for the Future DOE NCSP Training and Education Infrastructure Program

October 16, 2009

Introduction

The Criticality Safety Support Group (CSSG) was directed in Tasking 2009-03 (see Attachment 1) to provide a position paper regarding the establishment of an integrated DOE Nuclear Criticality Safety Program (NCSP) Training and Education Infrastructure Program that is consistent with the mission and vision of the DOE NCSP. The objective is to assess and recommend DOE NCSP-funded and -managed training options that address all requirements of ANSI/ANS-8.26-2007 excluding those which are not appropriate for inclusion in the DOE NCSP Training Infrastructure (e.g., academic training, site-specific training).

A subgroup of the CSSG was formed to draft the position paper, which was then submitted to the entire CSSG for review and comment.

Consideration of ANSI/ANS-8.26-2007 Content

The review team examined the content of ANSI/ANS-8.26-2007, with particular focus on determining which NCS staff training objectives should be addressed by DOE training and education efforts.

The selected training objectives were prioritized to reflect where DOE NCSP involvement should focus, considering schedule drivers (e.g., impending deinventory of LLNL for security category 1 materials), existing availability of training resources, and potential for improvement of DOE contractor NCS program performance. These priorities resulted:

> Top Priority: Provide a hands-on training experience addressing important characteristics of neutron multiplying systems, along with discussion of the theory and implications for safety of fissionable material operations. Since there are criticality safety engineer positions within the DOE complex that do not require DOE security clearances, and new hires may have an extended waiting period before clearance is granted, it is essential that this hands-on training be available to uncleared individuals.
>
> > Basis: The requirement for this type of experience cannot readily be met through DOE contractors' individual actions and resources, thus DOE needs to assist in this area.

Second Priority: Provide a consistent level of understanding and awareness to individuals entering DOE contractor criticality safety positions regarding:

- application of rules, standards, and guides,
- performance of criticality safety evaluations, and
- hazards analysis methods and implementation/maintenance of NCS controls.

Basis: Due to the diversity of facilities, operations, and contractor management across the DOE complex, DOE needs to take action to assure that individuals entering criticality safety engineering positions are exposed to a common and adequate level of understanding of requirements and expectations.

Third Priority: Provide training in interpretation of data (NCS handbooks, experimental data), computational methods (hand calculations, NCS codes), and other "tools of the trade" for criticality safety engineers. Also, provide training regarding issues associated with criticality accident alarm systems and emergency preparedness.

Basis: While proficiency with tools of the trade is essential to performance of criticality safety work, there are many existing venues (e.g., NCSET modules, training classes provided by universities and laboratories such as the UNM NCS course, the UT NCS courses, and training classes provided by DOE contractors such as the LANL MCNP and ORNL SCALE training courses) that provide training to criticality safety engineers in these areas. Similarly, special-purpose workshops have periodically been offered to address criticality accident alarm systems and emergency preparedness.

Examination of Training Proposals

The review team examined the training-related proposals that were submitted to DOE as part of the most recent (spring 2009) annual proposal and funding review for DOE NCSP activities. Also, the team examined proposals provided in response to a specific invitation for NCS training- and education-related proposals (issued to multiple academic and DOE contractor organizations in January 2009).

The proposals available for review pre-date determination of most of the training and education recommendations identified below. Thus, new or revised proposals by organizations willing and able to support specific DOE NCSP training and education objectives are needed.

CSSG Recommendations for "Hands-On" Training

Criteria or considerations for hands-on training (ANSI/ANS-8.26-2007, primarily Section 7.4) include:

(1) the ease and speed that the training can be established,
(2) the cost to establish the training program, the cost to operate once established, and cost sharing opportunities with other DOE programs,
(3) the location (ease or difficulty for student/instructor travel),
(4) minimal or no restrictions related to DOE security clearance requirements,
(5) the ability to integrate with other parts of DOE NCSP training,
(6) fissile assembly/fissile material availability,
(7) DOE control of continued training availability,
(8) the effectiveness of the training,
(9) clear identification of training prerequisites,
(10) demonstration of student competency, and
(11) the use of formalized training development methods.

