

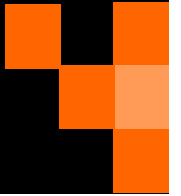
OSU Advanced Plant Experiment (APEX)

**3rd Research Coordination Meeting of the IAEA
CRP on Natural Circulation Phenomena, Modeling and Reliability of
Passive Systems that Utilize Natural Circulation**

José N. Reyes, Jr.

**September 11-15, 2006
CEA, Cadarache, France**



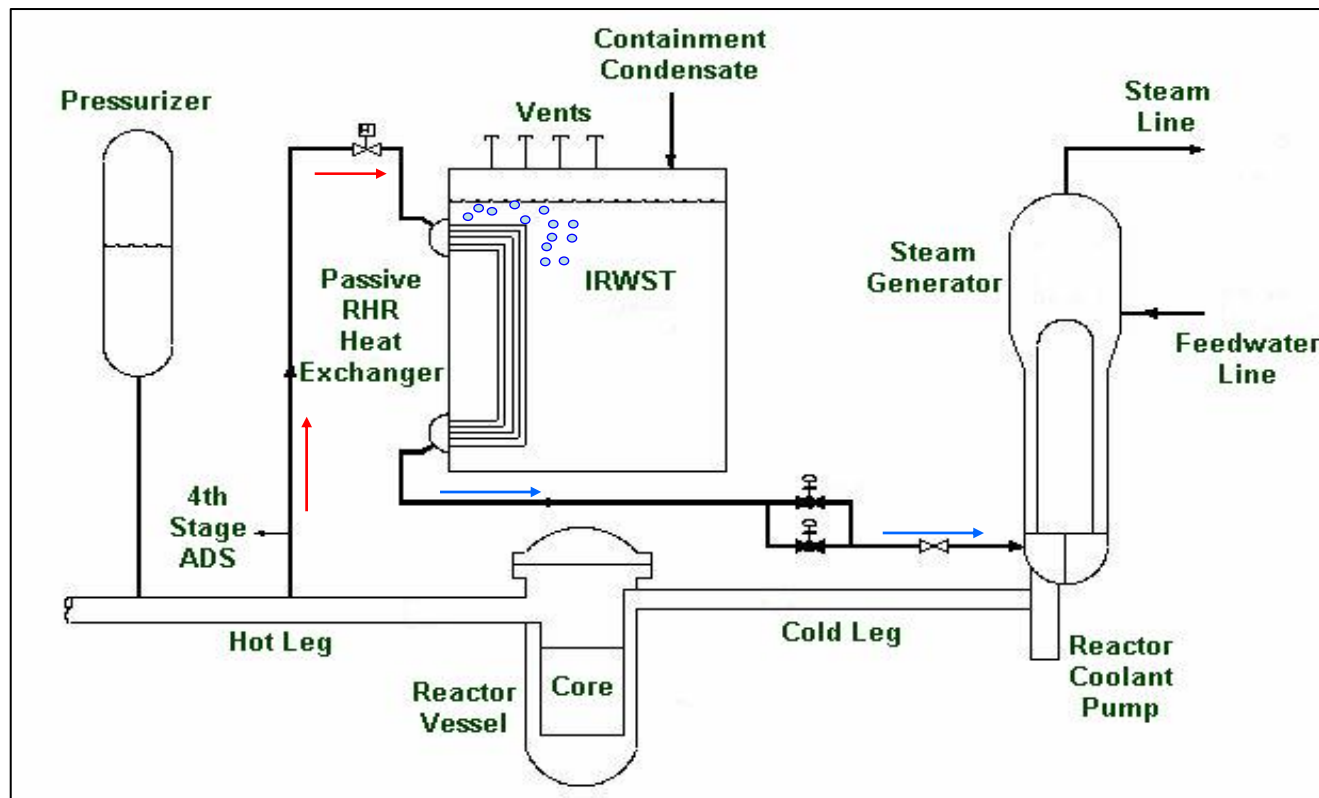


Outline

- Description of APEX Test Facility
- Types of Certification Tests
- Future of Facility
 - NRC Testing
 - NRC Training on Passive Safety Systems

