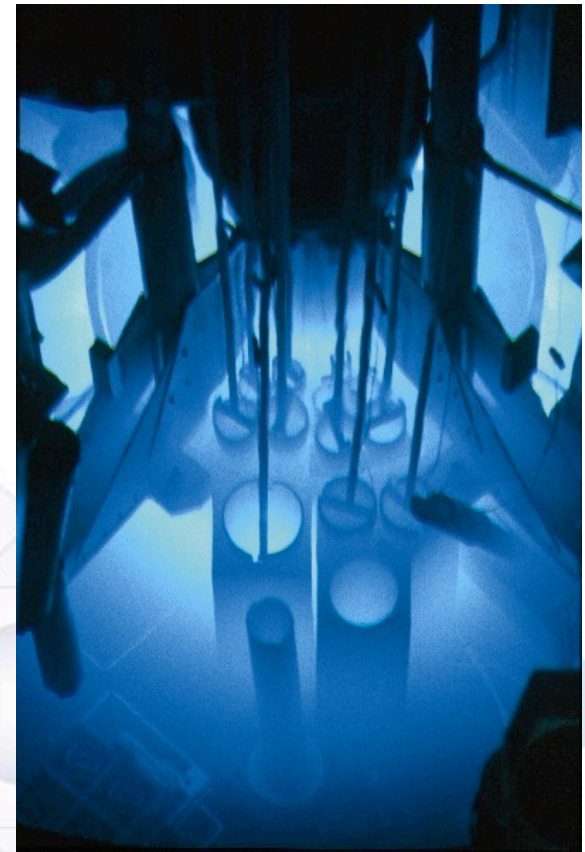


Conducting a State Systems of Accounting for and Control (SSAC) of Nuclear Materials Training Program at the University of Missouri Research Reactor (MURR)



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Presentation Overview

- Course Purpose, History and Overview
- History and Description of MURR
- Course Goals and Objectives
- Course Agenda
- Visits to the Model Facility
- Challenges and Issues
- Lessons Learned and Future Improvements
- Advantages of Using MURR for Future Courses

State Systems of Accounting for and Control of Nuclear Materials Training Course

Training courses to aid in the implementation of State Systems of Accounting for and Control (SSAC) of Nuclear Materials began three decades ago, as a way to improve the functioning of a member's state's regulatory authority in providing safeguards information to the International Atomic Energy Agency (IAEA).

- Attend lectures from subject matter experts
- Participate in workshops
- Visit a Model Facility where safeguards concepts can be demonstrated

