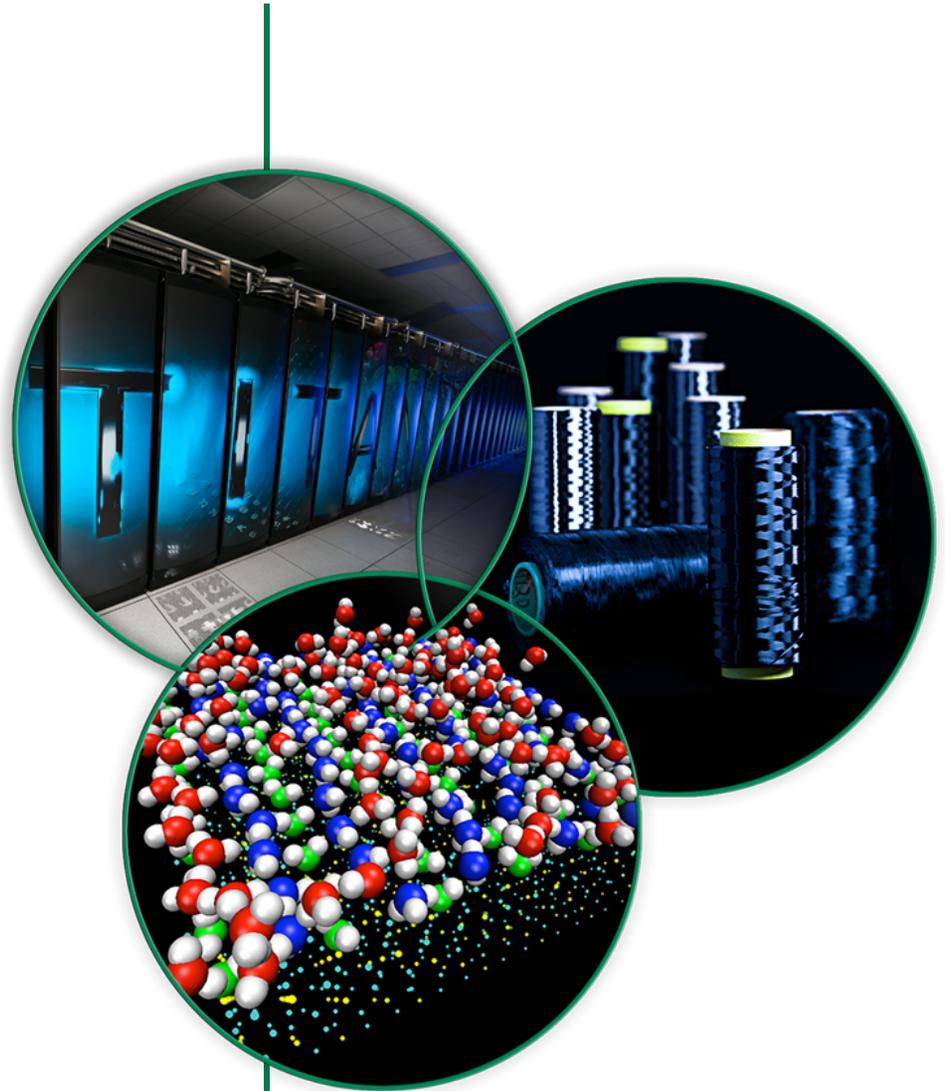


Status of the Development and Deployment of the NCSP Training and Education Courses

Douglas G. Bowen
Course Coordinator

NCSP Technical Program
Review Meeting
Livermore, CA
March 19, 2015



US DOE NCSP T&E Mission

- **The 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**
- **Primary purpose**
 - **...to maintain and enhance the technical abilities and knowledge of those who impact or are impacted directly by 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**

US DOE NCSP T&E Course Vision⁽¹⁾

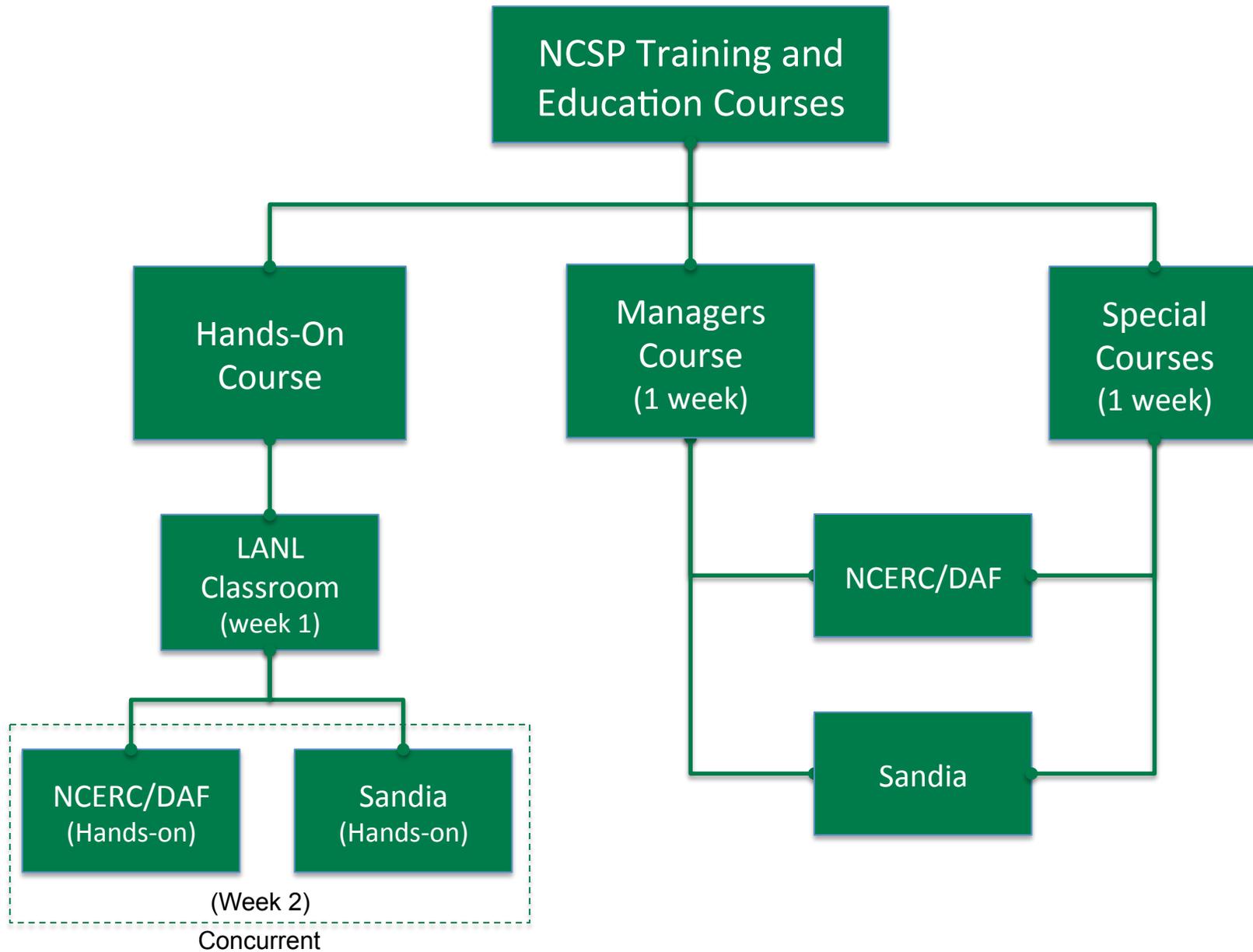
- **T&E Vision**
 - **This NCSP element will identify, develop, provide, and promote practical and excellent technical training and educational resources that help ensure competency in the art, science and implementation of nuclear criticality safety and is adaptable and responsive to the needs of those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