The following recommendations are offered:

(1) Hands-on training should be established at the Critical Experiments Facility (CEF) at the Nevada Test Site and also at Sandia National Laboratory (SNL).

(2) At the CEF:
- Uncleared student access should be established.
- The experiments/training exercises should involve the same assemblies as used in prior LANL training (e.g., Flattop, the 93%-enriched U foils/Plexiglas™ plates).
- The TACS shell experiments (part of current LLNL training) should be included.
- One or more experiments representing overmoderated configurations should be included.
- The training should include demonstration of student competency.

(3) At SNL:
- The tank assembly for fuel rod lattice experiments should be modified to allow control of critical conditions based on water level control.
- An assembly using 19%-enriched U plates/foils should be made available and included in the training program.
- One or more experiments representing overmoderated configurations should be included.
- The training should include demonstration of student competency.

(4) The same fundamental learning objectives for hands-on training should be addressed at both sites (CEF and SNL), regardless of the exercises performed or the particular assemblies used for the exercises. The developers for the two training sites should collaborate during training development, to ensure agreement on the specific learning objectives and to ensure that the final training modules address those objectives.

CSSG Recommendations for Classroom Training

The primary criterion for classroom/academic training (ANSI/ANS-8.26-2007, mainly Sections 7.5, 7.6, and 7.7) is the ability to foster consistency, throughout the DOE complex, of

- student understanding of NCS orders/guidance/standards,
- performance of NCS evaluations,
- use of formalized hazards analysis techniques,
- selection of appropriate NCS controls, and
- effective implementation and monitoring of NCS controls.

The following recommendations are offered:

(1) Formalized methods to develop the training (e.g., systematic approach to training, testing methods) should be used.

(2) The training content should be vetted for consistency (e.g., by the CSSG) with regard to
- DOE orders/guidance and ANS-8 standards,
- DOE expectations for NCS evaluations, and
- safety analysis techniques and control specification.

(These three topics should be covered concurrently, in a collocated setting.)

(3) Multiple NCS subject matter experts (SMEs) from multiple sites should provide the training.

(4) Prerequisite training using established resources should be required (e.g., student self-study of pertinent NCSETs).

(5) Practical exercises (e.g., application of standards, performing evaluations) should be included.

(6) For effectiveness of the NCS evaluation exercises, at least one of the following (listed in order of preference) is needed:
(a) access to an operating facility,
(b) use of a mockup facility, or
(c) some other means to illustrate on-the-floor issues that affect the development of NCS controls.

(7) The training should include demonstration of student competency.

(8) As the initial action during training development, the training developer(s) should document all learning objectives to be addressed during the classroom training. Assuming that multiple organizations may be involved in this development, the developers should collaborate throughout the training development to ensure the final training modules address all identified learning objectives.

CSSG Recommendations for Other Training, Other Training Resources

The primary criterion or objective may be stated as: Use NCSET modules, the NCSP website, special topic workshops and tutorials, and distance education methods to augment or to increase the overall effectiveness of DOE-managed NCS hands-on and classroom training.

The following recommendations are offered:

(1) Consider development of NCSET modules, NCSP website information, or distance education products addressing these topic areas:
- human factors,
- equipment reliability,
- formalized hazards analysis techniques,
- handbook usage,
- direct use of benchmark data, and
- criticality accident analysis.

(2) Consider periodic DOE/NCSP funding/support of ANS (or other) workshops/tutorials for
- criticality alarm systems/emergency preparedness, and
- NCS issues related to Material Control and Accountability (MC&A) and non-destructive assay/evaluation (NDA/NDE).

(3) For the NCSP website:
- Post important NCS reference documents, past tutorials, etc.
- Provide links to NCS reference documents that are posted elsewhere.
- Provide order or contact information for reference documents that cannot be posted on the web.
- Under training-related information, provide a road-map to documents useful for NCS staff to find information/training regarding ANS-8.26 Section 7 topics.