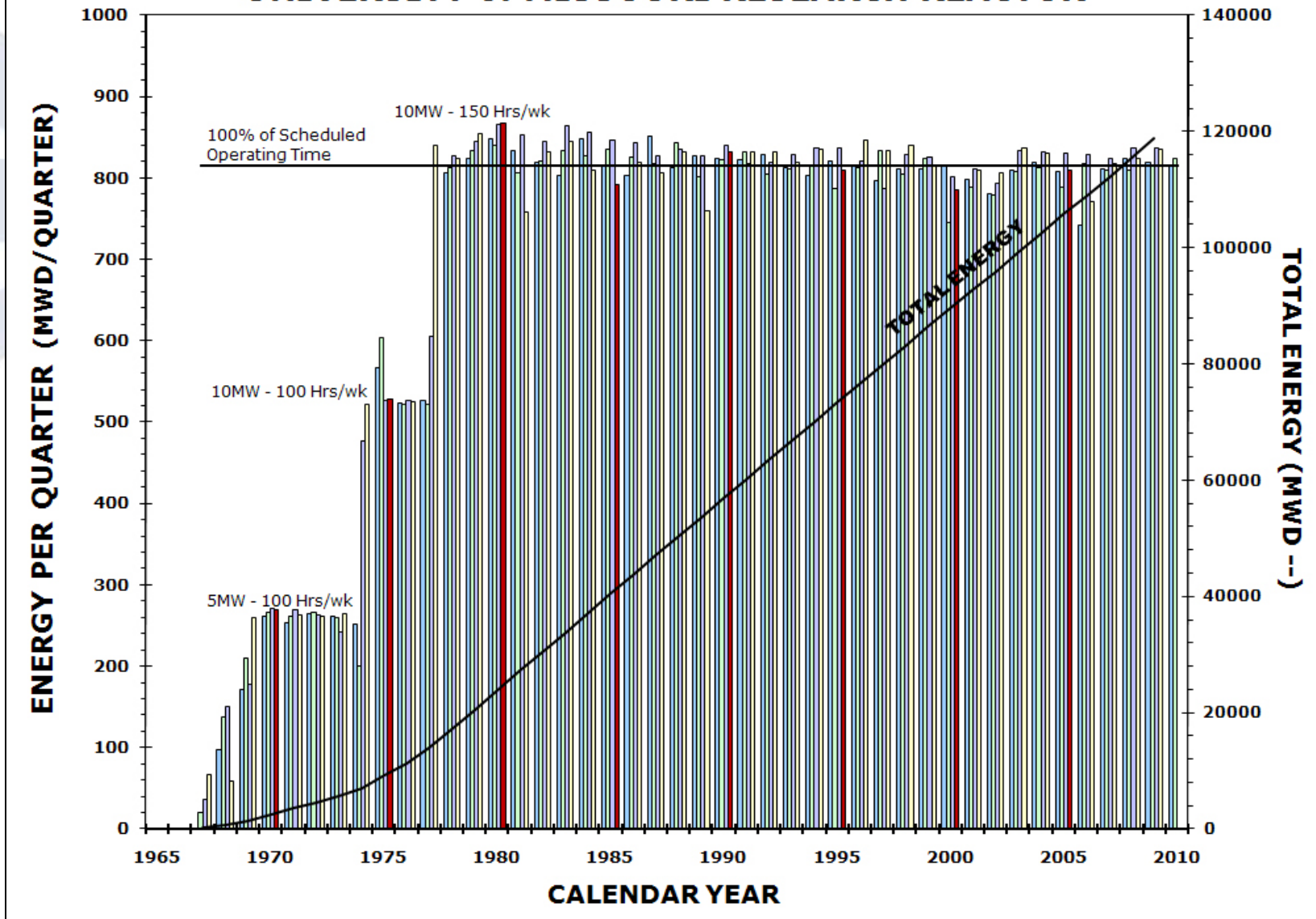
16th and 17th Biannual SSAC Training Courses

- When: May/June 2007 & May/June 2009
- 39 participants from 33 different countries
- Directed by Los Alamos National Laboratory
- Sponsored by the International Atomic Energy Agency, U.S. Department of Energy, and the U.S. Department of State
- Hosted by the University of Missouri-Columbia and the University of Missouri Research Reactor

University of Missouri Research Reactor

- Located in Columbia, Missouri
- Highest powered university-operated research reactor in the United States
- Internationally recognized leader in nuclear research and education, with an emphasis in the production of radioisotopes
- October 13, 1966 – Facility established initial criticality and is licensed to operate at 5 MWs
- July 18, 1974 – Facility is upgraded to 10 MWs
- September 1, 1977 – Facility starts a 10 MW, 150-hour-per-week operating schedule
- September 1, 2006 – Facility submits 20-year license renewal application to the NRC