(1) The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2009 – 2018, (<http://ncsp.llnl.gov/NCSP-MV-COMPRESSED.pdf>)

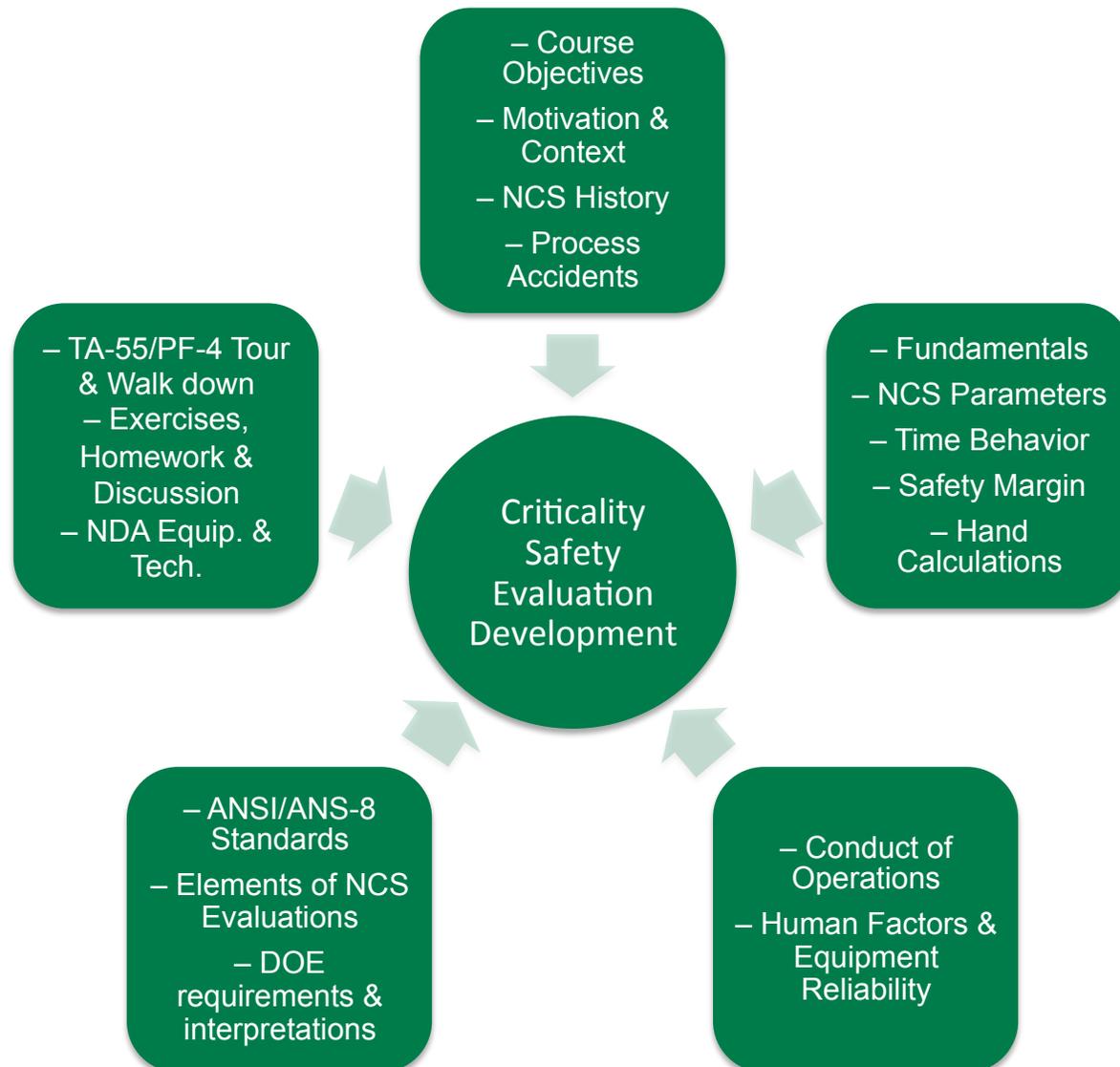
T&E General Course Objectives*

- **Provide a consistent level of DOE interpretation, understanding, awareness and applications regarding**
 - **DOE Orders, Guides, ANS Standards, Rules**
 - **Performance of Criticality Safety Evaluations**
 - **Hazards Analysis Methods and Implementation/maintenance of NCS Controls including precision and uncertainty of NDA and 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**
 - **Theory**
 - **Implications for the Safety of Fissionable Material Operations**

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



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



- Prerequisites
- Homework
- Quizzes
- Exam



2-week Hands-on NCS Course – Week 2

Hands-On Training Portion



**NCERC
Sandia**

- Course Objectives
- Motivation & Context
- Experimental Accidents

- Subcritical Exp. & Demos
(TACs, BeRP ball, Np-237 sphere, ACRR burst)
- Critical Exp.
(Planet, Flattop, Godiva, SPRF/CX)

- Fundamentals/Reactor physics lecture
- Subcritical multiplication
- Experiment bases for NCS

Criticality Safety Evaluation Development

- ANS-1 Standard
- NCS Evaluations
- DOE Req. & Interpretations
- ICSBEP Overview

- Conduct of Operations
- HF & Equip. Reliability
- Nuclear Instrumentation

Homework

Exam



HANDS-ON TRAINING & EDUCATION COURSE



NEW NEW NEW NEW

2-Week US DOE Nuclear Criticality Safety Course Offering for CSEs

No cost for the course!

Week 1 at Los Alamos National Laboratory

- ◆ DOE perspective on criticality safety regulations, standards and guides; overview of ANSI/ANS-8 standards
- ◆ Major emphasis on practical student exercises to developing criticality safety evaluations with:
 - TA-55/PF-4 tours and examples
 - DOE-STD-3007-2007 compliance
 - Nuclear Criticality Safety Fundamentals
 - Criticality Accidents
 - Proper utilization of NDA measurement data
 - Role of Hazards Analysis
 - Human Factors and Equipment Reliability



SECOND WEEK OFFERED AT TWO LOCATIONS!!!

- ◆ Major emphasis on "hands-on" subcritical and "remote" critical experiments

Week 2 at the Nevada National Security Site for students with Q/L clearances



Flattop Critical Assembly

HEU Training Assembly for Criticality Safety (TACS)



HEU Foils and Lucite Plates Hand Stacking and Remote Critical Assembly



Godiva IV Fast Burst Reactor



Pu BeRP Ball with Polythene Reflector Shells

Or...

Week 2 at Sandia National Laboratory for students with or without clearances



AGN-201M Reactor



7uPCX IEU Critical Assembly



BUCGX LEU Critical Assembly

Registration, syllabus, prerequisites, logistics, and contact information available.

<http://ncsp.llnl.gov>

(A 1-week course is also available for supervisors/managers & fissile material operations managers/handlers.)

