

Current Status of the DOE/NNSA Nuclear Criticality Safety Program Hands-on Criticality Safety Training Courses

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Group Leader

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Reactor and Nuclear Systems Division

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NCSD Topical Meeting

Carlsbad, NM

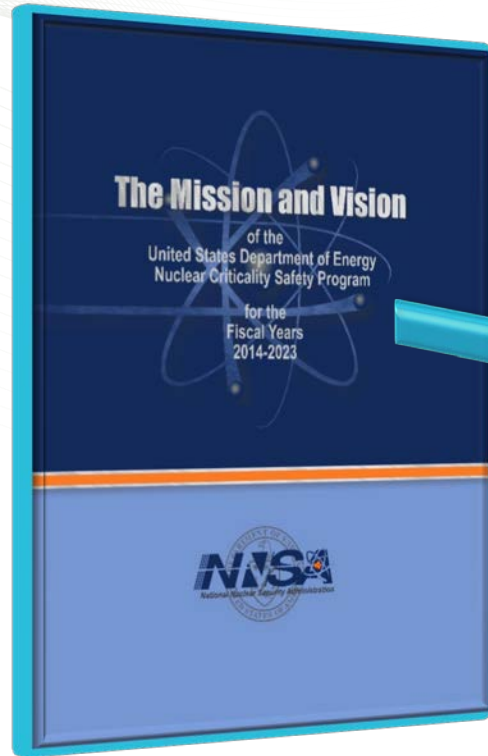


Agenda

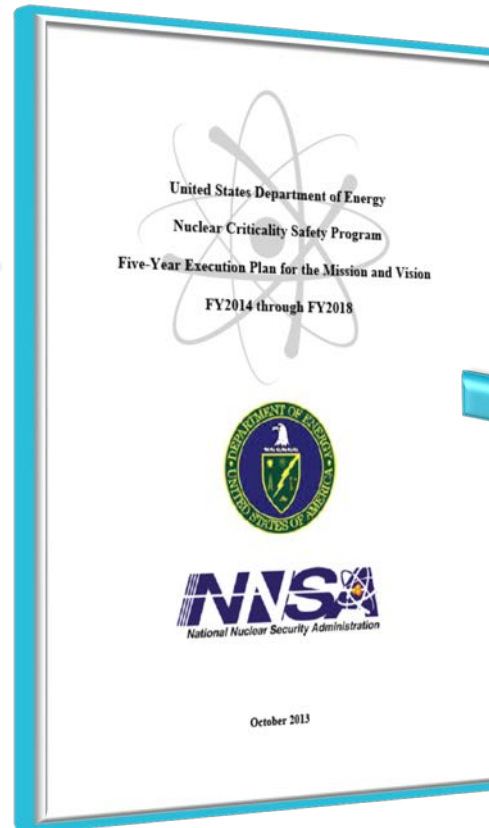
- Introduce the US Department of Energy/National Nuclear Security Administration (DOE/NNSA) Nuclear Criticality Safety Program (NCSP) and the Training and Education Project (T&EP)
- NCSP and T&EP Background
- Courses Offered
 - the 2-Week Hands-on course
 - the 1-Week Manager course
- Course Statistics
- Acknowledgements