Additional Observations

The CSSG review effort is consistent with the subject of ANSI/ANS-8.26-2007: training and education of NCS staff. Students in such a program may appropriately include DOE technical (regulatory) staff who are, or will be, tasked with NCS oversight.

Some program elements (e.g., periodic workshops, "advanced" courses for NCS codes) may be suitable for continuing education of more experienced NCS staff. More in-depth hands-on and classroom training events may be established for more experienced NCS staff, using the entry-level training programs as models.

Development of training recommendations for non-NCS staff is outside the scope of this CSSG position paper. However, as for current and past DOE-sponsored NCS training classes, the training classes and materials for NCS staff should be adaptable to students who have similar (but less technical) NCS training needs (e.g., production managers, operations supervisors, criticality safety officers/representatives).

Some training program content (e.g., regulatory guidance, state-of-the-art techniques for NCS computations) will change over time. The recommendations include a suggestion to use NCS SMEs from multiple sites for classroom training. These factors result in the need for careful documentation of training program content (including instructor notes and guidance) and periodic review of training for currency of content and effectiveness of training delivery.

Attachment 1

CSSG TASKING 2009-03
Date Issued: July 1, 2009

Task Title:

CSSG Recommendations for the Future DOE NCSP Training and Education Infrastructure Program

Task Statement:

The CSSG is directed to provide a position paper regarding the establishment of an integrated DOE NCSP Training and Education Infrastructure Program based upon the review and recommendation of existing or solicited proposals that are consistent with the vision and mission of the DOE Nuclear Criticality Safety Program (NCSP). The objective is to assess and recommend DOE NCSP-funded and -managed training options that address all requirements of ANSI/ANS-8.26 excluding those which are not appropriate for inclusion in the DOE NCSP Training Infrastructure (e.g., academic training, site-specific training).

Points to be addressed include, but are not limited to:

- Establishment of one or more hands-on training courses to incorporate and/or replace the current LLNL training course. At a minimum, the target audience must include uncleared personnel who are defined as "engineers in training" by ANSI/ANS-8.26-2007.
- Establishment of one or more classroom training courses (may or may not be included with the hands-on training curriculum(s); same minimum target audience as for hands-on training).
- Utilization of the NCSET and other self-directed study resources in a manner coordinated with the overall objective of the DOE NCSP Training Infrastructure.
- Means to demonstrate and document a defined minimal level of student competency.

Period of Performance:

The position paper will be developed by September 30, 2009.

Resources:

The CSSG will form a review and writing team composed of CSSG members. Contractor CSSG members of the writing team will use their FY09 and FY10 NCSP CSSG support funding; DOE CSSG members of the team will provide funding from their site offices. CSSG emeritus members may be included in the team on a voluntary basis.

An initial assessment of training proposals and options for consideration will by developed by ORNL staff as part of an existing (separate from the CSSG) NCSP effort. The assessment will be provided to the CSSG writing team in mid-August, and will be

presented at a writing team meeting to be held on August 24-25, 2009 at the Nevada DOE Office.

The writing team will consider training proposals submitted as part of the FY10 solicitation process, and may elect to further solicit training proposals (or refinement of existing training proposals already collected as part of the ORNL training evaluation effort) from various sites or organizations.

Task Deliverables:

By September 30, 2009, the writing team will forward a draft position paper to the entire CSSG for comments.

Within fifteen days of the date the draft position paper is distributed to the CSSG the writing team will address all comments from the CSSG and incorporate any comments that are accepted. The writing team lead will submit the position paper to the CSSG Chair for transmittal to the NCSP Manager.