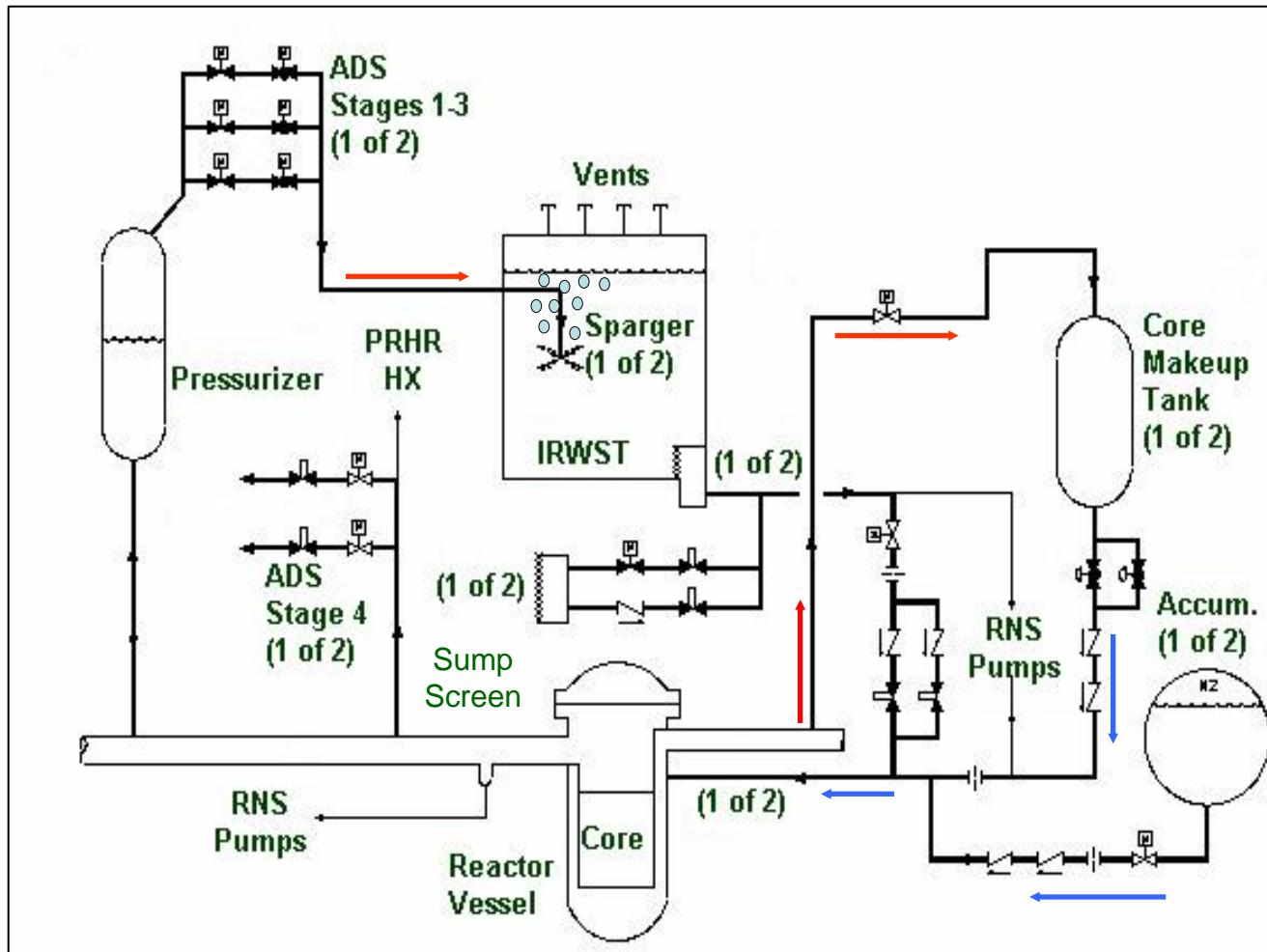


Passive Residual Heat Removal (PRHR) System



- Actuates on Low PZR Pressure or Level
- Station Blackout

Passive Safety Injection



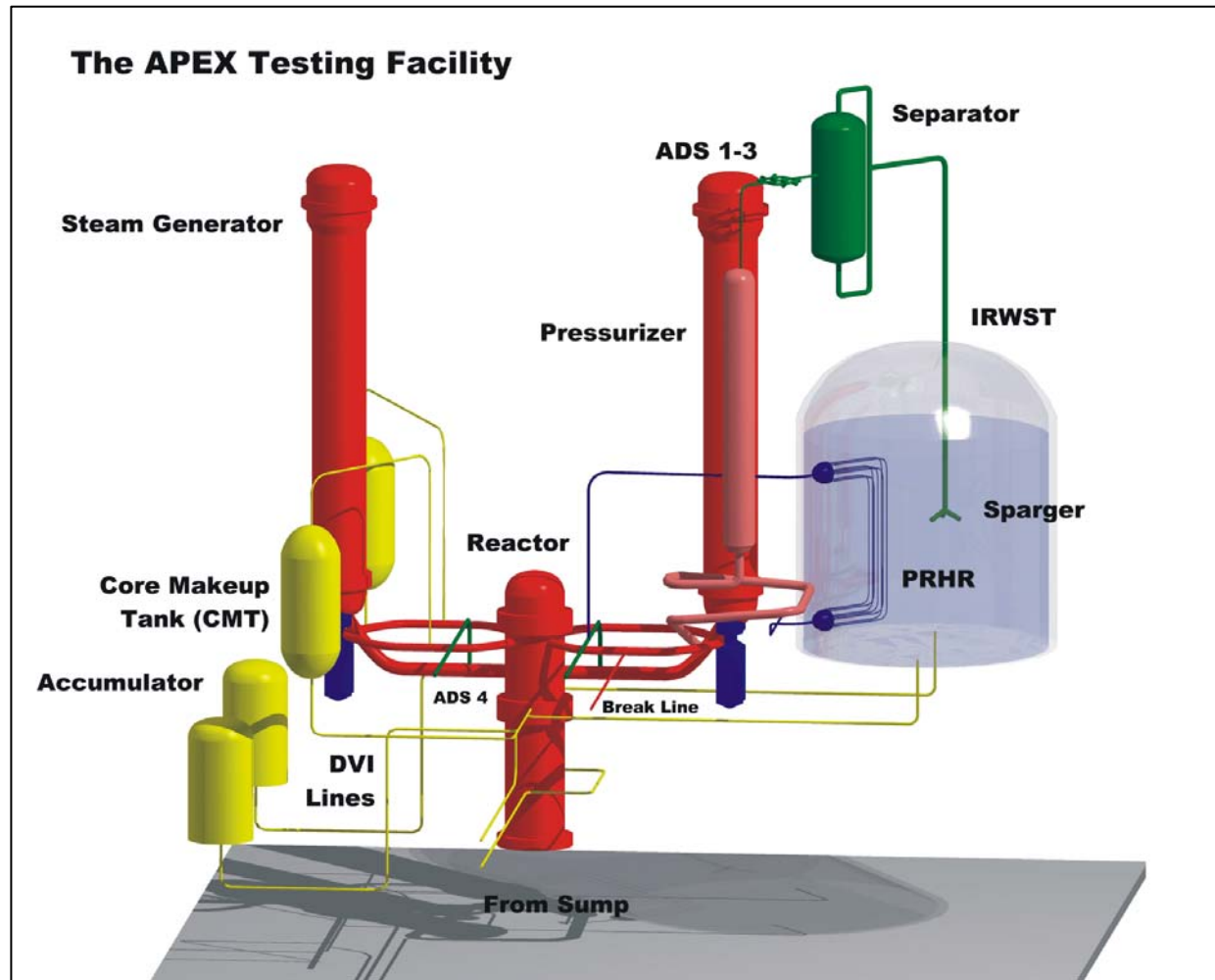
AP600 Design Certification Efforts

- Certification Process in U.S. required:
 - 10 CFR 50 Appendix B Testing Programs
 - Quality Assurance Program
 - NRC and DOE Audits
 - Detailed Code Benchmarks
 - Evaluation Models of AP600 demonstrating plant safety for Design Basis Accidents
 - Must be benchmarked against applicable experimental data.
 - Supported by the design, construction and operation of several test facilities.

AP600/AP1000 Safety Tests Successfully Conducted in OSU APEX

ATHRL Test Program	Sponsor	Facility Configuration	Types of Tests	Number of Tests
AP600 Certification Tests	USDOE Westinghouse	APEX-600	AP600 Design Basis Accidents (DBA)	28
AP600 Confirmatory Tests	USNRC	APEX-600	AP600 DBA and Beyond DBA	47
AP1000 Certification Tests	USDOE	APEX-1000	AP1000 Design Basis Accidents (DBA)	11
AP1000 Confirmatory Tests	USNRC	APEX-1000	AP1000 DBA and Beyond DBA	11