OPERATING EXPERIENCE UNIVERSITY of MISSOURI RESEARCH REACTOR

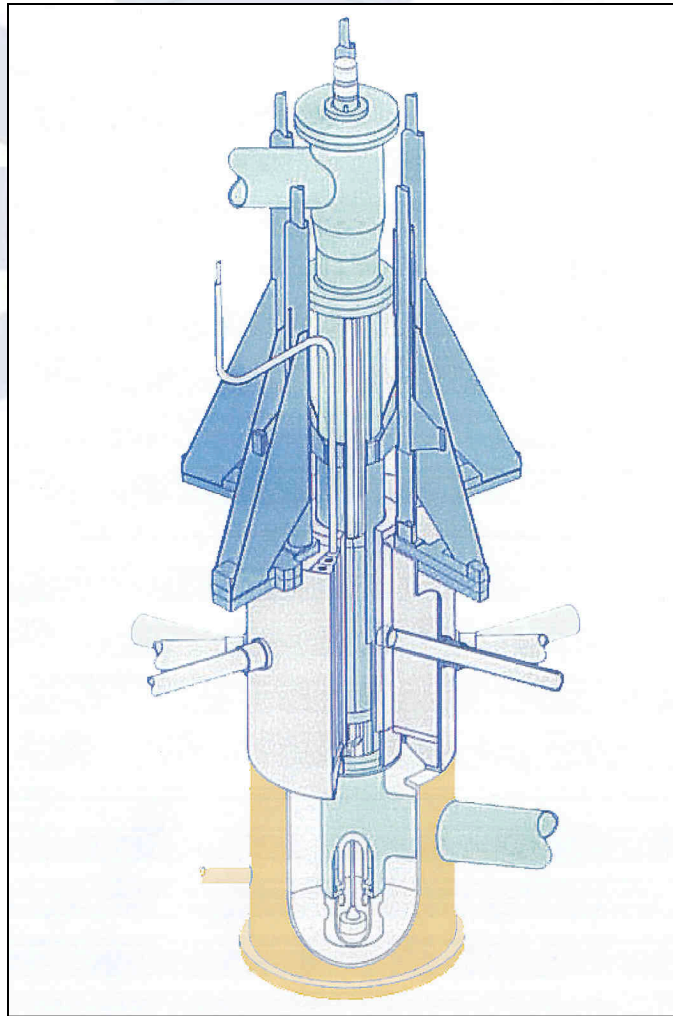


Key Reactor Parameters

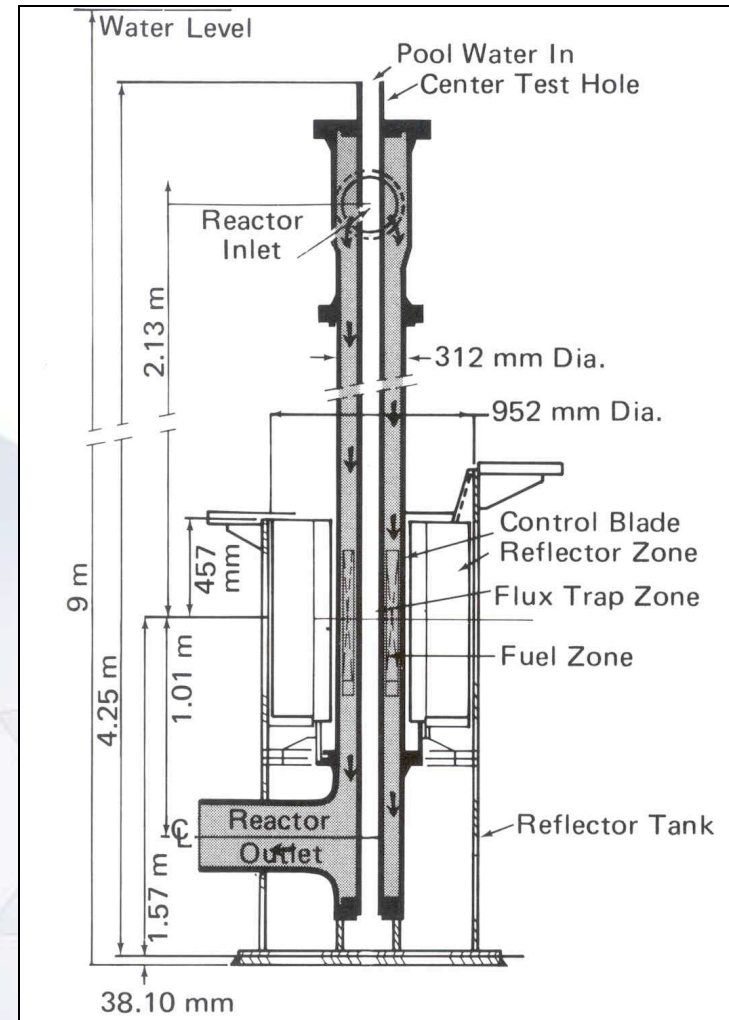
MURR is a pressurized, reflected, heterogeneous, open pool-type, which is light-water moderated and cooled

- Maximum thermal power – **10 MW**
- Peak flux in center test hole – **6.0E14 n/cm²-s**
- Core – **8 fuel assemblies (775 grams of U-235/assembly)**
- Control blades – **5 total: 4 boron shim-safety, 1 SS regulating**
- Reflectors – **beryllium and graphite**
- Forced primary coolant flow rate – **3,750 gpm (237 lps)**
- Forced pool coolant flow rate – **1,200 gpm (76 lps)**
- Primary coolant temps – **120 °F (49 °C) inlet, 136 °F (58 °C) outlet**
- Primary coolant system pressure – **85 psia (586 kPa)**
- Pool coolant temps – **100 °F (38 °C) inlet, 106 °F (41 °C) outlet**
- Beamports – **three 4-inch (10 cm), three 6-inch (15 cm)**