Task Due Date: October 31, 2009

Attachment 2
2014 – 2023 Mission and Vision
For
US DOE NCPS Training and Education

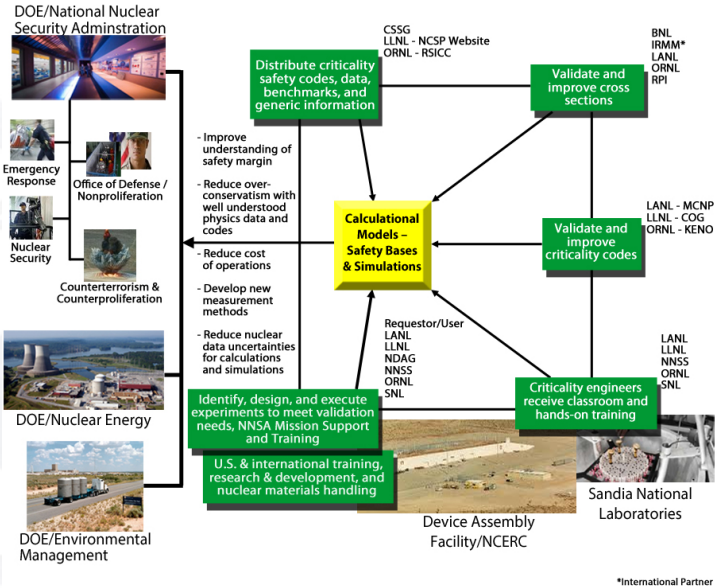
The Mission and Vision

of the
United States Department of Energy
Nuclear Criticality Safety Program

for the
Fiscal Years
2014-2023

National Nuclear Security Administration

The Nuclear Criticality Safety Program Infrastructure Supports Safe and Efficient Fissionable Material Operations DOE-Wide



The Integrated Nuclear Criticality Safety Program

The Department of Energy (DOE) Nuclear Criticality Safety Program (NCSP) is chartered with maintaining the technical infrastructure necessary to ensure safe, efficient operations from a criticality safety perspective. The NCSP and its initiatives have been planned and executed annually in a series of updates to a rolling Five-Year Plan. The Mission and Vision for the NCSP for the next five to ten years facilitates development of a coherent, integrated implementation plan. The Five-Year Execution Plan has been the plan to achieve the five-year vision of the NCSP. As such, revised editions of the Five-Year Plan will continue to be a roadmap to achieving the NCSP described in this Mission and Vision. Five years have passed since the original Fiscal Year 2009 – 2018 Mission and Vision was published. Every five years the Mission and Vision will be revisited and the current ten-year goals and attributes revised to reflect progress during the previous five years. This document will provide the planning basis for all funding and initiatives undertaken by the NCSP. It also defines the values and operating culture of the NCSP.

Nothing is more fundamental to operations with fissionable material than criticality safety. Ensuring that a criticality accident never happens again in a DOE facility is one key facet of the DOE mission supporting the national security and energy needs of the United States. It is with this ultimate goal in mind that this revision of the Mission and Vision for the NCSP is dedicated and approved.

Approved:

October 2013

Dr. Jerry N. McKamy, Director
Office of Environment, Safety and Health, NA-00-10
National Nuclear Security Administration

MISSION

The NCSP mission is to provide **sustainable expert** leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate the essential technical tools, training, and data required to support **safe, efficient** fissionable material **operations** within the DOE.

VISION

The NCSP will be a **continually improving, adaptable,** and **transparent** program that **communicates** and **collaborates** globally to incorporate technology, practices, and programs to be **responsive** to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.

VALUES

- **Continual Improvement** – The NCSP assesses its products and processes.
- **Adaptability** – The NCSP encourages innovation.
- **Transparency** – The NCSP discloses its plans, processes, and accomplishments.
- **Communication** – The NCSP dialogues with its stakeholders.
- **Collaboration** – The NCSP engages national and international resources.
- **Responsiveness** – The NCSP responds to the needs of its DOE stakeholders.
- **Sustainability** – The NCSP prepares the next generation of technical leaders.
- **Expertise** – The NCSP involves world-class criticality safety experts.
- **Safety** – The NCSP resolves any threat to criticality safety.
- **Efficiency** – The NCSP tailors solutions to maximize efficiency.
- **Operations** – The NCSP adopts DOE missions and goals as its own.