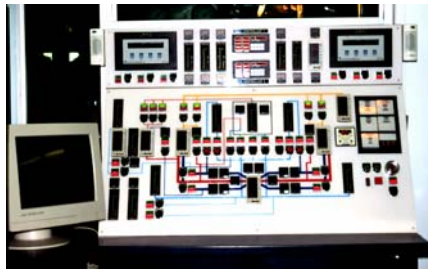
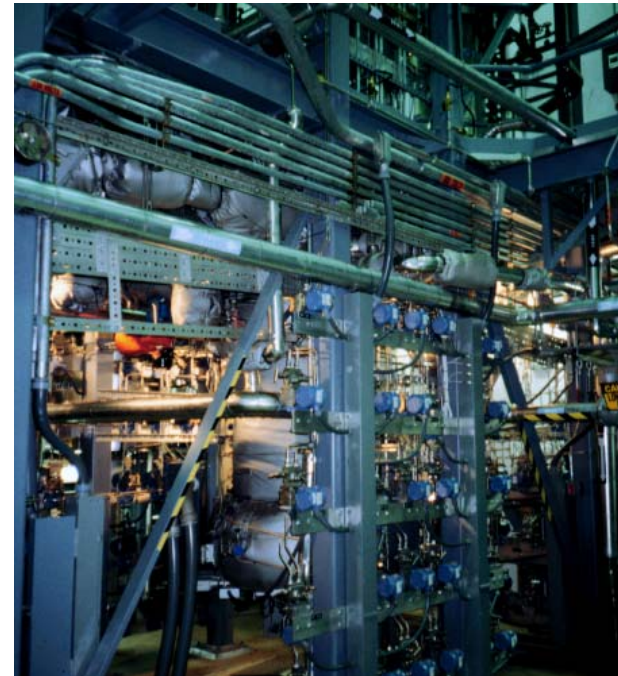
APEX Test Facility at Oregon State University