Reactor Core Assembly



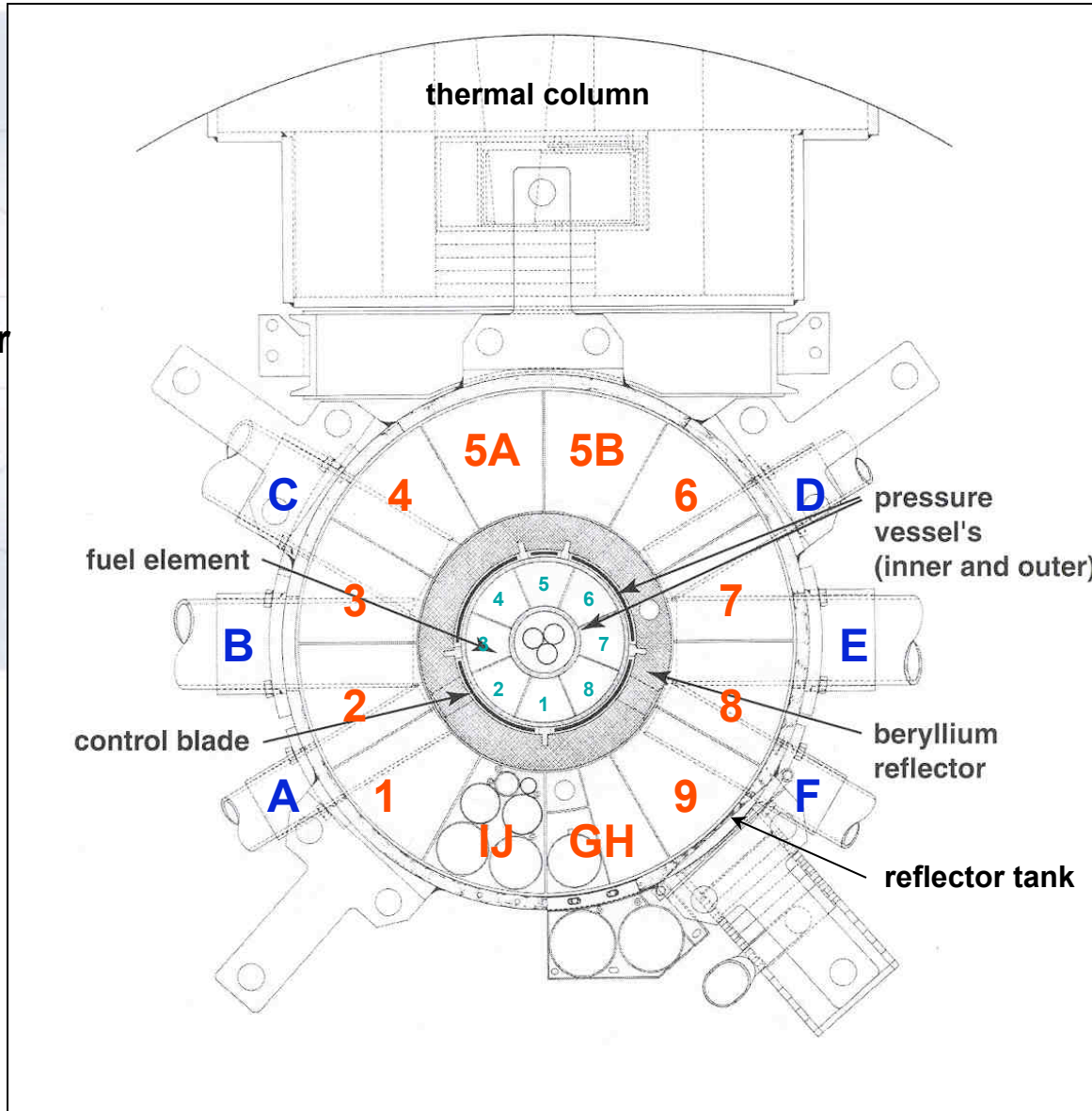
3-D View



2-D View

graphite reflector elements (12):

- 1
- 2
- 3
- 4
- 5A
- 5B
- 6
- 7
- 8
- 9
- GH
- IJ



beamports (6):

- A
- B
- C
- D
- E
- F

fuel elements (8):

