

Contributions of U.S. National Laboratories to International Nuclear Safety

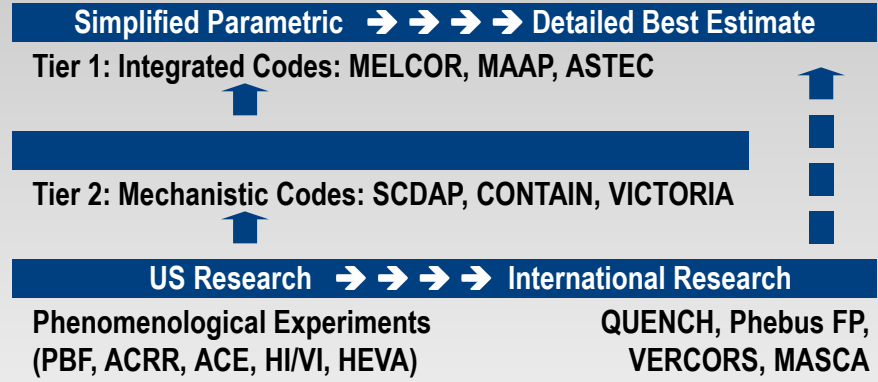


**Peter B. Lyons
Principal Deputy Assistant Secretary
Office of Nuclear Energy
United States Department of Energy**

**IAEA International Conference
on
Challenges Faced by Technical and Scientific Organizations in
Enhancing Nuclear Safety and Security**

**25-29 October 2010
Tokyo Japan**

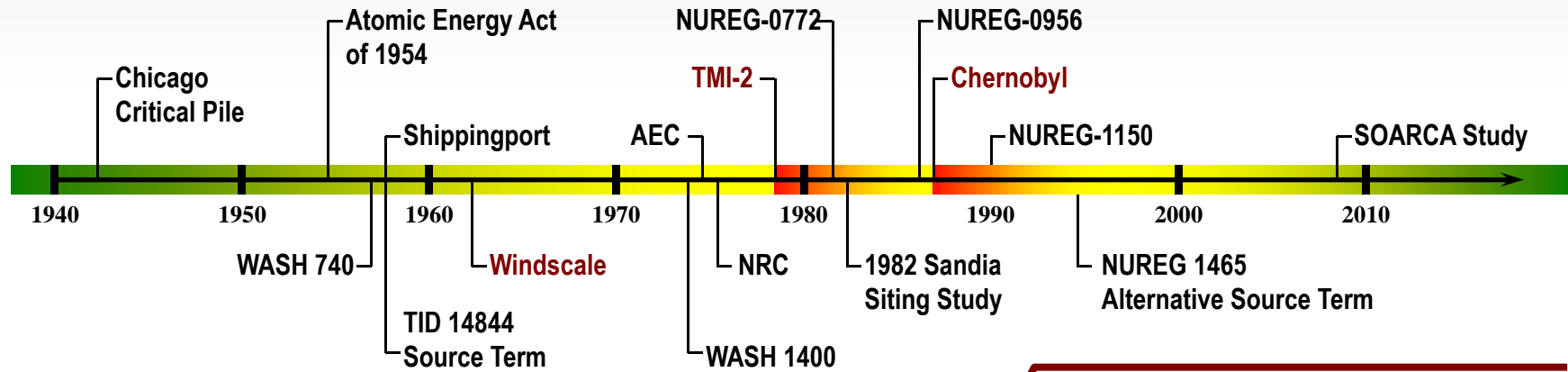
Timeline of Nuclear Safety Technology



Deterministic Bounding Analysis

↓ Risk Informed Regulation

Probabilistic Risk Informed Analysis



Nuclear Power Outlook

Optimistic

Guarded

Pessimistic

EMERGING ISSUES

- Risk Informing Regulation
 - Modernization, NUREG-1465
- License Amendments and Extension
 - MOX, High Burnup
 - Plant Aging
- Emergency Response Planning
- Spent Fuel Pool Accidents
- Advanced Reactors
 - AP1000, ESBWR, US-EPR
- Next Generation Nuclear Plant (NGNP)
- Small Modular Reactors



International cooperation in Nuclear Safety is needed now more than ever

- **Global expansion of nuclear energy underway**
- **Many new nuclear nations have no regulatory infrastructure**
- **Modern reactor designs marketed to wide range of customers**
 - Wide range of regulatory infrastructure
 - Large need for technical support, tools and training
 - Safety culture development
- **Energy security depends on uniform application of best practices and standards**
 - “an accident anywhere, is an accident everywhere”
- **DOE Laboratories can provide needed technical support**