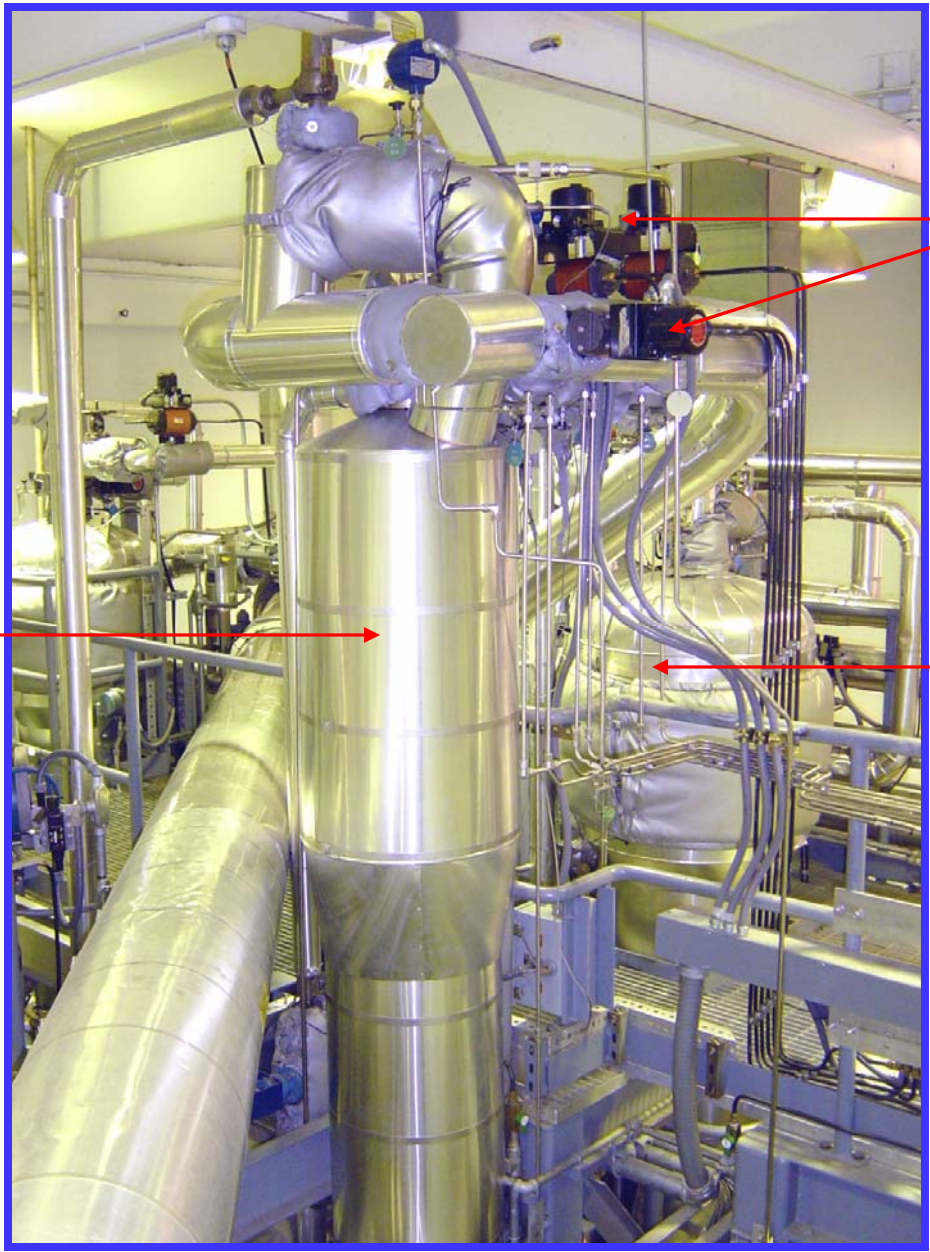


APEX Facility Description

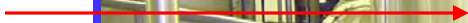
- Complete 2x4 Loop Primary System:
 - 1:4 Length Scale, 1:2 Time Scale, 1:192 Volume Scale, Stainless Steel Construction.
 - 2 Hot Legs, 4 Cold Legs, 2 Steam Generators, Pressurizer, Reactor Vessel with an Electrically Heated Rod Bundle and Upper Plenum Internals.
- Passive Safety Systems:
 - 2 Core Makeup Tanks (CMTs) , 2 Accumulators, a Passive Residual Heat Removal (PRHR) Heat Exchanger, IRWST, and a 4-Stage ADS System.
- Operating Conditions:
 - Core Power ~ 1 MW, Steam Generator Shell Side Pressure (20 Bar), Pressurizer Pressure (25.5 Bar)
- Testing Capabilities:
 - Hot & Cold Leg SBLOCAs, MSLB, Inadvertent ADS, Double-Ended DVI Line Break, Station Blackout and Long Term Recirculation.

APEX Facility

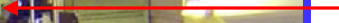




Pressurizer



ADS 1-3
Valves



Steam
Generator





Accumulator (1 of 2)



Core Makeup Tank
(1 of 2)