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8

Goal and Objectives of the Course

- Goal:
 - Provide participants with an in-depth understanding of the requirements of a state in fulfilling its international safeguards obligations
- Objectives:
 - Demonstrated safeguards concepts
 - ✓ Lectures, workshops, and visits to the model facility
 - ✓ Question and answer session with panel group
 - Panel group was comprised of personnel from countries with established SSAC programs

Course Agenda – Week 1

- **Module 1:** International Safeguards – Legal Instruments and IAEA requirements
- **Module 2:** International Safeguards – Strategies and Verification Techniques
- **Workshop A:** Demonstrations of C/S, NDA and DA Equipment. First Technical visit to the Model Facility
- **Module 3:** Establishment and Maintenance of an SSAC of Nuclear Materials
- **Workshop B:** DIQ and the Role of SSAC in DIE and DIV for the Model Facility

Course Agenda – Week 2

- **Workshop B:** DIQ and the Role of SSAC in DIE and DIV for the Model facility
- **Workshop C:** Establishing an SSAC of Nuclear Materials at the Model Facility
- **Module 4:** Nuclear Material Accounting and Control (NMAC: State and Facility Level Considerations)
- **Workshop D:** Nuclear Material Accounting Reports
- **Module 4/a:** Requirements for SQP Countries

Course Agenda – Week 2 (con't)

- **Workshop E:** SQP Reporting Requirements
- **Module 5:** Preparation and Submission of AP Declarations
- **Workshop F:** Additional Protocol Workshop on Initial Declaration and Subsequent Declarations
- **Module 6:** Effectiveness of State Systems: Experiences of National and Regional Authorities
- **Workshop G:** Establishing an SSAC of Nuclear Materials at the State Level

Visits to the Model Facility

- **First Visit (6 teams)**
 - **Overview of facility operations**
 - ✓ Control room and general layout of facility
 - ✓ Questions on all aspects of nuclear material handling, accounting and research
 - **Workstations**
 - ✓ Containment and surveillance (C/S) – Canberra-Albuquerque Demonstration/Training Surveillance System
 - ✓ Non-destructive analysis (NDA) – Canberra Model S535 Genie-2000 U-Pu InSpector Unit
 - ✓ Destructive analysis (DA)
 - ✓ Tour of facility, including details of reactor operation and the fuel cycle – Inspection and measurements of a “dummy” fuel element

Visits to the Model Facility

- Second Visit (6 teams)
 - MURR provided participants with a copy of a mock up Design Information Questionnaire (DIQ)
 - ✓ Intentional errors were incorporated into the DIQ
 - Participants then conducted a Design Information Verification (DIV) of MURR
 - ✓ Drawings and schematics were provided
 - ✓ Nuclear material pathways were confirmed
 - ✓ Photos and measurements were taken for review
 - ✓ Inconsistencies were reported to the other teams

Challenges and Issues

- Overcoming Initial Reluctance
- Conducting Background Checks/Clearances
- Handling of Security-Sensitive Information
- Language Barriers
- Differences in Safeguards Terminology Between the International Community and the U.S. (significant efforts into completing the DIQ)
- Sufficient Facility Escorts/Signing in Participants
- Reactor Operating Schedule

Lessons Learned and Future Improvements

- Stagger the arrival time of participants at the model facility
- Work more closely with the NRC
- Improve ways to address the needs of the SQP states
- Computer-based training
- Virtual reality-based tools

Advantages of Using MURR as the Model Facility

- Facility is sufficiently significant enough in size and complexity
- Access is available to most areas
- Reliable operating schedule
- Entire course can be supported at the same location/facility – addition of new classrooms
- Experience gained in supporting a previous course
- All analytical equipment is available – C/S, DA, NDA, counting, etc.

SSAC Participants and Instructors

International Training Course on Implementation of State Systems of Accounting for and Control of Nuclear Materials
 May 20-June 1, 2007



Joint Meeting – TRTR/IGORR - 2010
 September 22, 2010 Knoxville, Tennessee

Work Hard – Play Hard

- Course work from 8 - 5; Monday thru Friday
- Worked ½ day on Sunday and full day on Memorial Day weekend – Picnic on Memorial Day evening
- Saturday tour of St. Louis Arch and Botanical Gardens
- Many evening trips to Wal-Mart, Best Buy, downtown etc.





Thanks for your attention!

Questions???