Operational Data Collection and Analysis

• Reactor Data

Power Reactor		Event Number: 45624				
Facility: INDIAN POINT Region: 1 State: NY Unit: 01111 RX Type: [2] W-4-LP [3] W-4-LP NRC Notified By: JOHN DIGMAN HQ OPS Officer: JOE OHARA		Notification Date: 01/11/2010 Notification Time: 18:31 [ET] Event Date: 01/11/2010 Event Time: 15:59 [EST] Last Update Date: 01/11/2010				
Emergency Class: NON EMERGENCY 10 CFR Section: 50.72(b)(2)(v)(B) - RPS ACTUATION - CRITICAL 50.72(b)(3)(v)(A) - VALID SPECIF SYS ACTUATION		Person (Organization): ANTHONY DIMITRADIS (R100)				
Unit	SCRAM Code	RX CRIT	Initial PWR	Initial RX Mode	Current PWR	Current RX Mode
2	AR	Y	100	Power Operation	0	Hot Standby
Event Text						
AUTOMATIC TRIP DUE TO MAIN GENERATOR ELECTRICAL TRIP						
*At 1559 on January 11, 2010, Indian Point Unit 2 tripped from 100% power due to a main generator electrical trip. The investigation into the generator trip is ongoing. All systems responded as expected. The auxiliary feedwater system responded as expected and is maintaining steam generator water levels. Decay heat removal is via the steam generators to the main condenser. Offsite power and plant electrical lineups are normal. No primary or secondary side relief valves lifted. The reactor plant is in mode 3 and stable.						
Indian Point Unit 3 was not affected and remains at 100% power.						
The licensee notified the NRC Resident Inspector and the N.Y. State Public Service Commission. The licensee intends to notify the Mayor's Office and issue a press release.						

- Operating Experience (LERs, AITs, ENs, EPIX from INPO, etc.)
- Fire DB (Industry Cooperative Project, New Metric, Updated IEs)
- HERA – Human Event Repository & Analysis Database

• Computational Support

- PRA Data Collection and Basic Event Parameter Updates
- CCF – Data Collection and CCF Parameter Estimates
- System Performance – Trending of Operational Performance

• Industry Trending – Annual Report to Congress on Health of Nuclear Industry

• NMED – Nuclear Materials Events Database

- Loss/Theft/Abandonment; Medical Misadministrations; Releases/Contaminations; Fuel Cycle Facility Events, etc.

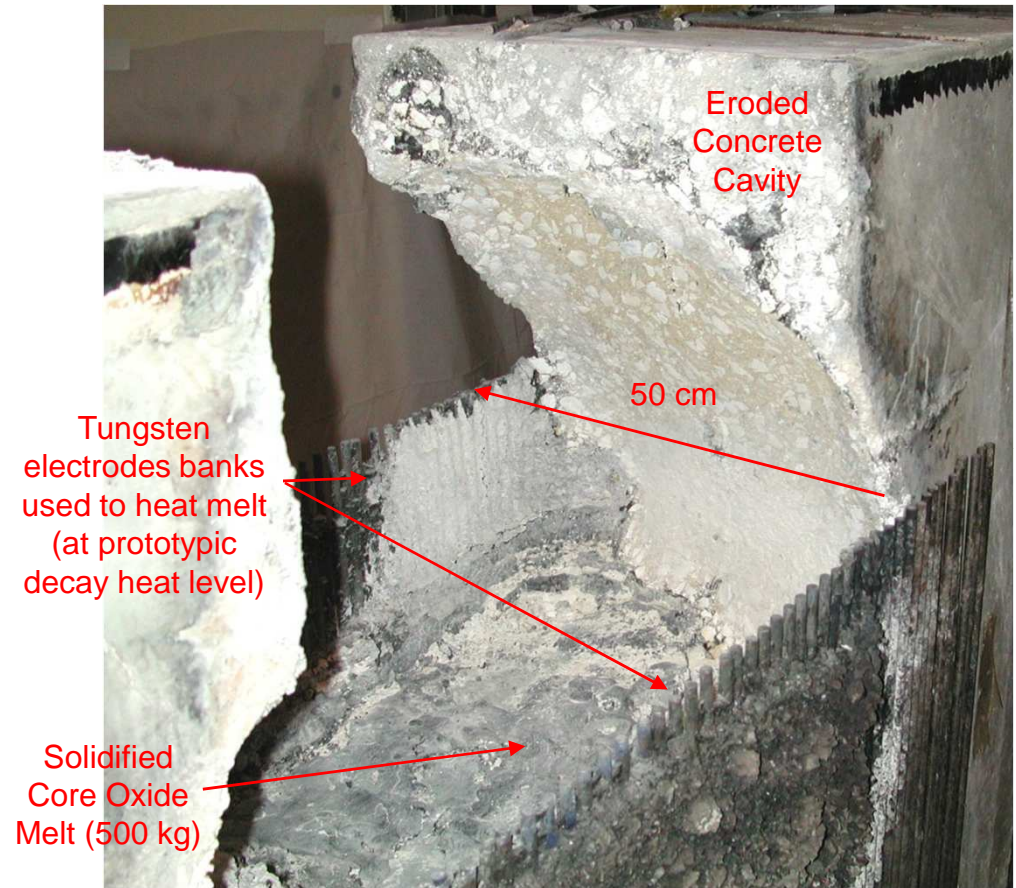
Figure 7. General Event Information.