NNSA Nuclear Criticality Safety Program

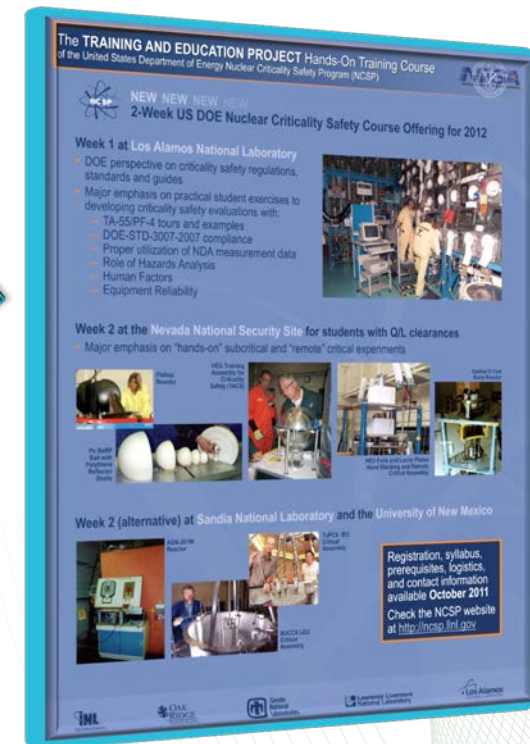
10 Year Mission & Vision



5 Year Plan



Work Tasks



US DOE NCSP T&E Element

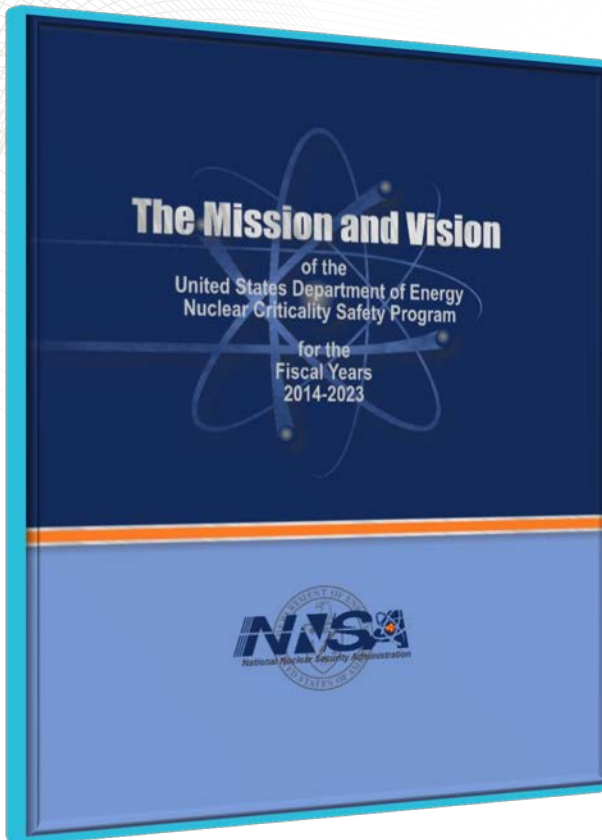


- **T&E Mission**

- 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.

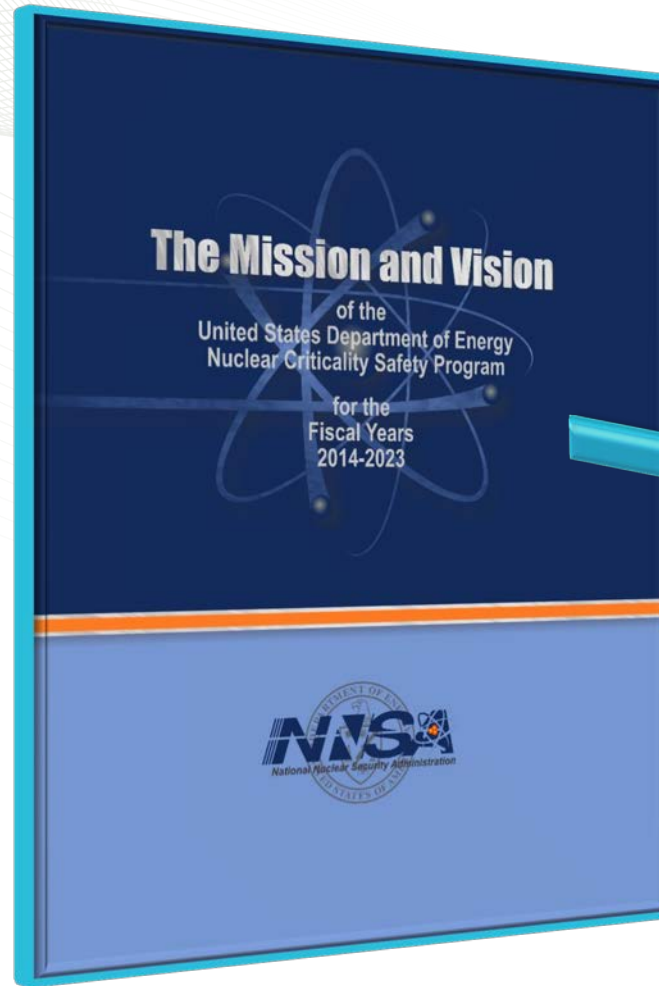
- **T&E Vision**

- 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.