STRATEGY

The NCSP Mission and Vision will be achieved by identifying and accomplishing a set of five-year programmatic goals in five broad technical program elements that support identified ten-year goals. The yearly implementation plans to accomplish these goals will be developed with the advice and assistance of **experts** appointed by the NCSP manager or working under charters approved by the NCSP manager. The five technical program elements are:

- Analytical Methods
- Information Preservation and Dissemination
- Integral Experiments
- Nuclear Data
- Training and Education

The following sections identify the mission, vision, strategy, and goals for each of these elements as related to the overall mission and vision of the NCSP. Each section contains a list of specific goals to be attained by the end of Fiscal Year 2023. Detailed lists of attributes (a quality or characteristic; a distinctive feature), and five- and ten-year goals for each element have been developed to support the NCSP Vision and are detailed within each program element.

MID-TERM ASSESSMENT

The purpose of this mid-term review of the first NCSP Mission and Vision document for Fiscal Years 2009-2018 is to assess progress in meeting the goals contained in the first document and to provide a road map for **continuing** to **improve** the criticality safety infrastructure necessary to ensure **safe**, **efficient operations** from a criticality safety perspective. Many of the goals in the first Mission and Vision document have been met and each program element will highlight some of the accomplishments within each program element. Some noteworthy accomplishments during the last five years include the start-up of all four critical assemblies in the new National Criticality Experiments Research Center (NCERC) in Nevada; the restart of a water moderated critical experiments capability at Sandia National Laboratories (SNL), Albuquerque; and the initiation of new hands-on training courses at Los Alamos National Laboratory (LANL), NCERC, and SNL for nuclear criticality safety practitioners, managers responsible for criticality safety, and nuclear material handlers. This new Mission and Vision document for Fiscal Years 2014-2023 is organized differently from the last document in that each program element section flows from Mission; Vision; Attributes of a Robust Program Element; to Five Year, Ten Year, and Stretch Goals that if met will help sustain the attributes of a robust program. Furthermore, the Attributes and Goals tables are color-coded to depict a consensus of technical and budget priorities. As before, future, revised versions of this document will **continue** to provide the foundation for the NCSP Five-Year planning process.

Please note that the original Appendix A section is being preserved in this document for archival and future out-year comparison purposes. New Goals and Attributes tables are provided in the main body of this document within each program element.

MISSION

The Training and Education (T&E) program element will *continue* to identify, develop, and facilitate training needs and educational resources (including hands-on training with fissionable material systems) in areas where no suitable alternative exists. The primary purpose of the T&E element is to maintain and enhance the technical abilities and knowledge of those who impact (Criticality Safety Engineers, Criticality Safety Officers, and managers) or are impacted directly by (operators and process supervisors) the practice of criticality safety. This includes training and education of people entering the criticality safety discipline from related scientific fields and maintaining and enhancing competency levels of those already in the community.

T&E Vision

The T&E element will identify, develop, provide, and promote practical and excellent technical training and educational resources that help ensure competency in the art, science, and implementation of nuclear criticality safety and is **adaptable** and **responsive** to the needs of those responsible for developing, implementing, and maintaining criticality safety.

T&E Strategy

The following strategy has been developed to direct the T&E element towards achieving its vision. The T&E element will:

- *Continually* evaluate qualification and knowledge expectations and *communicate* identified needs for training and education resources.
- Actively *communicate*, promote, and evaluate new and available training and education opportunities.
- Be *responsive* to identified training and education needs by developing and providing resources that *sustain* nuclear criticality safety capabilities and adequate oversight and awareness of criticality safety requirements.
- Provide *sustainable*, hands-on training in the behavior of fissionable material systems including those at or near critical conditions.
- Integrate training and education objectives through sharing of resources and *collaboration* with national and international partners.
- Develop *transparent* assessment processes to ensure competency for criticality safety engineers and/or criticality safety training programs consistent with ANSI/ANS 8.26 requirements and recommendations.