1-week Manager Course (SNL & NCERC)



NCERC
Sandia

- Course Objectives
- Motivation & Context
- Experimental Accidents

- Subcritical Exp. & Demos (TACs, BeRP ball, Np-237 sphere, ACRR burst)
- Critical Experiments (Planet, Flattop, Godiva, SPRF/CX)

- Fundamentals/Reactor physics lecture
- Subcritical multiplication
- Experiment bases for NCS

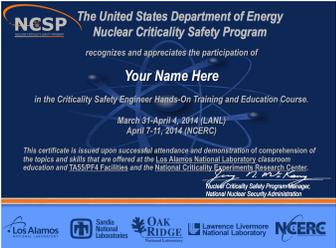
Understanding the Student's Role in an NCS Program

- ANS-1 Standard
- NCS Evaluations
- DOE Req. & Interpretations
- ICSBEP Overview

- Conduct of Operations
- HF & Equip. Reliability
- Nuclear Instrumentation

Homework

Exam



HANDS-ON TRAINING & EDUCATION COURSE



NEW NEW NEW NEW NEW

1-Week US DOE Nuclear Criticality Safety Course for:

“supervisors and managers, fissile material operations managers/handlers”

Course Overview

- ◆ DOE perspective on criticality safety regulations, standards and guides; overview of ANSI/ANS-8 standards
- ◆ Major emphasis on “hands-on” subcritical and “remote” critical experiments
- ◆ Major emphasis on practical exercises to developing criticality safety evaluations with:
 - DOE-STD-3007-2007 compliance
 - Nuclear Criticality Safety Fundamentals
 - Criticality Accidents
 - Proper utilization of NDA measurement data
 - Role of Hazards Analysis
 - Human Factors and Equipment Reliability

OFFERED AT TWO LOCATIONS!!!

No cost for the course!

Nevada National Security Site for students with Q/L clearances



Flattop
Critical
Assembly

HEU Training
Assembly for
Criticality
Safety (TACS)



HEU Fols and Lucite Plates
Hand Stacking and Remote
Critical Assembly



Godiva IV Fast
Burst Reactor



Pu BeRP
Ball with
Polythene
Reflector
Shells

Sandia National Laboratory for students with or without clearances



AGN-201M
Reactor



7uPCX IEU
Critical
Assembly



BUCCX LEU
Critical
Assembly

Registration, syllabus,
prerequisites, logistics,
and contact information
available.

<http://ncsp.llnl.gov>

*(A 2-week course is also
available for CSEs.)*

NCERC Courses

Device Assembly Facility – NCERC



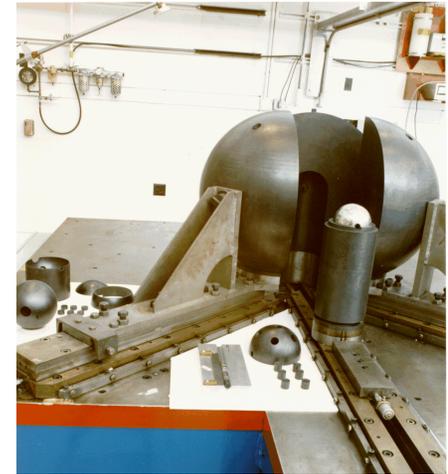
Godiva – 93.2% HEU



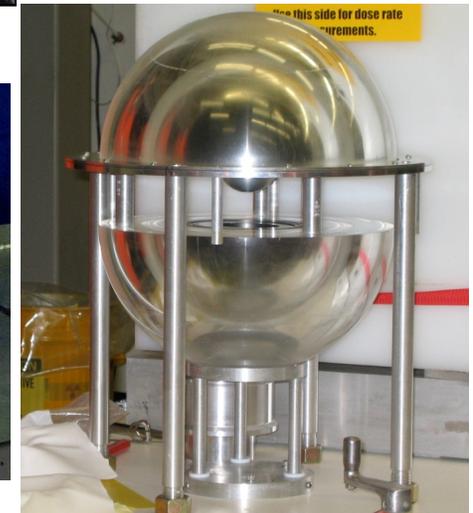
Planet – 93.2% HEU metal foils



Flattop – 93% HEU metal, nat. U refl.



TACS – 8 HEU shells (93.2%)

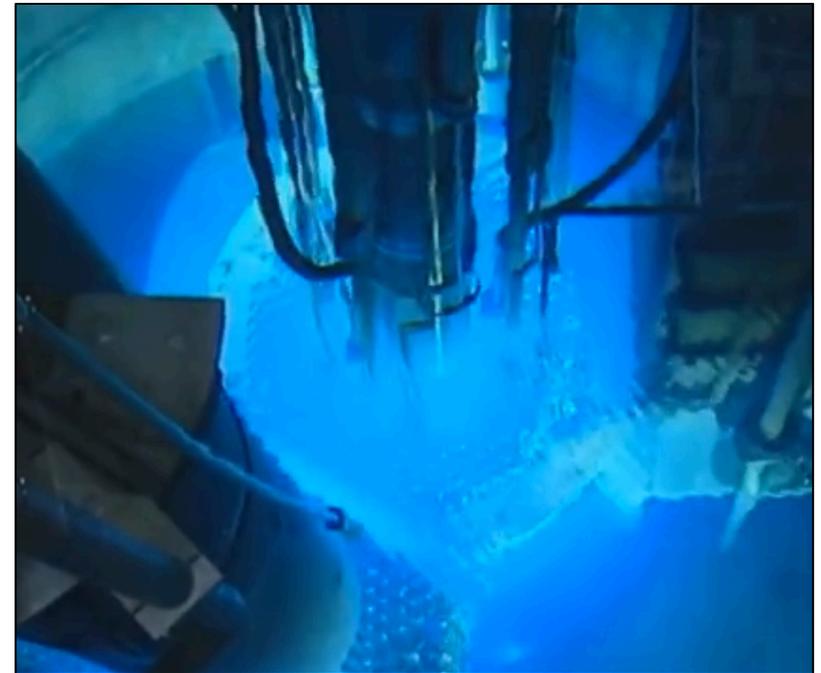
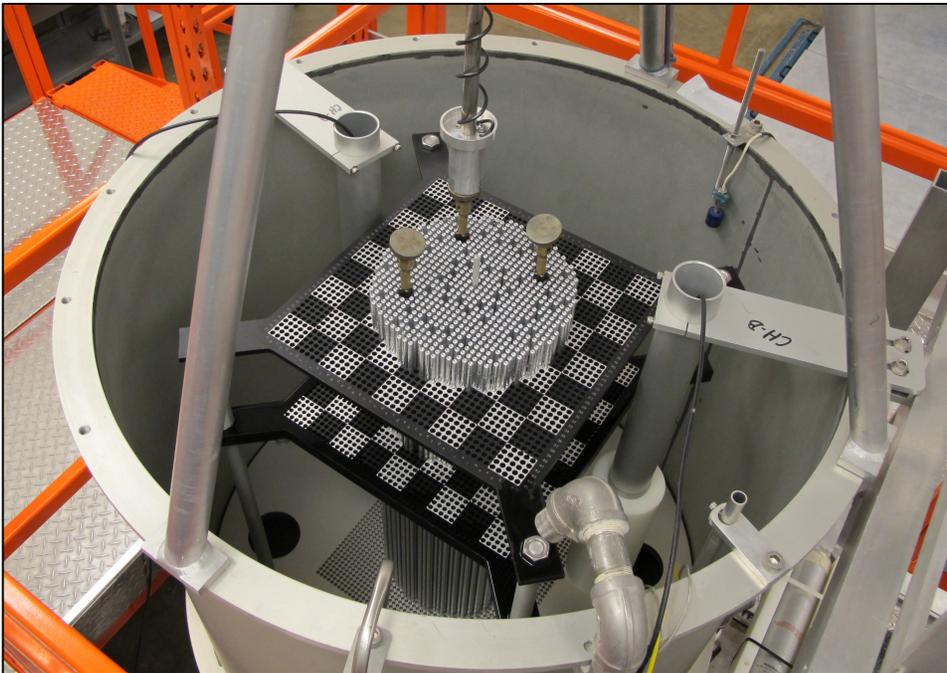


BeRP Ball – α -phase Pu, poly refl.