US DOE NCSP T&E M&V

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

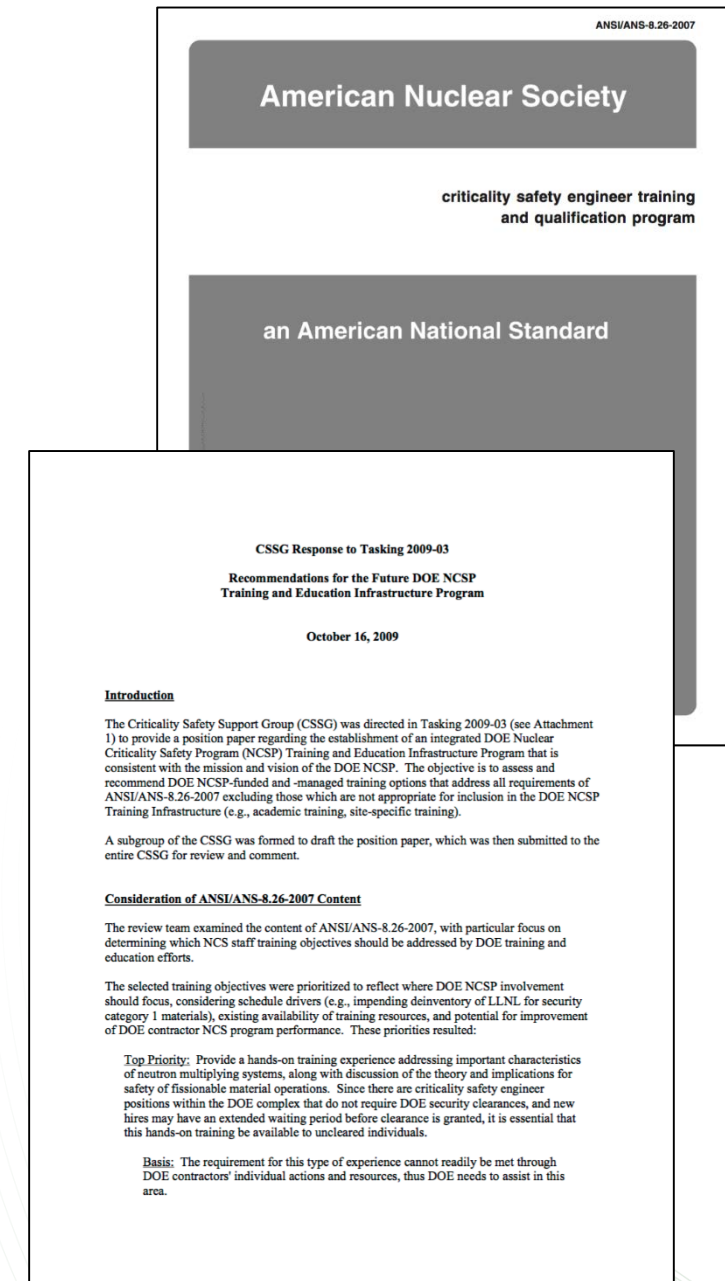


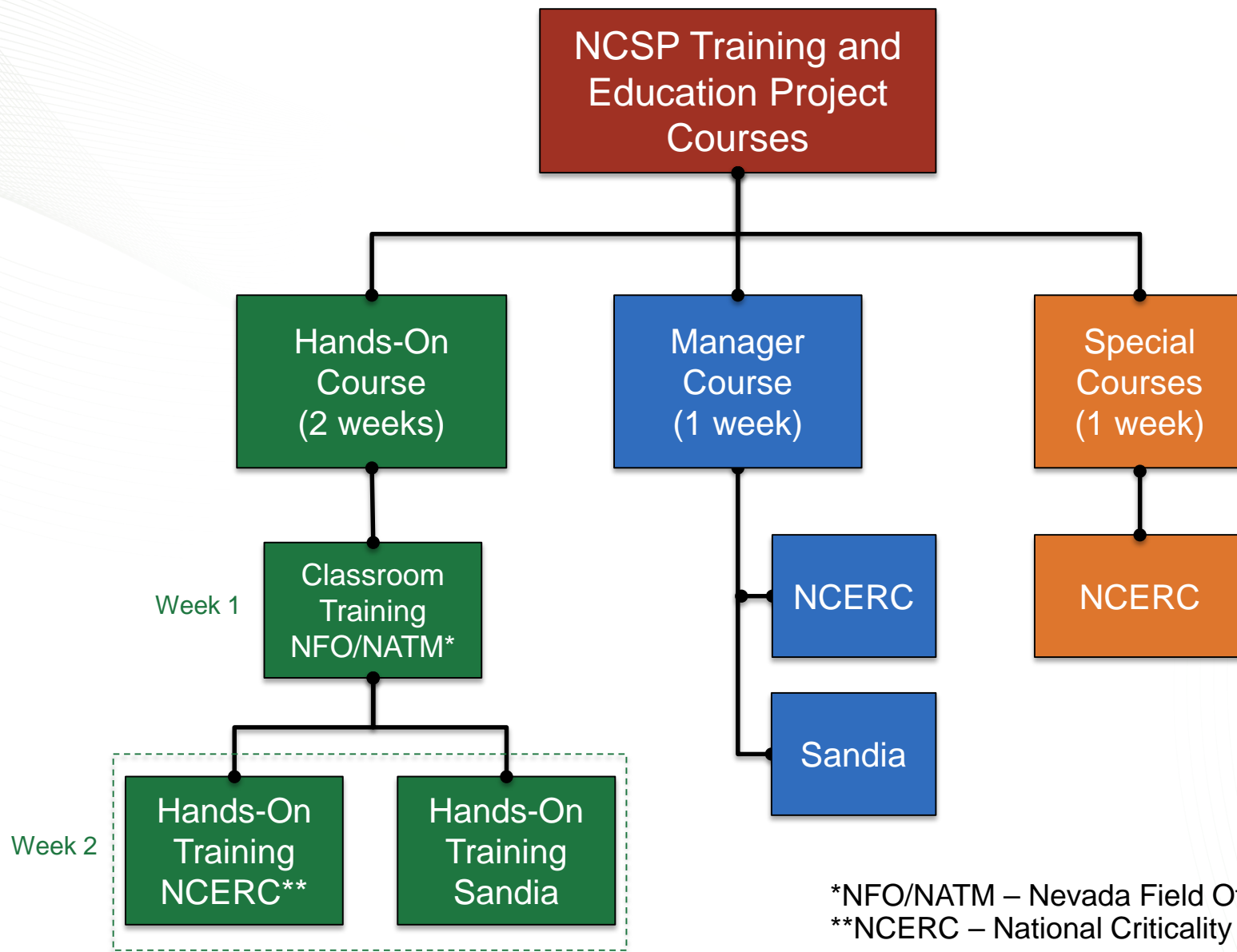
Color Code	
High Priority	Red
Medium Priority	Yellow
Low Priority	Green
STRETCH	Blue

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	High Priority	Medium Priority
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	High Priority	High Priority
	A criticality simulator is available to demonstrate criticality physics fundamentals to process operators	Medium Priority	Low Priority
	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)	Medium Priority	Low Priority
	A mobile (CAT III or IV material) criticality hands-on critical or near critical demonstration capability is available	Low Priority	High Priority
	Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users	Medium Priority	Medium Priority
	Tutorials on CAAS system placement evaluation needs and design options and considerations	Medium Priority	Medium Priority
	Tutorial on D&D related to criticality safety	Medium Priority	Medium Priority
	Sustain a training course for managers, supervisors, criticality safety officers, or criticality safety representatives, and DOE facility representatives	High Priority	Medium Priority
	Develop an NCSET module on the use of criticality safety accident slide rule to support emergency response	Low Priority	Low Priority
	Develop a mobile CAT 1 criticality hands-on critical or near critical demonstration capability	High Priority	High Priority

General Course Objectives

- Course content is based on CSSG Response to Tasking 2009-03 and ANSI/ANS-8.26-2007, “Criticality Safety Engineer Training and Qualification Program”
- Provide a consistent level of Department of Energy (DOE) interpretation, understanding, awareness and applications regarding
 - DOE Orders, Guides, American National Standards Institute/American Nuclear Society (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 experimental hands-on training addressing
 - Characteristics of neutron multiplying systems
 - Discussion of
 - Reactor dynamics
 - Implications for the safety of fissionable material operations