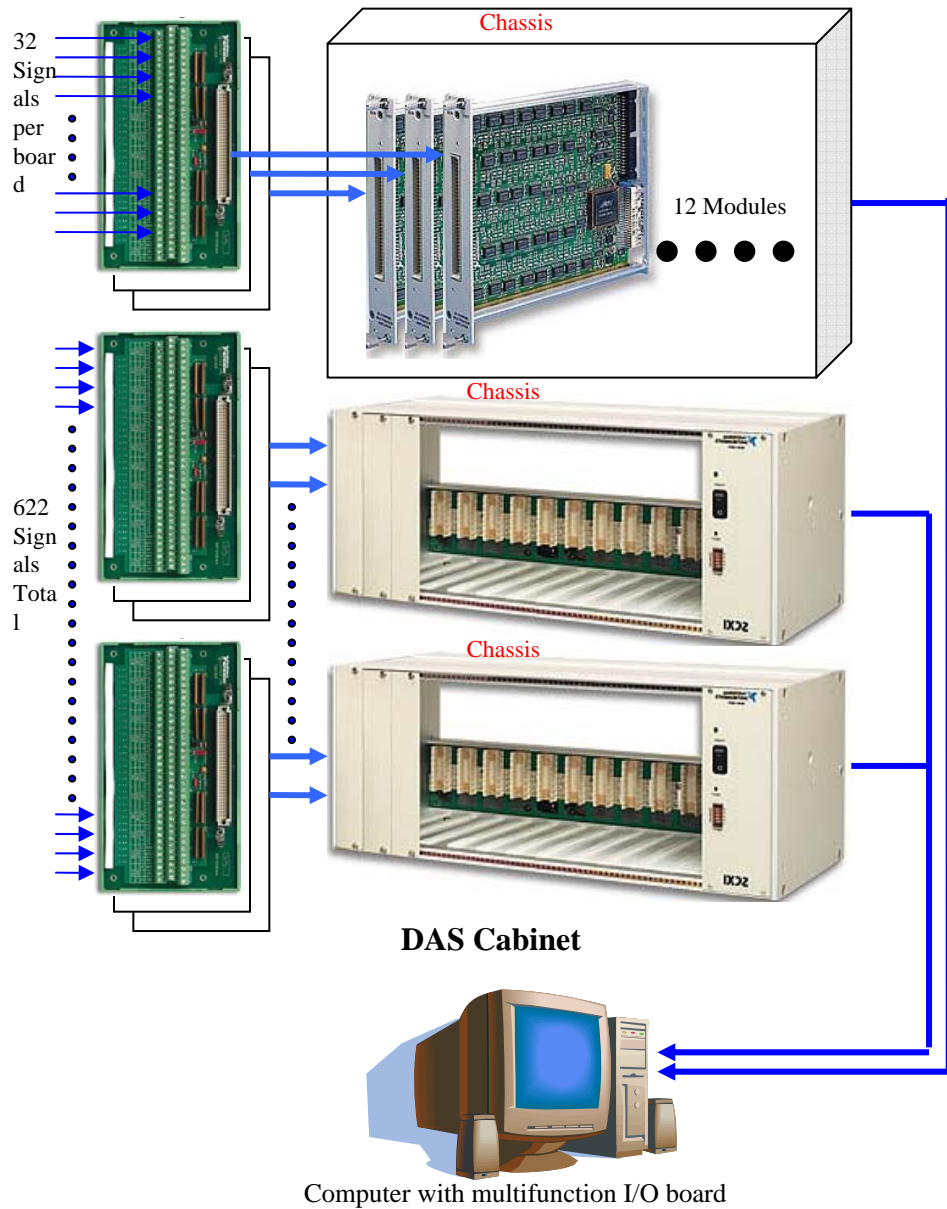
IRWST



PRHR Heat Exchanger



ADS 1-3 Sparger



Data Acquisition System

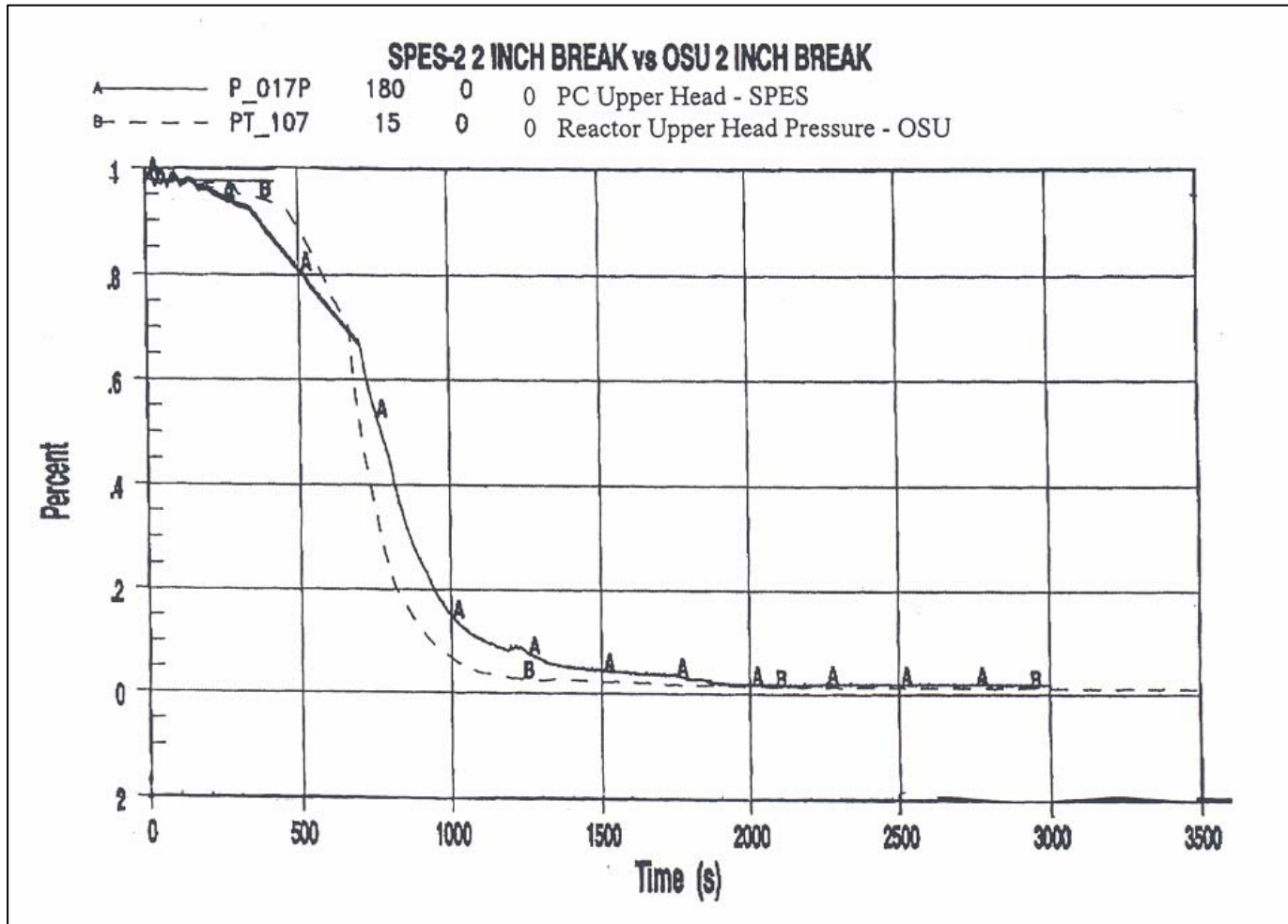


Comparison of Test Facility Results