T&E Technical Gap

The T&E element has successfully utilized *expertise* throughout the DOE enterprise to establish and execute two individualized, *sustainable* training courses, for (1) on the floor process personnel and (2) managers, on nuclear criticality safety that combines classroom and fissile material processing facility instruction with hands-on instruction using criticality systems at experimental facilities. In addition, a joint program with the French CEA has enabled effective exchange of ideas and *expertise* on the conduct of experiments. Training on key computational analysis tools (MCNP, SCALE, and COG) *continues* to be provided by developers and experienced users. Training tutorials were completed on ICSBEP experiment evaluations, the ICSBEP experiment data base (DICE), human factors (embedded within the 2-week training course), and differential data and cross-sections while a tutorial on MC&A and its relationship to criticality safety was developed and jointly sponsored by the NCSP and the American Nuclear Society. Training on subcritical noise measurement methods and instrumentation for critical experimentation were accomplished under the IE Program Element and will be maintained under IE.

Goals that were not initiated or completed, but are still considered to be of interest to the NCS community, are carried forward as 5- or 10-year goals. These goals are:

- Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users,
- Tutorial on CAAS systems: placement evaluation needs and design options and consideration, and
- Tutorial on D&D related to criticality safety.

A few other T&E goals were not completed but were reassessed and modified as either a 5- or 10-year goal and included within the T&E Program Element or a sister Program Element. These goals are:

- Additional historical Pioneer videos (to IP&D and incorporated into a goal for creating operational experience interviews and training videos).
- Tutorial for managers, supervisors, criticality safety officers or criticality safety representatives, and DOE facility representatives (T&E goal modified to be a short course instead of being a tutorial).
- Module on the use of the criticality accident slide rule, NUREG/CR-6504, Vol. 2, “An Updated Nuclear Criticality Safety Slide Rule” (T&E goal modified to focus on support for emergency response activities).

A number of training goals related to specialized training in cross-section evaluation or processing (e.g., SAMMY, NJOY, PREPRO, and AMPX) were judged to be a component of sustaining subject matter experts and not relevant to general criticality safety practitioners and were modified and moved to the Nuclear Data Program Element. Some other T&E goals were simply deleted from the attribute/goal table based upon an assessment of the current need for the goal. The deleted goals typically include the development of training that had either already existed or were of low relative value to the NCS community.

T&E Technical Gap *(cont'd)*

There needs to be an expanded effort to identify or develop T&E resources that meet the needs of those that can impact the assurance of criticality safety or that might be impacted by criticality safety requirements. *Efficient* and effective training for on-the-floor process personnel are specific areas that need to be addressed. Providing improved methods and tools for evaluating training effectiveness will support ongoing enhancement of training and help ensure students are able to translate the learning experience to the workplace. Effective implementation of the T&E vision has meant a broadening of the mission and strategy to seek enhanced *collaboration* on identification, utilization, and assessment of existing T&E resources within the national and international community. The T&E element will also strive to assess competency expectations and suggest or implement tools and processes that will help ensure those competency expectations are maintained in individuals and/or programs.

T&E Attributes and Goals

The T&E program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
	Medium Priority
	Low Priority
	S T R E T C H

Hands-On Training

Training and Education - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel/Facilities:		Budget Priority	
		Technical Priority	
Access to an integrated, coordinated, and consistent compendium of criticality safety training and education resources that provide effective training commensurate with need	A sustainable process to identify and communicate available training classes and education resources in the national and international communities		
	A gap analysis of training needs based on an assessment of available training and education resources in the national and international communities		
	An integrated compendium of training and education resources that is coordinated for consistency across US agencies and institutions and accessible to the criticality safety community		
	An integrated compendium of training and education resources coordinated with international partners to foster consistency on material and maximize use of unique resources		
	A sustainable process to obtain and incorporate feedback to expand or improve training course(s), training modules, or NCSET modules		
Collaborative environment between national and international communities	Cultivate and maintain university partnerships		
	Sustainable program (internship, rotational assignments, etc.) to facilitate collaborative training and education opportunities (national and international)		
	Collaborative training for experimenters in U.S. and foreign facilities		
Transparent qualification assessment tool for criticality safety engineers and/or criticality safety training programs	Evaluate recommendations from a multi-lab team and select a qualification program approach, complete with criteria, benefits, and required resources to ensure adequate implementation of the ANSI/ANS-8.26 standard		