SNL Courses

- 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

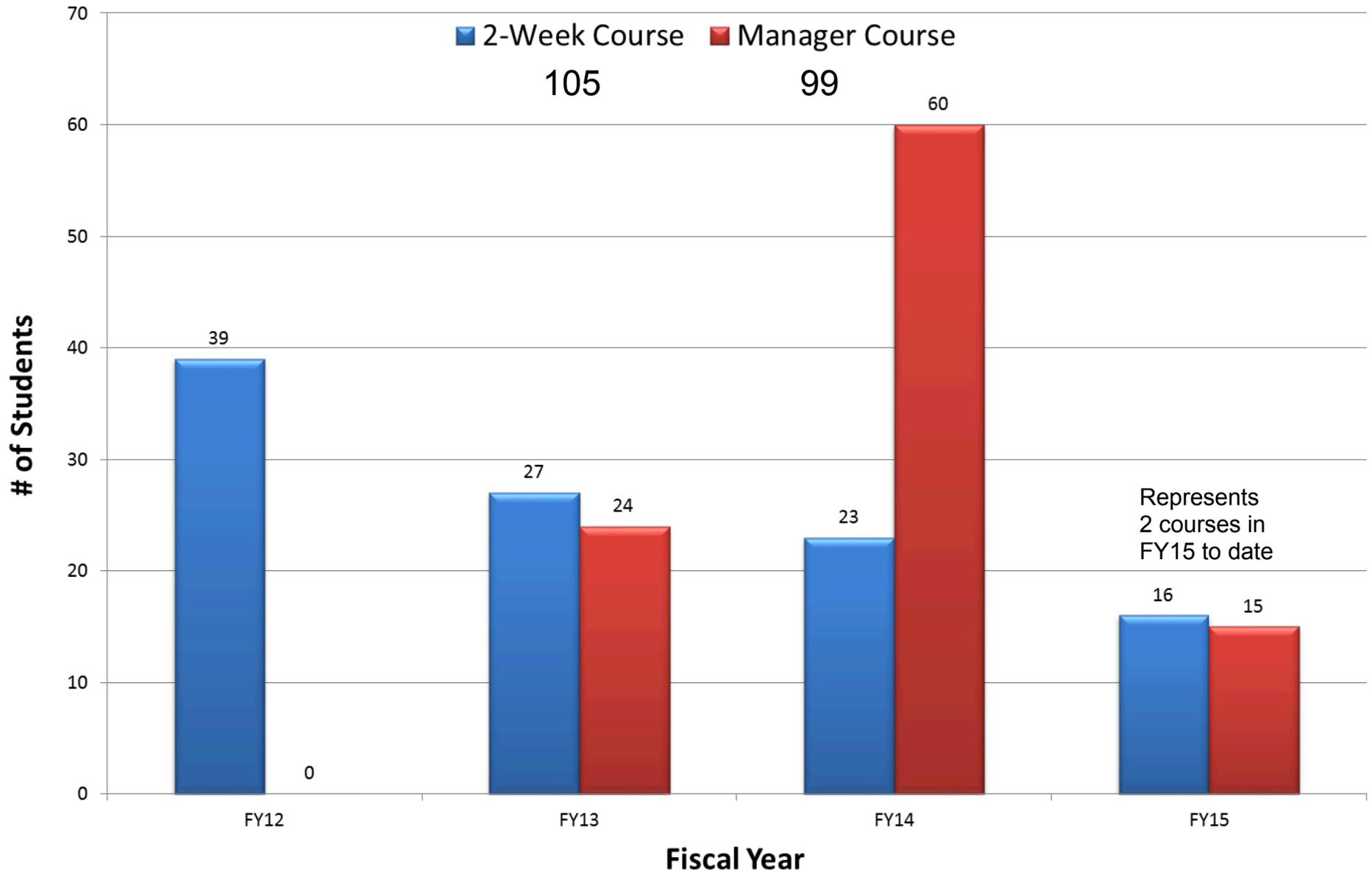
Annular Core Research Reactor
(ACRR)

NCSP T&E Courses – Timeline

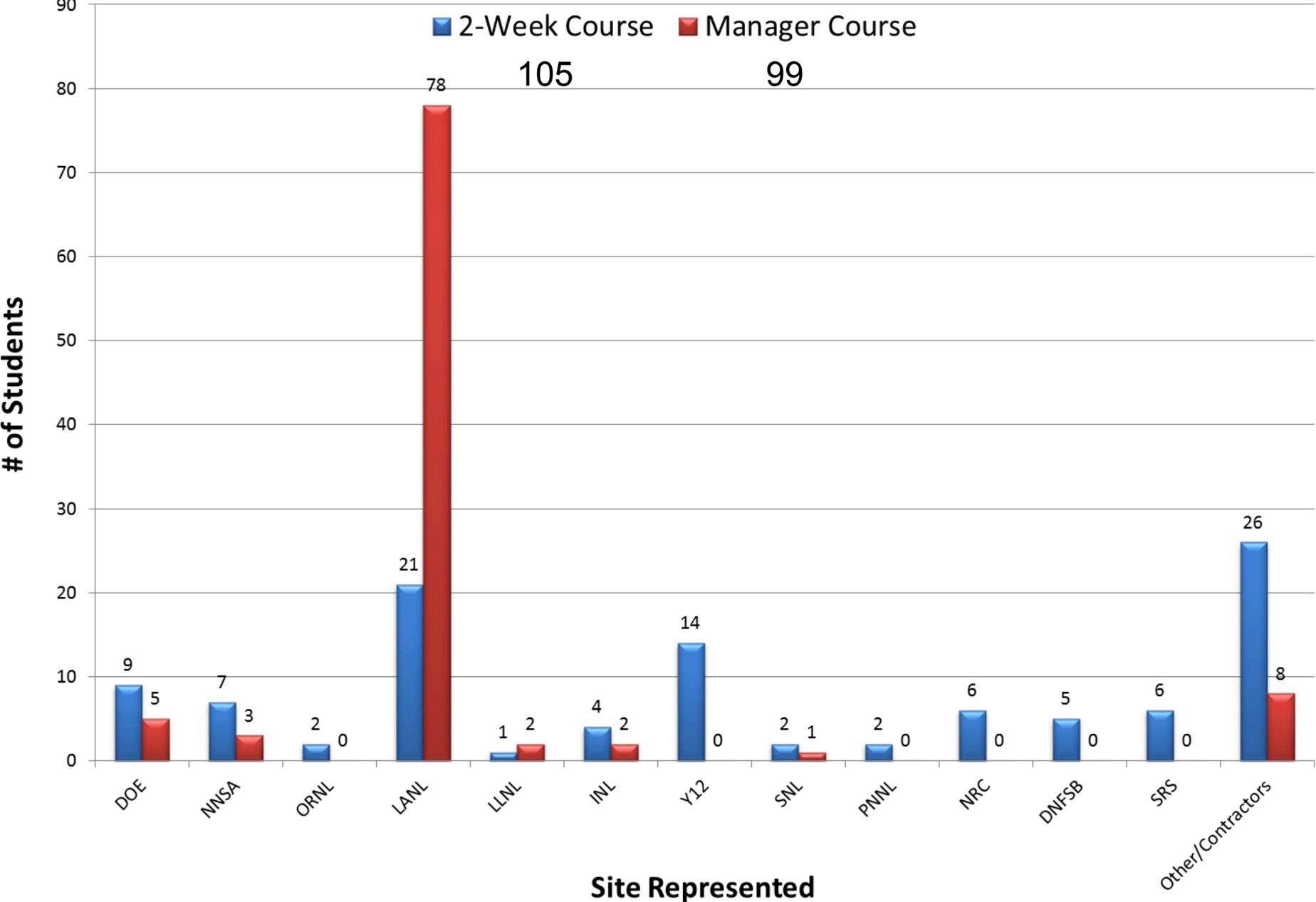
• FY11	1 st Pilot Course (Aug. 2011)			
• FY12	Hands-on Course (Jan./Feb. 2012)	Hands-on Course (May 2012)	Hands-on Course (Aug. 2012)	
• FY13	Hands-on Course (Jan./Feb. 2013)	Hands-on Course (May 2013)	Manager Course (Apr. 2013)	Manager Course (Sep. 2013)
• FY14	Hands-on Course (Dec. 2013)	Hands-on Course (Mar./Apr. 2014)	Manager Course (Nov. 2013)	Manager Course (Jan. 2014)
	Manager Course (Feb. 2014)	Manager Course (May. 2013)	NFO 1d Course (May. 2013)	
• FY15	Hands-on Course (Jan. 2015)	Hands-on Course (Jun. 2015)	Manager Course (Feb. 2015)	Manager Course (Aug. 2015)
	AWE Course (Mar. 2015)			
• FY16	Hands-on Course (Feb. 2016)	Hands-on Course (Jun. 2016)*	Manager Course (Jan. 2015)	Manager Course (Aug. 2015)*

