Status of the Development and Deployment of the NCSP Training and Education Courses

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Oak Ridge National Laboratory

NCSP Technical Program Review
Washington, DC
March 14-15, 2017
Agenda

• Introduce the Nuclear Criticality Safety Program and the Training and Education Project

• Discuss
  – the 2-Week Hands-on course
  – the 1-Week Manager course

• Course Statistics

• Acknowledgements
NNSA Nuclear Criticality Safety Program

10 Year Mission & Vision

5 Year Plan

Work Tasks
US DOE NCSP T&E Element

• T&E Mission
  – 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.
  – 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.
  – 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
  – 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.
### Training and Education - Budget and Technical Priority Rankings (cont’d)

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

**Legend**
- Budget Priority
- Technical Priority
T&E General Course Objectives*

• Provide a consistent level of Department of Energy (DOE) interpretation, understanding, awareness and applications regarding
  – DOE Orders, Guides, American Nuclear Society/American National Standards Institute (ANS/ANSI) standards, rules
  – Performance of NCS evaluations
  – Hazards analysis methods and implementation/maintenance of NCS controls including precision and uncertainty of Non-destructive Assay (NDA) and Destructive Assay (DA) requirements
• Ensure versatility for cleared and un-cleared students
• Provide alternate/backup facility capabilities for hands-on training
• Provide experimental hands-on training addressing
  – Characteristics of neutron multiplying systems
  – Discussion of
    • Reactor dynamics
    • Implications for the safety of fissionable material operations

* CSSG Tasking 2009-03, Recommendations for the Future DOE NCSP Training and Education Infrastructure Program
NCSP Training and Education Courses

Hands-On Course (2 weeks)

Manager Course (1 week)

Special Courses (1 week)

Classroom Training NFO*

NCERC

Sandia

NCERC

* NFO – Nevada Field Office
** NCERC – National Criticality Experiments Research Center
Focus: NCS Evaluation Development

- DOE Requirements, National standards, and the DOE NCSP
- Process criticality accident lessons-learned
- NCS fundamentals
- ANSI/ANS-8 consensus standards
- Single unit and array hand calculation methods
- NCS evaluations and evaluation workshops
- Human factors and reliability principles for NCS evaluations
- NDA – interpretation and application of NDA methods and results to NCS evaluations
- Validation of Computational Methods
- Homework and quizzes assigned daily
- Students must pass the course with an overall grade of 80%
2-Week Hands-on Course – Week 2 Hands-On Portion

Focus: Hands-on with fissionable materials

- Overview of Sandia and NCERC facilities and assemblies
- Overview of the experiment procedures and methodology
- Neutron dynamics fundamentals and subcritical multiplication
- Nuclear instrumentation
- ANSI/ANS-1 *Conduct of Critical Experiments*
- Lessons learned from experimental criticality accidents

**Subcritical and critical experiments**
- NCERC – operations with Planet, Flattop, Godiva IV, BeRP Ball, Np-237 Sphere, and Training Assembly for Criticality Safety (TACS)
- Sandia – Seven percent critical experiment (7uPCX), Annular Core Research Reactor Core (ACRR) burst

- Critical experiments and the International Criticality Safety Benchmark Evaluation Project (ICSBEP) handbook
- Students must pass the course with an overall grade of 80%
1-Week Manager Course

Focus: Understanding of the student’s role in an NCS Program

• DOE Requirements, national standards, and the DOE NCSP
• Overview of Sandia and NCERC facilities and assemblies
  – Overview of the experiment procedures and methodology
• Neutron dynamics fundamentals and subcritical multiplication
• Nuclear instrumentation; conduct of operations
• ANSI/ANS-1 & 8 consensus standards
• NCS Evaluations
• Lessons learned from criticality accidents
• Subcritical and critical experiments
  – NCERC – Ops with Planet, Flattop, Godiva IV, BeRP Ball, Np-237 Sphere, and Training Assembly for Criticality Safety (TACS)
  – Sandia – Seven percent critical experiment (7uPCX), Annular Core Research Reactor Core (ACRR) burst
• Students must pass the course with an overall grade of 80%
NCERC Hands-on Course

Device Assembly Facility/
National Criticality Experiments Research Center

TACS Subcritical Assembly
Flattop Critical Assembly
Godiva Critical & Delayed/Prompt Supercritical Assembly
Planet Critical Assembly

BeRP Ball and Np-237 Sphere Demonstration
Sandia Hands-on Course

- The hands-on subcritical and critical experiments are performed in the SNL SPRF/CX lattice water tank

- EX1: Approach to critical on fuel loading
- EX2: Approach to critical on moderator height
- EX3: Approach to critical on fuel separation
- EX4: Interior fuel rod removal

Annular Core Research Reactor (~$3 Prompt Supercritical Pulse)
Course Statistics
NCSP Training and Education Project Course Attendance by FY

Total Student Attendance = 325

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## Status of 2-week Hands-on Course
### CSSG Tasking 2016-01 Comment Resolution

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Course Dates

• FY17 – Remaining Courses
  – 2-week Hands-on Course for NCS Practitioners
  – 1-week Manager Course
    • Jun 19 - Jun 23, 2017 at Nevada Field Office/NCERC (Closed)

• FY18 – Course Dates
  – 2-week Hands-on Courses for NCS Practitioners
    • Jan 29 - Feb 02, 2018 at National Atomic Testing Museum and Feb 05 - Feb 09, 2018 at NCERC/Sandia
  – 1-week Manager Courses
    • Jun 11 - Jun 15, 2018 at Nevada Field Office/NCERC
    • Sandia Manager Course – dates TBD
Acknowledgements

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- Charlotte Carter (NFO)
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- Steve Clement (LANL)
- Jeff Lewis (NSTec)
- Cyle Everson (NFO)
- Catherine Percher (LLNL)
- Jeff Chapman (ORNL)
- Jerry Hicks (NNSA Ret.)
- Bob Wilson (DOE EM)
- Don Mueller (ORNL)
- B.J. Marshall (ORNL)
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- Nichole Murchison (SNL)
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LANL
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- Theresa Cutler (LANL)
- Shean Monahan (SNL)
- Mark Mitchell (LANL)
- Susan Stevens-Adams (SNL)
- Jeff Chapman (ORNL)
- Jerry Hicks (NNSA Ret.)

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- Ron Knief (SNL)
- John Miller (SNL)
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- Eric Moyer (SNL)
- Rafe Campbell (SNL)
- Jerry Hicks (NNSA Ret.)
- Bob Busch (UNM)

NCERC
- Jen Alwin (LANL)
- Theresa Cutler (LANL)
- Jeff Lewis (NSTec)
- Shean Monahan (SNL)
- Mark Mitchell (LANL)
- Jessie Walker (LANL)
- Susan Stevens-Adams (SNL)
- Jerry Hicks (NNSA Ret.)
- Dave Hayes (LANL)
- Bill Myers (LANL)
- Catherine Percher (LLNL)
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- Joetta Goda (LANL)
- Jesson Hutchinson (LANL)
- John Bounds (LANL)
- Travis Grove (LANL)

In addition:
- RCTs, Fire watchers, escorts, ACRR operators, badge office personnel, fissile material handlers, and numerous facility support personnel
- CSSG reviewers: Calvin Hopper, Mikey Brady-Rapp, Fitz Trumble, and Kevin Kimball
Are there any questions?