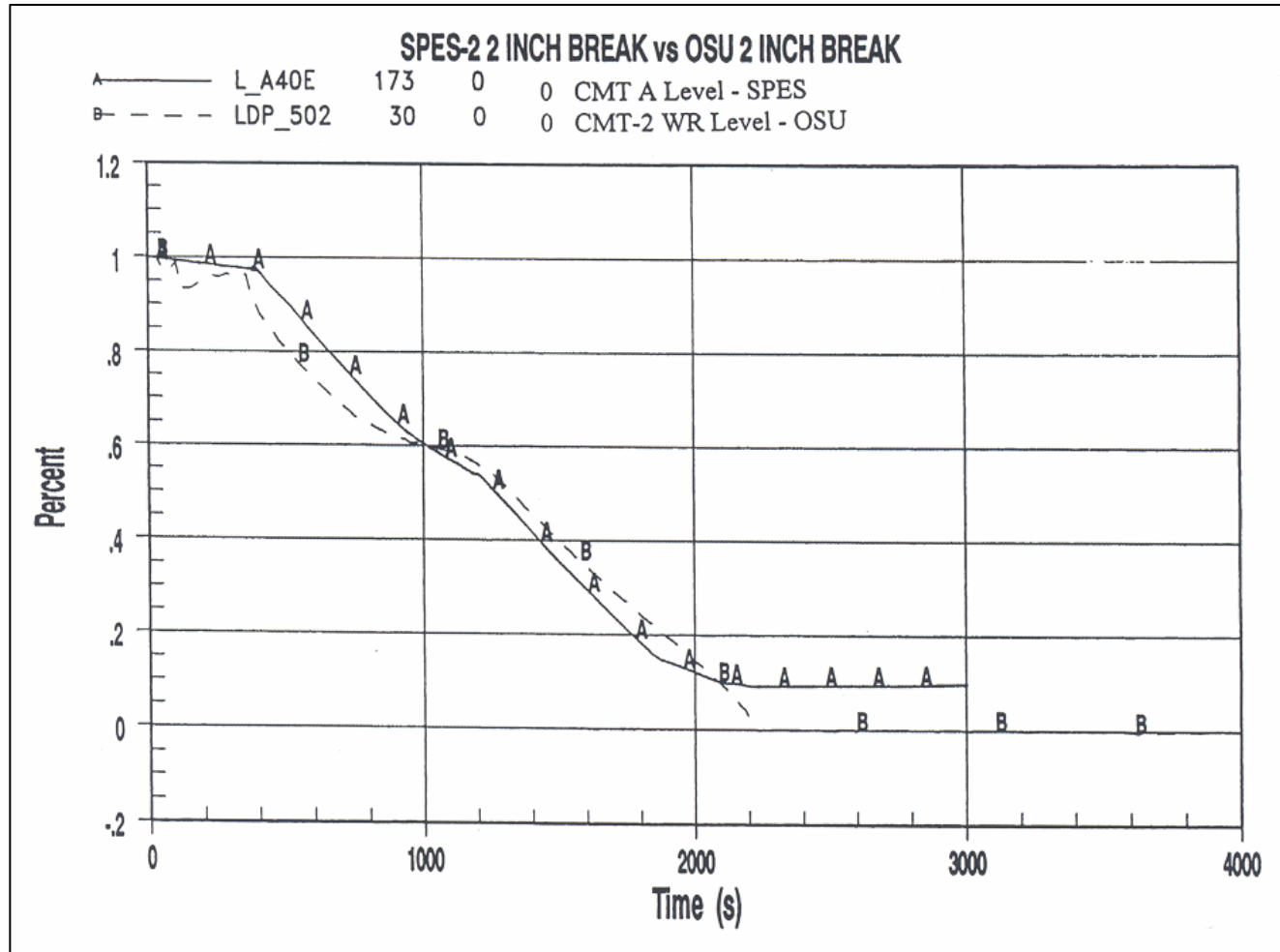
- Can reduced scale facilities duplicate full scale plants?
- Scaling Assessment. A comparison of the Full Height-Full Pressure SPES-2 and the ¼-Height Reduced Pressure OSU APEX 5 cm LOCA