2-Week Hands-on Course – Week 1 Classroom Portion

Focus: NCS Evaluation Development

- DOE Requirements 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%



Aug. 2016 Class Photo – NATM



Feb. 2017 Class Photo – NFO

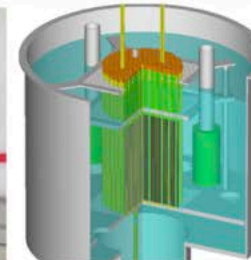


Aug. 2017 Class Photo – NATM

2-Week Hands-on Course – Week 2 Hands-On Portion

Focus: Hands-on with fissionable materials

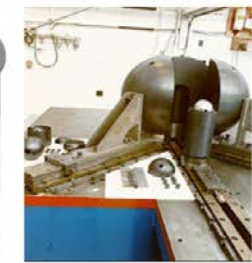
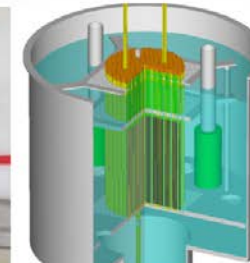
- Overview of Sandia and NCERC facilities and assemblies
- Overview of the experiment procedures and methodology
- Neutron dynamics fundamentals and subcritical multiplication
- Nuclear instrumentation
- ANSI/ANS-1 *Conduct of Critical Experiments*
- Lessons learned from experiment criticality accidents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

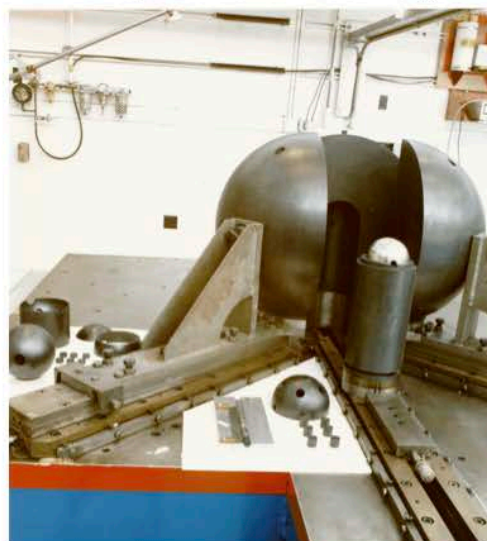
BeRP Ball and Np-237 Sphere Demonstration