* Tentative

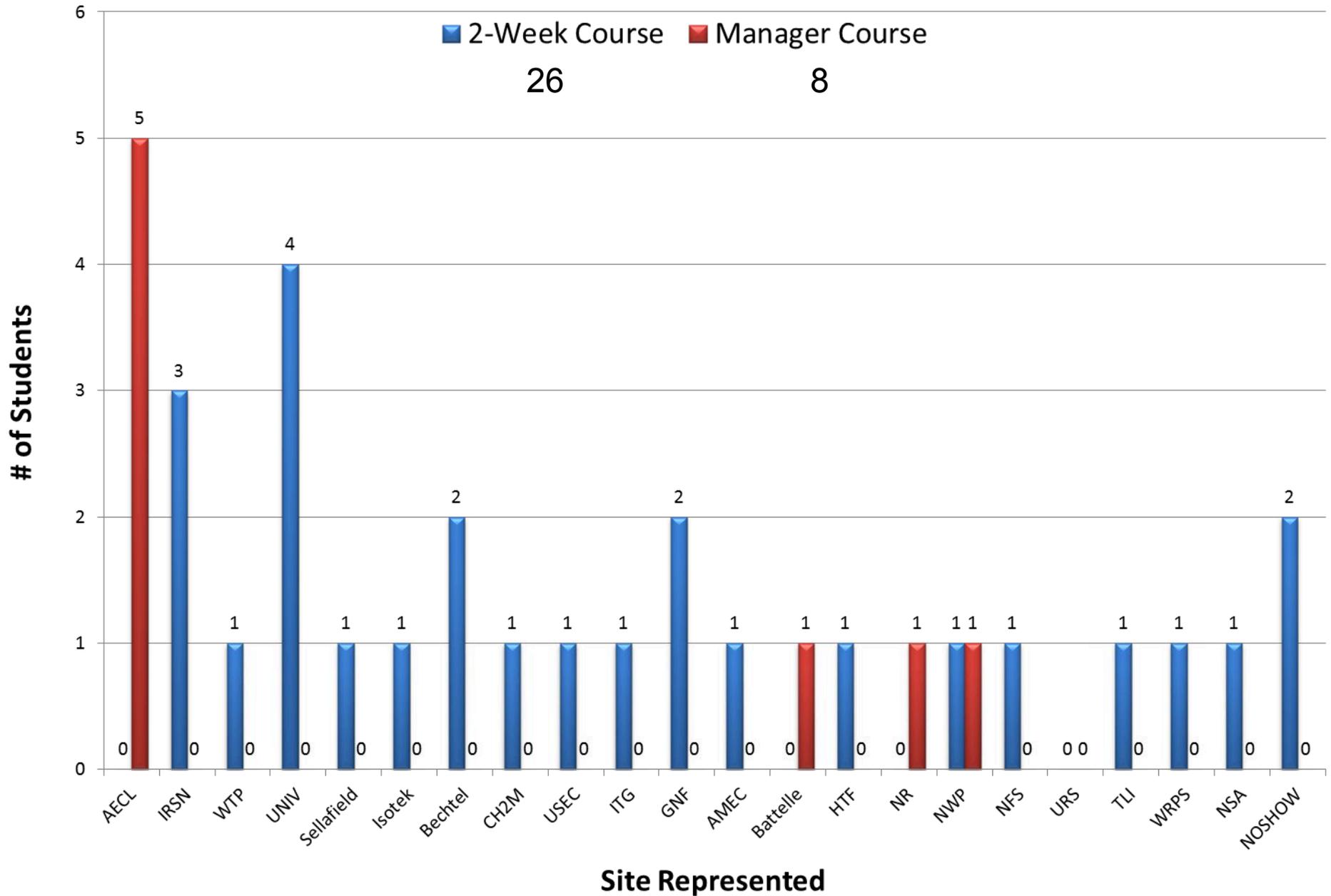
NCSP Training and Education Project Course Attendance by FY