Training and Education - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Personnel/Facilities (cont'd):		Budget Priority Technical Priority	
Transparent qualification assessment tool for criticality safety engineers and/or criticality safety training programs	Qualification guidance consistent with the ANSI/ANS-8.26 standard graded from entry level criticality safety engineers to requalification for experienced criticality safety engineers		
Provider of criticality safety training not readily available from other sources	The existing and unique training provided by the NCSP, e.g., classroom and hands-on experiment training, and NCSET modules, remains a high priority		
	A criticality simulator is available to demonstrate criticality physics fundamentals to process operators		
	A criticality simulator is available to simulate plant/process conditions and simulate a walk-through, i.e., simulated facility could be staffed by role players (e.g., operators)		
	A mobile (CAT III or IV material) criticality hands-on critical or near critical demonstration capability is available		
	Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users		
	Tutorials on CAAS system placement evaluation needs and design options and considerations		
	Tutorial on D&D related to criticality safety		
	Sustain a training course for managers, supervisors, criticality safety officers, or criticality safety representatives, and DOE facility representatives		
	Develop an NCSET module on the use of criticality safety accident slide rule to support emergency response		
	Develop a mobile CAT 1 criticality hands-on critical or near critical demonstration capability		

Table A.6. Training and Education 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
ICSBEP		
o Handbook/DICE training	√	√
o Tutorial on ICSBEP evaluations	√	√
o Tutorial on uncertainties/statistics	√	√
Nuclear Data		
o Tutorial on development of differential data and cross sections (experimental) for end-users	√	
o Multiplicity and NuBar interpretation and methods		√
Analytical Methods		
o MCNP training	√	√
o SCALE training	√	√
o Sammy training	√	√
o NJOY training	√	√
o Covariance and uncertainty training	√	√
o AMPX training		√
o PREPRO training		√
o COG training		√
o Tutorial on development of differential data and cross sections for the end-user		√
Integral Experiments		
o Hands-on training on critical systems	√	√
o Collaborative training for experimenters in U.S. and foreign facilities	√	√
o Educational opportunities for non-experimenters at experimental facilities	√	√
o Tutorial on subcritical noise measurement methods	√	
o Tutorial on instrumentation for critical experimentation		√
o Hands-on training involving Security Category III/IV quantities		√

Table A.6 (cont'd). Training and Education 5- and 10-Year Goals and Attributes

Goals (cont'd)	5y	10y
Other		
o Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users	√	
o Tutorial on MC&A and its relationship to criticality safety including nondestructive assay	√	
o Tutorial on human factors related to criticality safety	√	
o Tutorial on formal methods for criticality hazards analysis	√	
o Plutonium chemistry/uranium chemistry/material properties	√	
o Additional historical Pioneer videos	√	
o Tutorial on CAAS system designs		√
o Tutorial on CAAS placement evaluation (accident yields, transmission, standards)		√
o Tutorial on D&D related to criticality safety		√
o Destructive analysis tutorial		√
o Tutorial for managers, supervisors, criticality safety officers or criticality safety representatives, and DOE facility representatives		√
o Module on use of criticality accident slide rule		√
Attributes	**5y**	**10y**
Develop a process to allow the end-user community to identify needed training	√	
Interactive multimedia training capability	√	
Transferable cards/certificates of accomplishment from DOE for criticality engineers	√	
University partnerships	√	
Find, tailor, and adapt and make generally available training that exists at DOE sites	√	
Online university classes	√	
Survey of best contractor training practices	√	
Simulation environment for training		√
SimCity with process control and limits to "run your own electronic process"		√
DOE NCSP scholar/intern program/rotation program		√
The single center of excellence for criticality safety training that provides for tailored training commensurate with need o Criticality simulator o Ability to do hands-on material experimentation o Ability to handle cleared/uncleared o Staffed by experts with specific knowledge basis o Ability to simulate plant/process conditions and simulate walking them down (i.e., simulated facility should be staffed by role players [e.g., operators]).		√
IP&D training o Lessons learned from criticality accident near misses		√