Argonne Support to NRC and International Community: Melt Coolability and Concrete Interaction (MCCI) Program

- Work organized by the OECD.
- Participating countries: Belgium, Czech Republic, Finland, France, Germany, Hungary, Japan, Norway, South Korea, Spain, Sweden, Switzerland, and the United States of America.
 - All experiments are conducted at Argonne
 - NRC functions as the project Operating Agent.
- Current program focus is on ex-vessel debris coolability
 - Viewed internationally as an important technical challenge impacting accident management strategy for LWR plants

Post-test Debris from Core-Concrete Interaction Tests

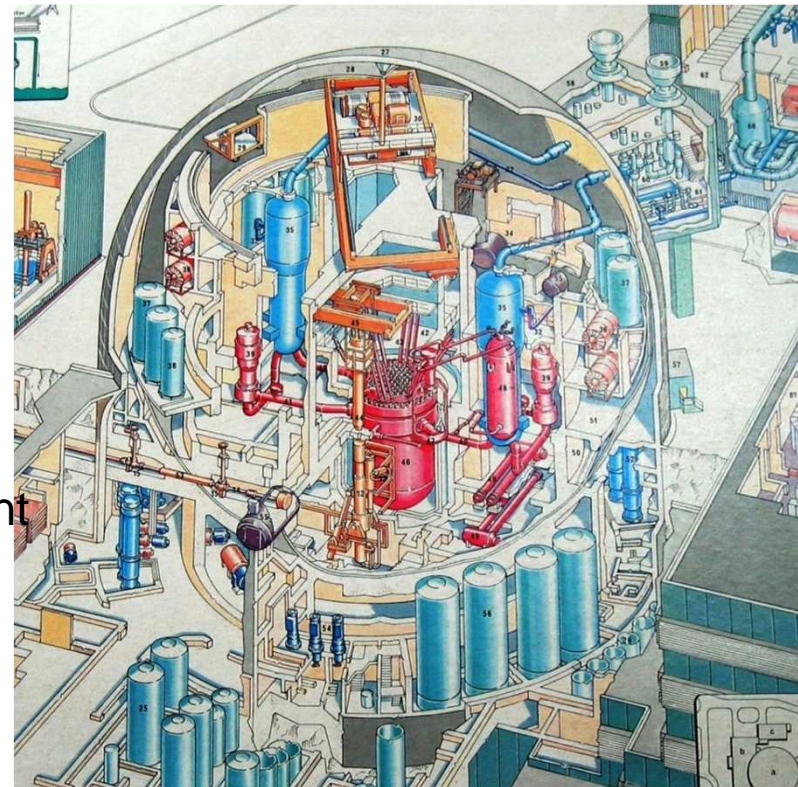