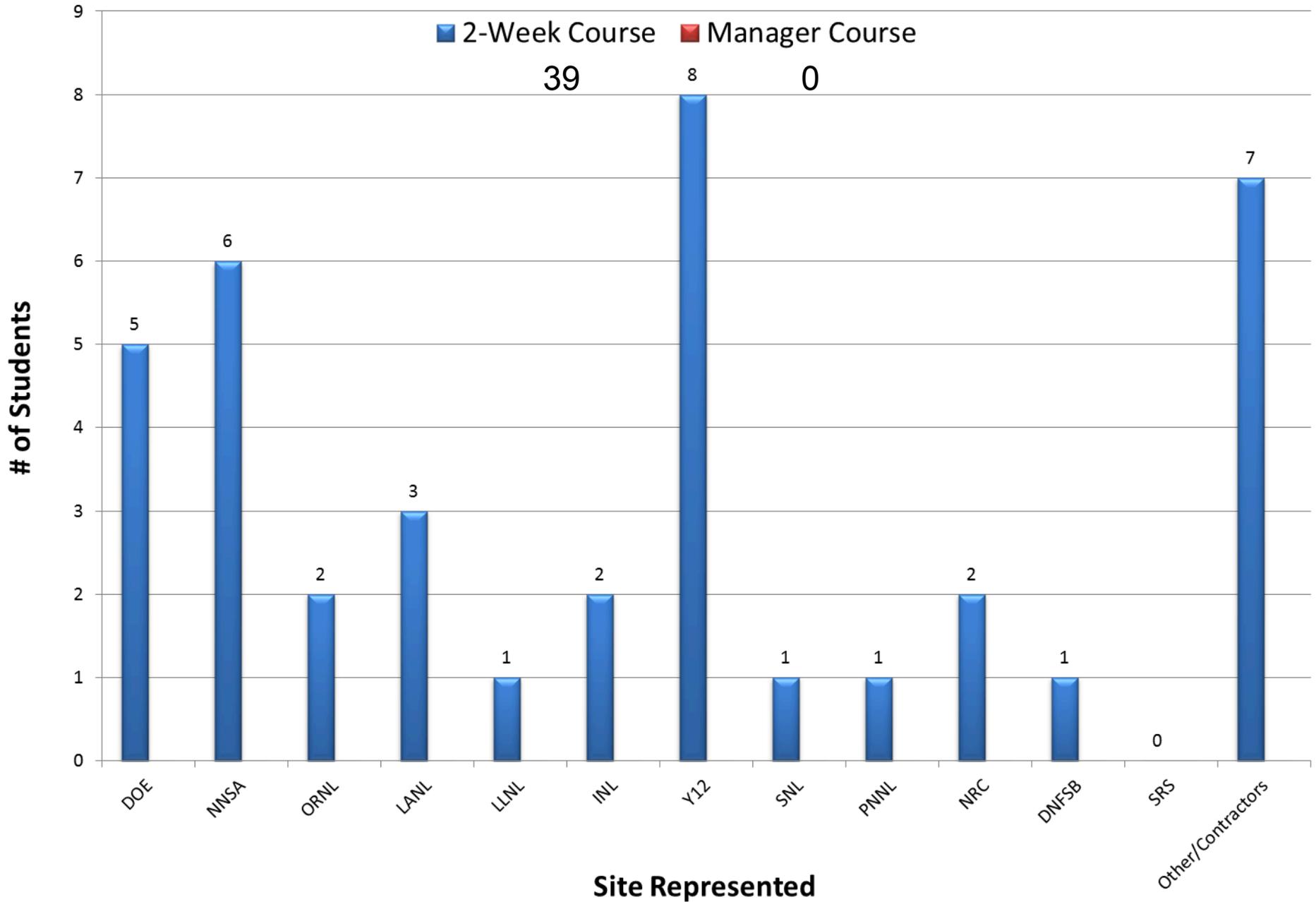
NCSP Training and Education Project Course Attendance



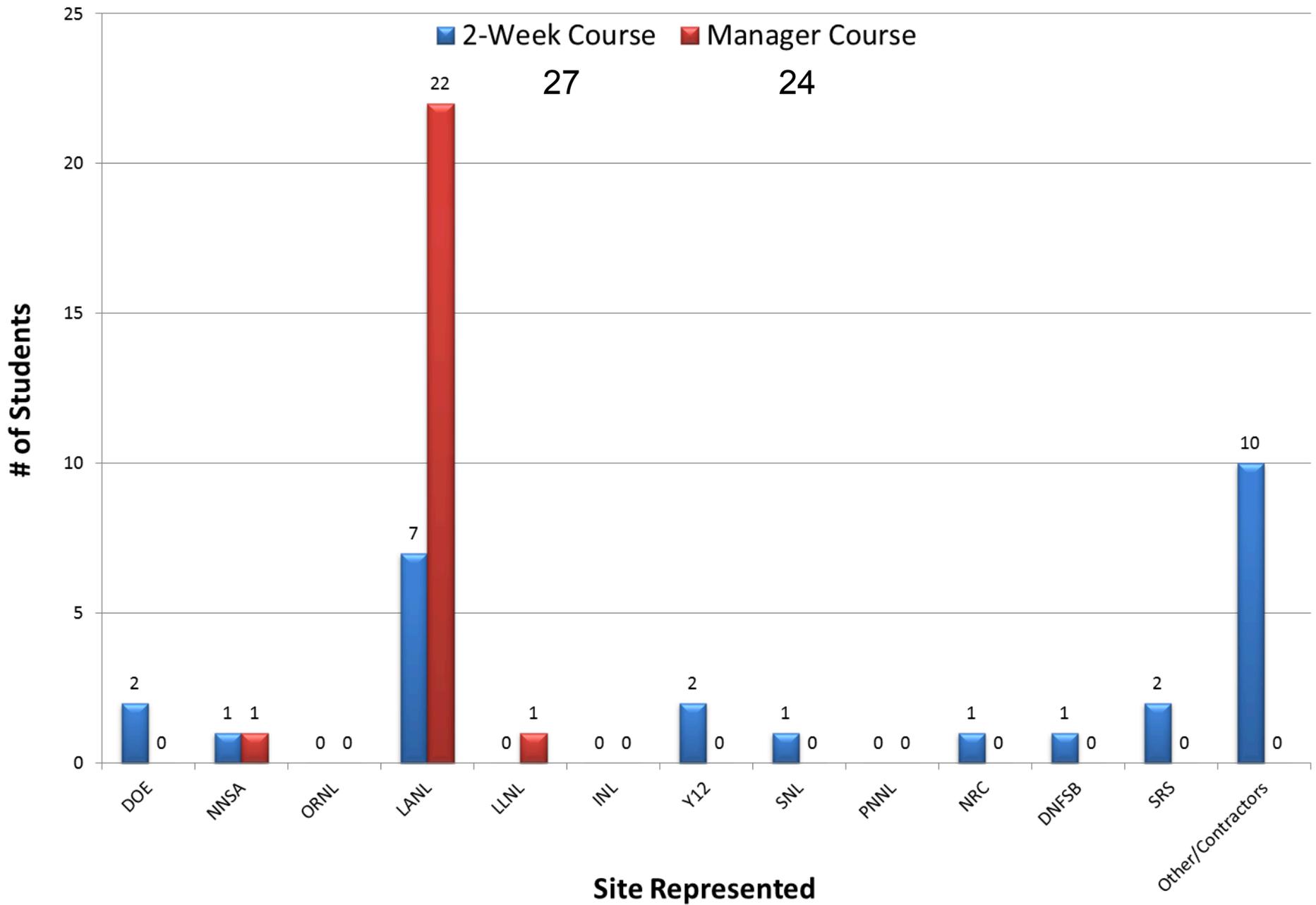
NCSP T&E Project Course Attendance – Others/Contractors – Since FY12