TACS Subcritical Assembly



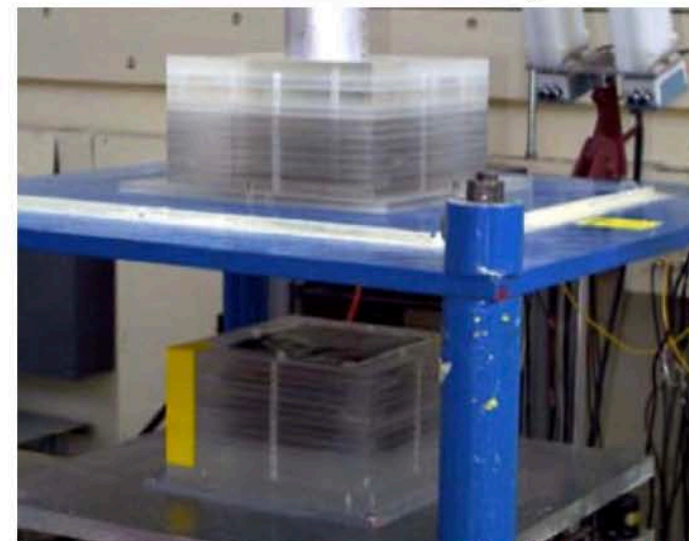
Flattop Critical Assembly



Godiva Critical & Delayed/Prompt
Supercritical Assembly

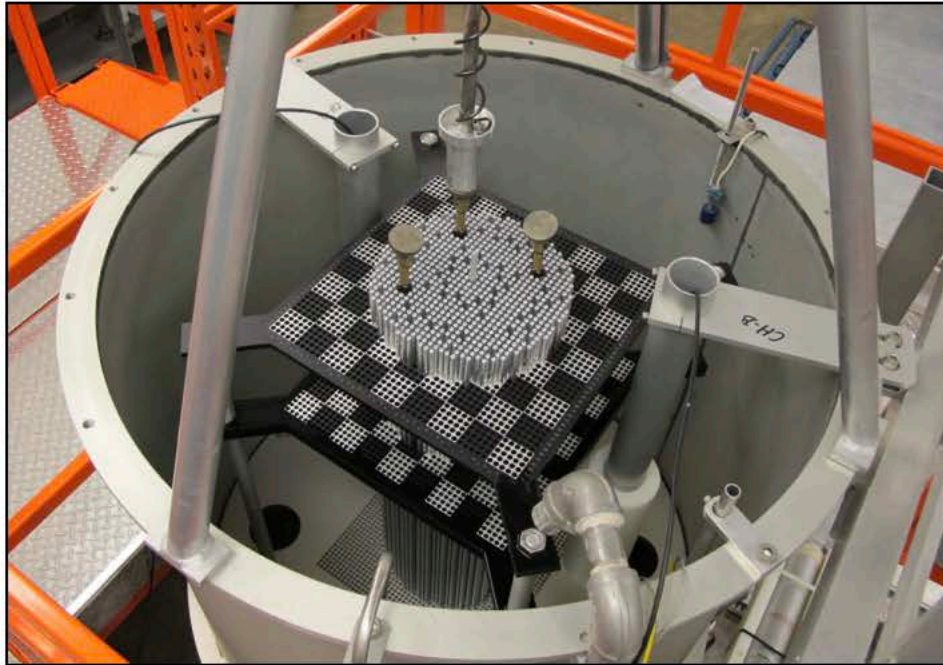


Planet Critical Assembly

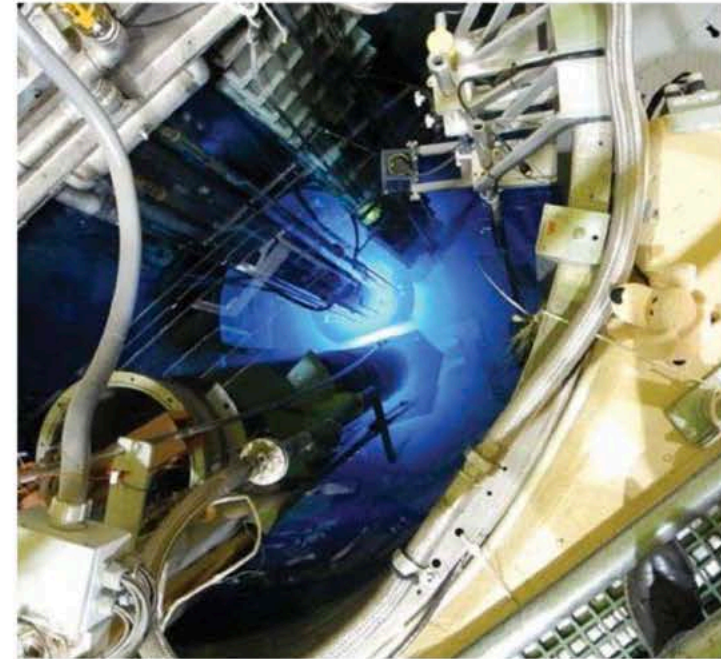


Sandia Hands-on Course

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



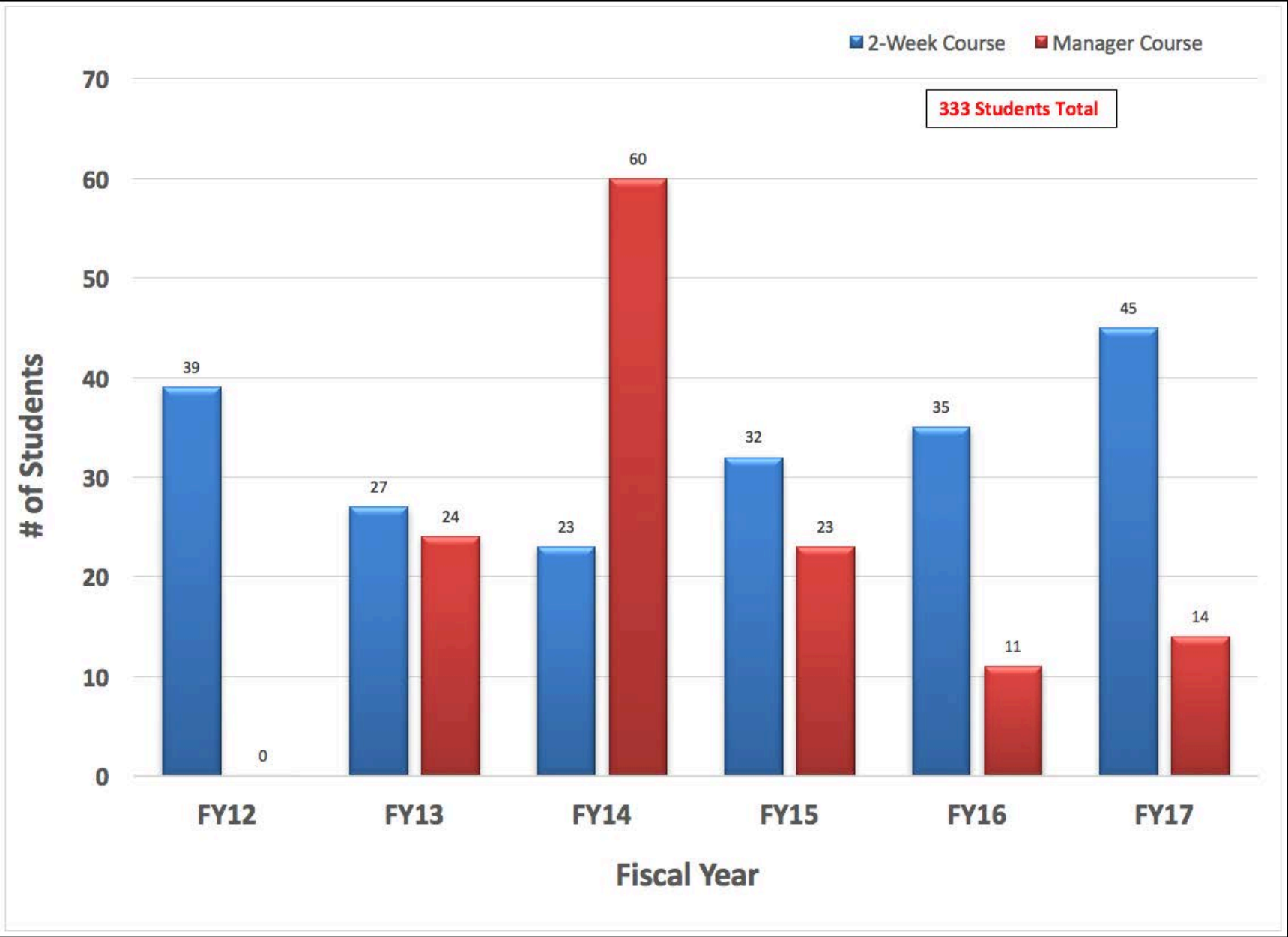
- EX1: Approach to critical on fuel loading
- EX2: Approach to critical on moderator height
- EX3: Approach to critical on fuel separation
- EX4: Interior fuel rod removal



Annular Core Research Reactor
(~\$3 Prompt Supercritical Pulse)

Course Statistics

Student Attendance



Acknowledgements

Registration & Badging

- Becka Hudson (LLNL)
- Sue Ziehm (LANL) – DAF Badging
- Brooke DeWane (LLNL) – NFO Badging
- Chuck Lee (LLNL)

National Atomic Testing Museum

- Grant Bowler

NFO

- Lori Scott (ORNL)
- Charlotte Carter (NFO)
- Cliff Washington (NFO)
- 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)
- Susan Stevens-Adams (SNL)
- Nichole Murchison (SNL)
- Chris Haught (Y-12)
- Forrest Brown (LANL)

LANL

- Jen Alwin (LANL)
- Theresa Cutler (LANL)
- Shean Monahan (SNL)
- Mark Mitchell (LANL)
- Susan Stevens-Adams (SNL)
- Jeff Chapman (ORNL)
- Jerry Hicks (NNSA Ret.)

Sandia

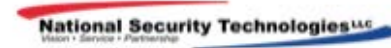
- Mary Ellen Ratzer (SNL)
- Gary Harms (SNL)
- John Ford (SNL)
- Shean Monahan (SNL)
- Ron Knief (SNL)
- John Miller (SNL)
- Kerstan Cole (SNL)
- Eric Moyer (SNL)
- Rafe Campbell (SNL)
- Jerry Hicks (NNSA Ret.)
- Bob Busch (UNM)

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)
- Rene Sanchez (LANL)
- 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?**