SNL Foreign Regulatory Support

■ Technical support contractor to Argentina Regulatory Nuclear (ARN) Authority

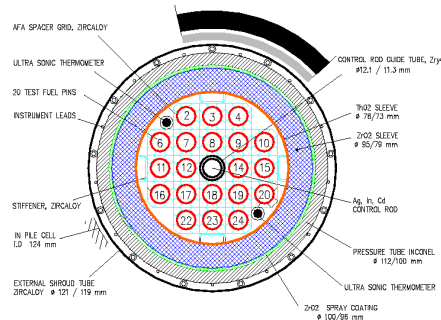
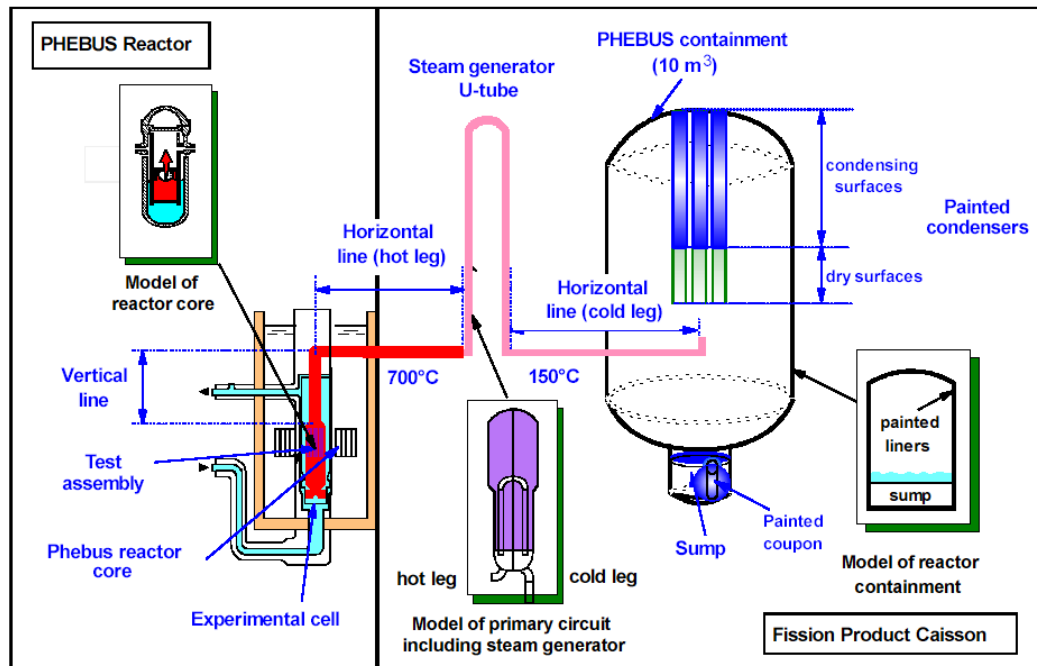
- Licensing of Atucha-II
 - *One-of-a-kind heavy water reactor*
 - *Complex severe accident issues*
- Expert review of Vendor Licensing Documents
 - *Application of IAEA regulatory guides (IAEA-TECDOC-1229: “Regulatory review of probabilistic safety assessment (PSA) Level 2”*
 - *PSA Level I-II interface*
 - *PSA Level II*
 - *PSA Level III*



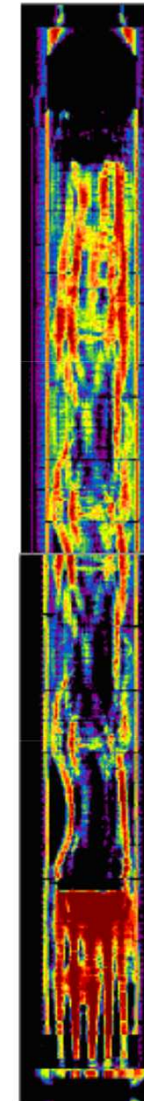


International Cooperation on Reactor Safety Research Phebus Testing Program and MELCOR Validation