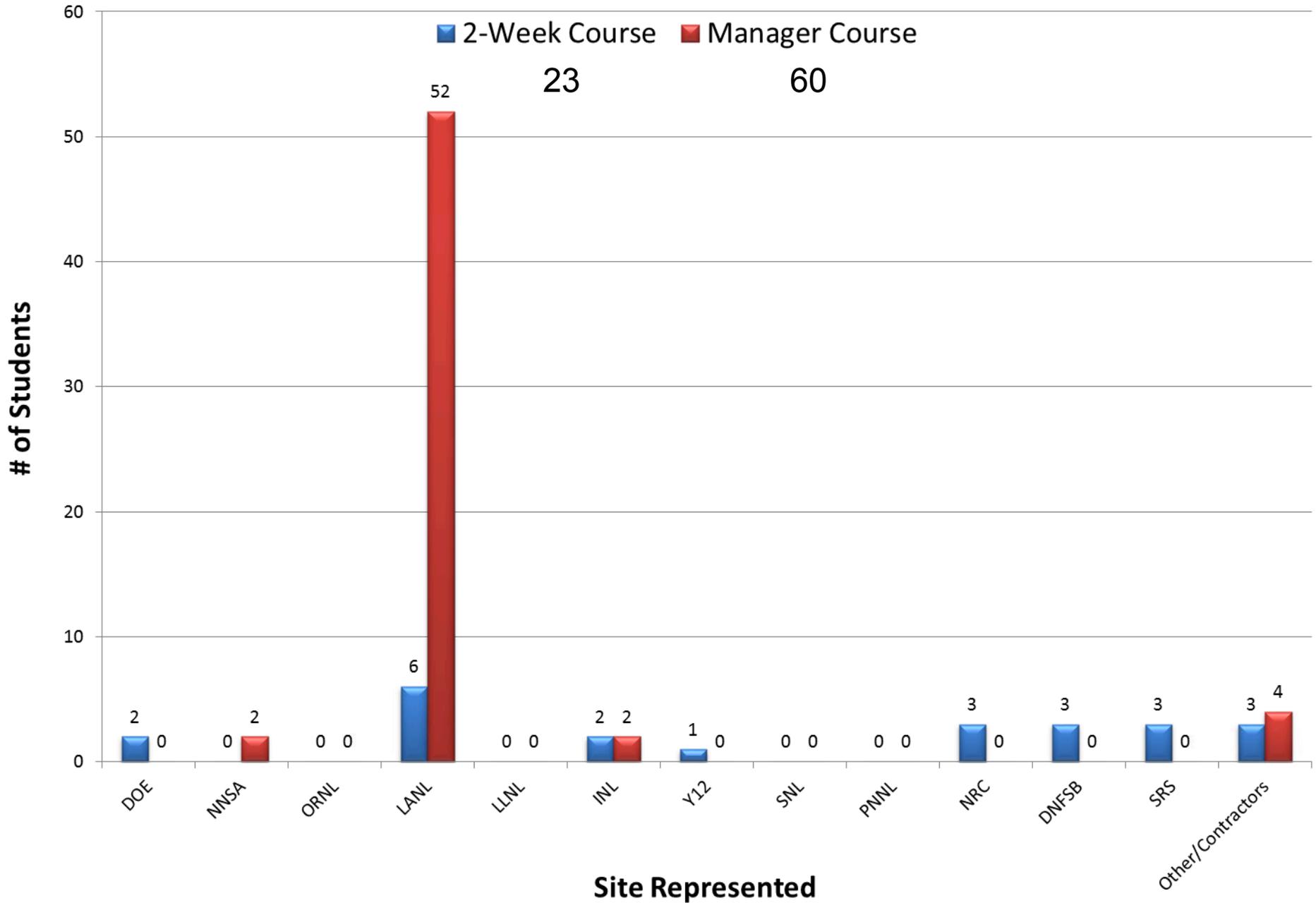
NCSP Training and Education Project Course Attendance – FY12



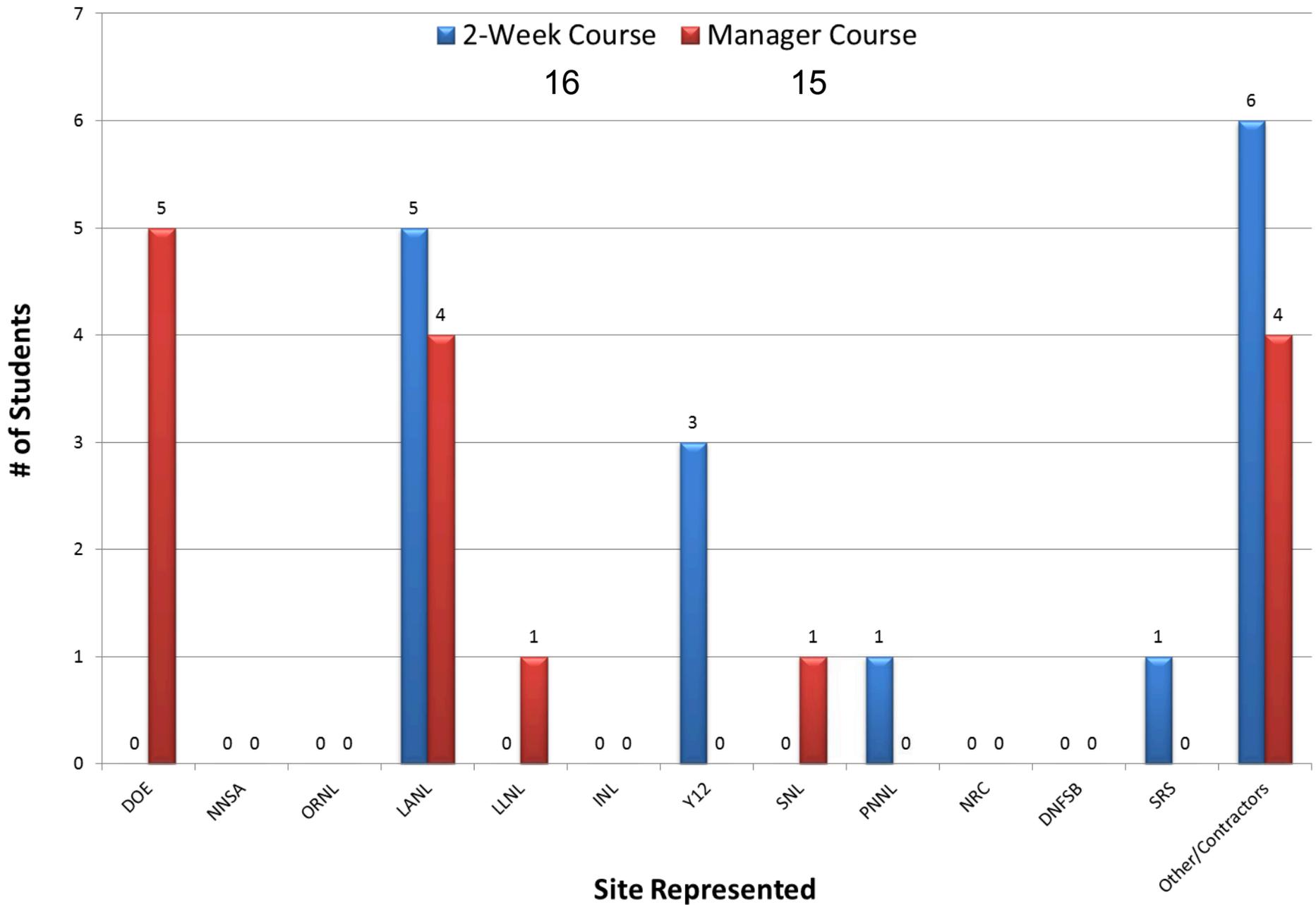
NCSP Training and Education Project Course Attendance – FY13



NCSP Training and Education Project Course Attendance – FY14



NCSP Training and Education Project Course Attendance – FY15



NCSP T&EC – FY14 & FY15 Summary

- **FY14**

- **Total 7 courses**

- 2 hands-on courses (LANL/SNL/NCERC)
 - 4 manager courses
 - 1 special course – NFO course (1 day at NCERC)

