Training Next Generation NCS Engineers at the Y-12 NSC

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Outline

- NCS Qualification and Training Program
- Structured Training Sessions
- Brownbag Sessions
- Offsite Training Opportunities
- Conclusion

NCS Training Program Overview

- Qualification program per DOE 5480.20A
- Program requirements are formally documented
- Program is administered by a qualification verification official (QVO)
- Program is approved by QVO, training management, and NCS management
  - Training management ensures requirements from DOE 5480.20A are met
  - NCS management ensures needs of the NCS organization are met
  - Various subject matter experts in NCS provide technical guidance

NCS Training Program Structure

- Four qualified positions
  - Engineer-in-Training
  - NCS Engineer
  - Sr. NCS Engineer
  - NCS Manager
- Twelve Tasks
  - Analysis and Computations (3)
  - Review Tasks (3)
  - Floor Support (1)
  - Emergency Response (2)
  - Document Approval (1)
  - Program Management (2)

NCS Training Program Structure

- Ten “Facilities”
  - Enriched uranium processing facilities (4)
  - Enriched uranium storage facilities (2)
  - Analytical chemistry laboratory
  - Processing facility undergoing decommissioning
  - Onsite transportation vehicle
  - New facility project

Position Requirements

- EIT
  - Six months NCS experience, 1 year nuclear
  - Hand calculations
  - Document familiarization (ANS 8 series standards, DOE orders and guides, Y-12 Plant NCS procedures)
- NCS Engineer
  - EIT
  - 2 years NCS experience (1 at Y-12)
  - Analysis and floor support tasks
  - Facilities in one group
  - Oral board
- Sr. NCS Engineer Requirements
  - NCS Engineer
  - 10 years NCS experience (5 at Y-12)
  - Facilities in both groups
  - Review and compliance tasks

Engineer-in-Training

- Basic Practice Knowledge
- Basic Document Knowledge

NCS Engineer

- Analysis and Floor Support Tasks
- Facility Qualifications (partial)
- Oral board

Sr. NCS Engineer

- Review Tasks
- Facility Qualifications (all)
- Compliance Task
- Oral Boards

Support for Trainees

- Mentor-protégé arrangement
- Balance of experienced to inexperienced challenges one-on-one mentoring
- Eight structured training sessions recently developed
  1. Plant Mission
  2. Regulatory Requirements and NCS Program Structure
  3. Critical Experiments
  4. Handbook Data
  5. Hand Calculations and Introduction to Computer Codes
  6. Monte Carlo Codes
  7. Criticality Accidents and Alarm Systems
  8. Field Incident Simulator

Plant Mission

- Provide trainee with “big picture” point of view
- Enriched uranium (EU) weapons components
  - Production
  - Dismantlement
  - Quality evaluation
  - EU for Naval fuel
  - EU for reactor fuel
  - Safeguarding EU
- Types of operations in each facility, intermediate products, waste streams
- How facilities interact

Regulatory Requirements and NCS Program

- Documented NCS policy (responsibilities, accountability, process analysis requirement, reporting, training, program management and oversight, and meeting laws and orders)
- Sources of regulatory requirements
- DOE O 420.1B, ANS 8.1 and 8.19
- Flowdown of regulatory requirements to implementing documents
- Understanding the Double Contingency Principle and Process Analysis Requirement

Critical Experiments

- What they are
- Why they were done
- Experiments used to derive subcritical limits
- Importance to NCS analysis and computations
- Effect of neutron sources on experiments and k-eff

Handbook Data

- Understanding subcritical/critical curves
  - Identifying minimum mass limits
  - Indentifying limiting concentration
  - Relationship between mass and volume curves
  - Convergence of reflected and unreflected curves
  - Convergence of metal-water and solution curves
- Shape conversions
- Reflector properties
- Heterogeneity

Hand Calculations and Introduction to Computer Codes

- Core density conversions – criteria for its application
- Buckling conversion - criteria for its application
- Neutron transport equation
  - Understanding the terms in the balance
  - Adjusting the equation to solve for subcritical/supercritical states
  - When time dependence is important
- Discrete ordinates and Monte Carlo
- Energy grouping and cross section treatment

Monte Carlo Codes

- Advantages and disadvantages vis-a-vis discrete ordinates
- Decisions in a Monte Carlo simulation
- Differences b/w MCNP and KENO sequence in SCALE
- Cross section libraries
- Understanding cross sections of fissile material and absorbers
- Limitations in SCALE cross section treatment (BONAMI and NITAWL)
- Source convergence
- Reading and interpreting output
- Validations, bias, area of applicability

Criticality Accidents and Alarm Systems

- Types of accidents – metal and solution
- Past accidents, lessons learned
- Transient behavior
- Consequences of accidents
- Shutdown mechanisms
- Y-12 criticality accident alarm systems
  - Actuation logic
  - Redundancy
  - Impact of excessive shielding

Field Incident Simulator

- Training room outside of fissile control areas
- Mock-up storage and processing areas
- Postings and container labels
- Non-compliant conditions are set up
- Trainee asked to identify noncompliances
- Trainee asked to specify corrective actions

Brown-bag Seminars

- Informal presentations and discussions
- Scheduled after group meetings
- Technical Topics
  - Low concentration, low H/X systems
  - U metal systems (shapes, density, piece sizes)
  - K-eff of the world
  - Use of the Criticality Safety Index
  - CIDAS criticality alarm system
  - Immediate evacuation zone analysis
- Analysis Topics
  - Risk and the Double Contingency Principle
  - Applying realistic conservatism
  - Risk and Criticality Safety of Casting
  - Absorption of water into uranium powders
  - Standard Review Plan for CSEs

Brown-bag Seminars

- Feedback and Updates
  - Peer review comments
  - ANS conference summaries
  - Changes to ANS standards
  - Changes to plant procedures
  - Updates on new facility projects
- Trip Reports
- Training Course Summaries
  - TSUNAMI
  - Holdup measurement workshop

Offsite Courses and other Opportunities

- Hands-on course (LANL/LLNL)
- University of New Mexico short courses
- University of Tennessee short courses
- MCNP and KENO courses
- ANS conferences and professional development workshops
- Educational assistance program
  - University of Tennessee graduate course in NCS
  - MS and PhD in NE

Conclusion

- NCS analysis, computations, and data not covered in detail in most university NE programs
- NCS Training and Qualification Program is a mentor-protégé program
  - structured provided by requirements for task and facility qualifications
  - Competency is judged by mentors and oral boards
- Augmented by:
  - Training sessions
  - Offsite training
  - Brown bag seminars
- Fully capable of training engineers to perform calculations, perform process evaluations, and provide field support