PHEBUS facility



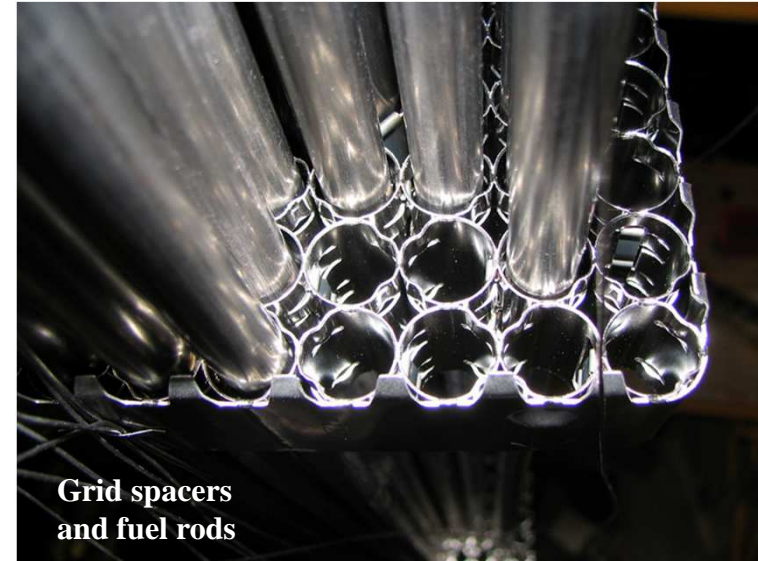
- **Integral tests**
- **Prototypic fuel**
 - Fission heating
 - Pre-irradiated fuel
- **Verification of**
 - Fuel damage
 - Melt progression
 - Hydrogen generation
 - Fission product release and transport
 - Deposition in RCS
 - Containment behavior
- **All Phebus experiments completed**
 - Documentation lagging



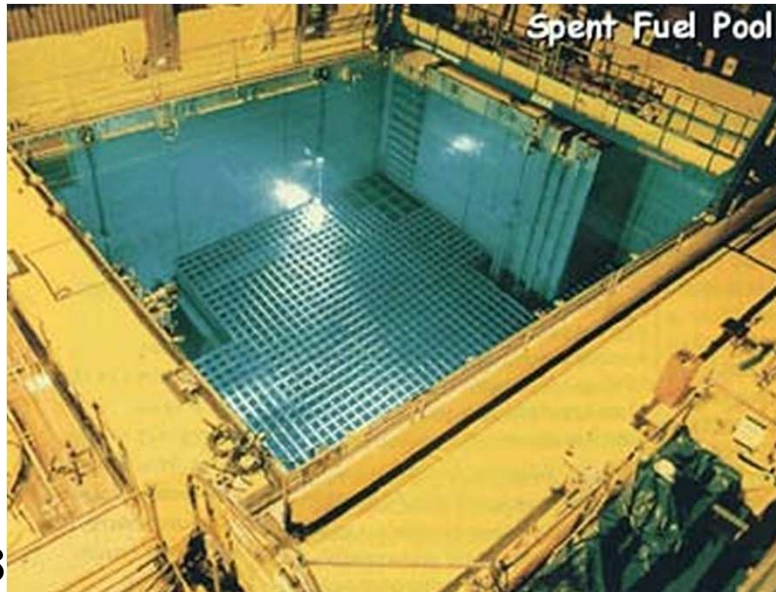


NRC-OECD Spent Fuel Pool Experiments

- NRC research into pool-draining accidents
- Electrically heated full scale prototypic fuel assemblies
- Measuring thermal-hydraulic performance under air natural draft conditions leading to Zr-fire
- Models implemented into MELCOR
- Test results are impacting practices at nuclear power plants in the US leading to safer operations under accident scenarios



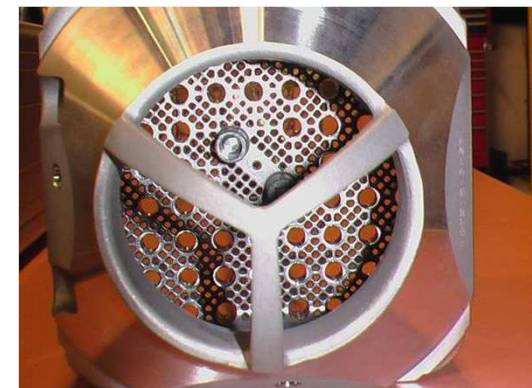
Grid spacers and fuel rods



Spent Fuel Pool



Fuel Damaged by Zr-fire



Fuel Assembly Lower Tie Plate



MELCOR and MACCS Safety Tools Used Worldwide





Expertise and capabilities in DOE national laboratories' are available to regulators and industries in other countries



- Computational simulation
- Experimentation and model validation
- Methodology development
- Regulatory infrastructure



Closing Thoughts*

- Great Value in Collaborations of International Regulatory Bodies and Associated TSOs
- Needs of Each Regulatory Body Must Determine TSO Support Arrangements
- International Commitment to Research Collaboration Must Continue

*** From my talk presented at April 2007 IAEA Conference on this subject**