- **A total of 83 students trained**

- 23 in the hands-on courses
 - 60 in the manager courses

- **FY15**

- **Total 5 courses**

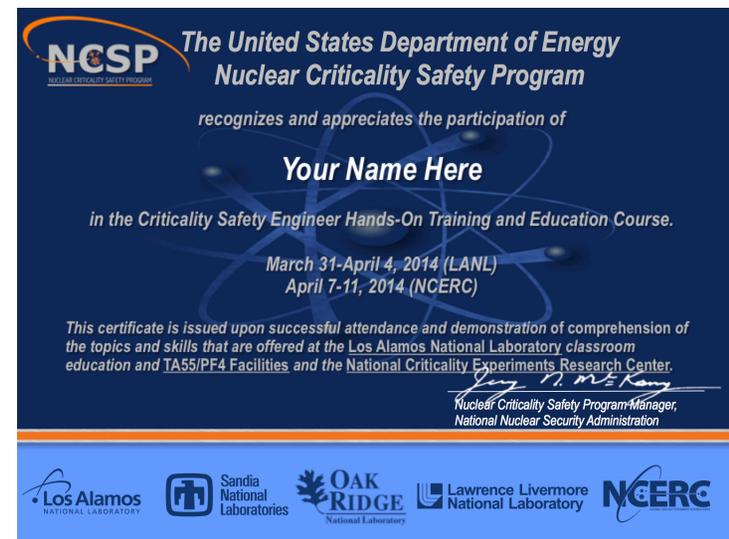
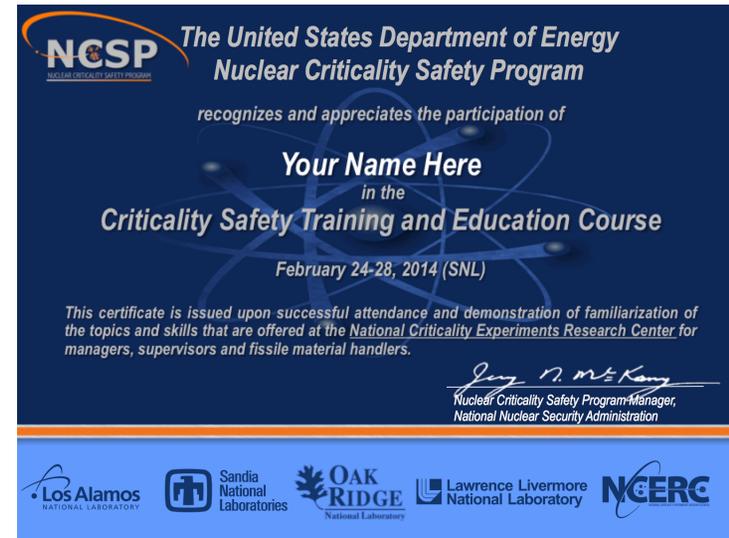
- 2 hands-on courses (LANL/SNL/NCERC)
 - 2 manager courses
 - 1 special course AWE course (1 week at NCERC)

- **A total of 40 students trained so far**

- 16 in the Jan. hands-on course
 - 15 in the Feb. manager course
 - 9 in the AWE course in March

Completion Certificates

- For the hands-on course, students must attend both classroom and one of the hands-on weeks
- Must demonstrate comprehension by passing closed-book exams
 - 80% or better for both weeks to receive a certificate of completion and
 - 70% test, 30% participation during the hands-on week
- If failed, may attend the course again (with approval)
- Discontinuous attendance allowed on a case by case basis (to be completed within 1 year)
 - No certificate until both completed successfully



US DOE NCSP T&E Course Vision

- **Be a continually improving, adaptable, and transparent project**
 - **Student evaluations**
 - **Lessons-learned discussions with POCs and instructors as necessary**
 - **Instructor feedback**
 - **Contributor feedback**
 - **Management feedback**
 - **CSSG feedback**

Improvements in Progress

- **Integration of Human Factors and NDA**
 - Case studies
 - HF and NDA instructors are available most of the week rather than just one day
 - Integrate into the course rather than having large block of course modules
 - Process accidents
 - CSE exercise classroom discussions
- **Proposed modules/experiments are in progress**
 - Planet experiment with multiple foils between moderator plates
 - Module for why Validation is important to NCS practitioners

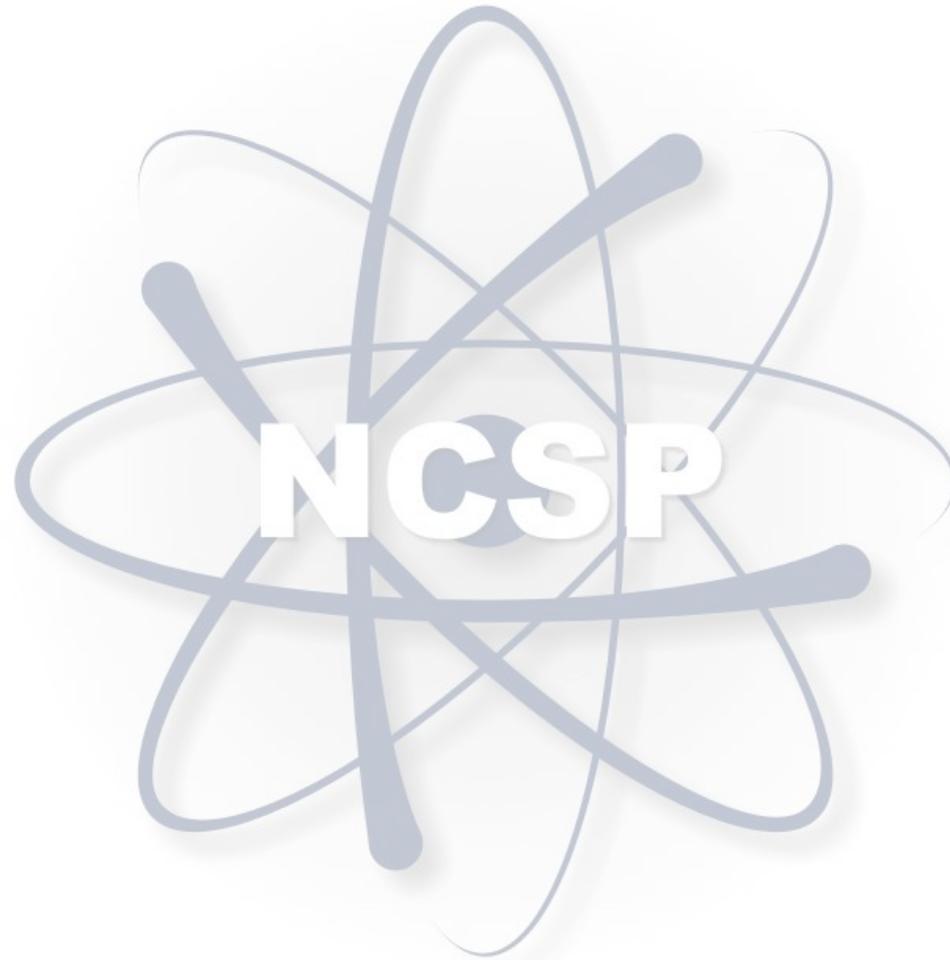
FY16 Course Dates – Get the Word Out

- **Two-week hands-on courses**
 - **Offering #1**
 - LANL Classroom: Feb. 1-5, 2016
 - NCERC & SNL: Feb. 8-12, 2016
 - **Offering #2 (proposed)**
 - LANL Classroom: Jun. 20-24, 2016
 - NCERC & SNL: Jun. 27-Jul. 1, 2016
- **One-week Manager Courses**
 - SNL: Jan. 11-15, 2016
 - NCERC: Aug. 24-28, 2016 (proposed)
- **No special courses proposed at this time**

Class Photos



Questions?



UNITED STATES DEPARTMENT OF ENERGY
Nuclear Criticality Safety Program