Scaling Ratios	APEX	SPES-2
Lengths	1:4	1:1
Relative elevations	1:4	1:1
Flow Areas	1:48	1:395
Volumes	1:192	1:395
Decay Power	1:96	1:395
Fluid Velocity	1:2	1:1
Fluid Transient Time	1:2	1:1
Mass Flow Rate	1:96	1:395

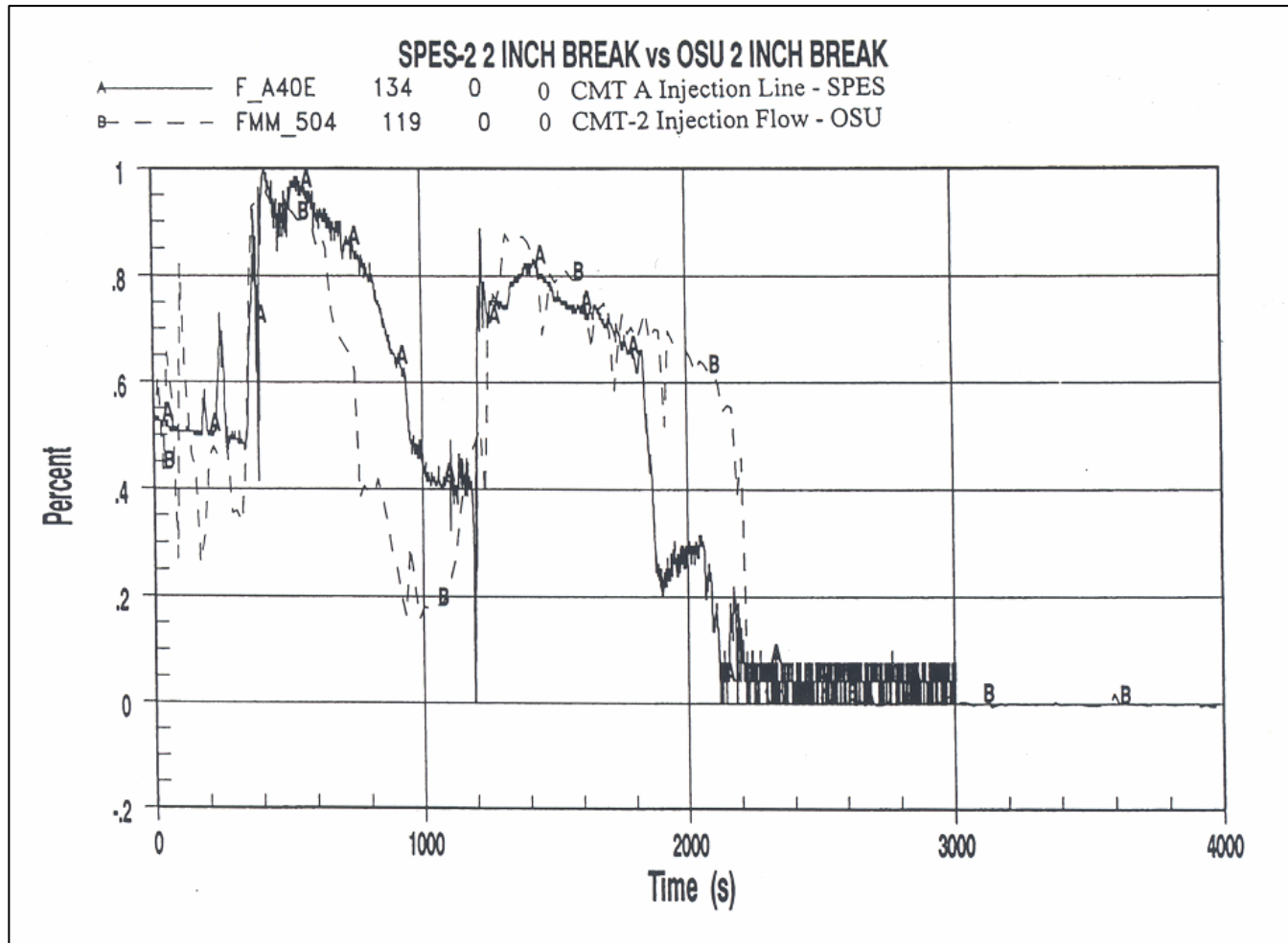
Comparison of Reactor Head Pressures (AP600 Testing)



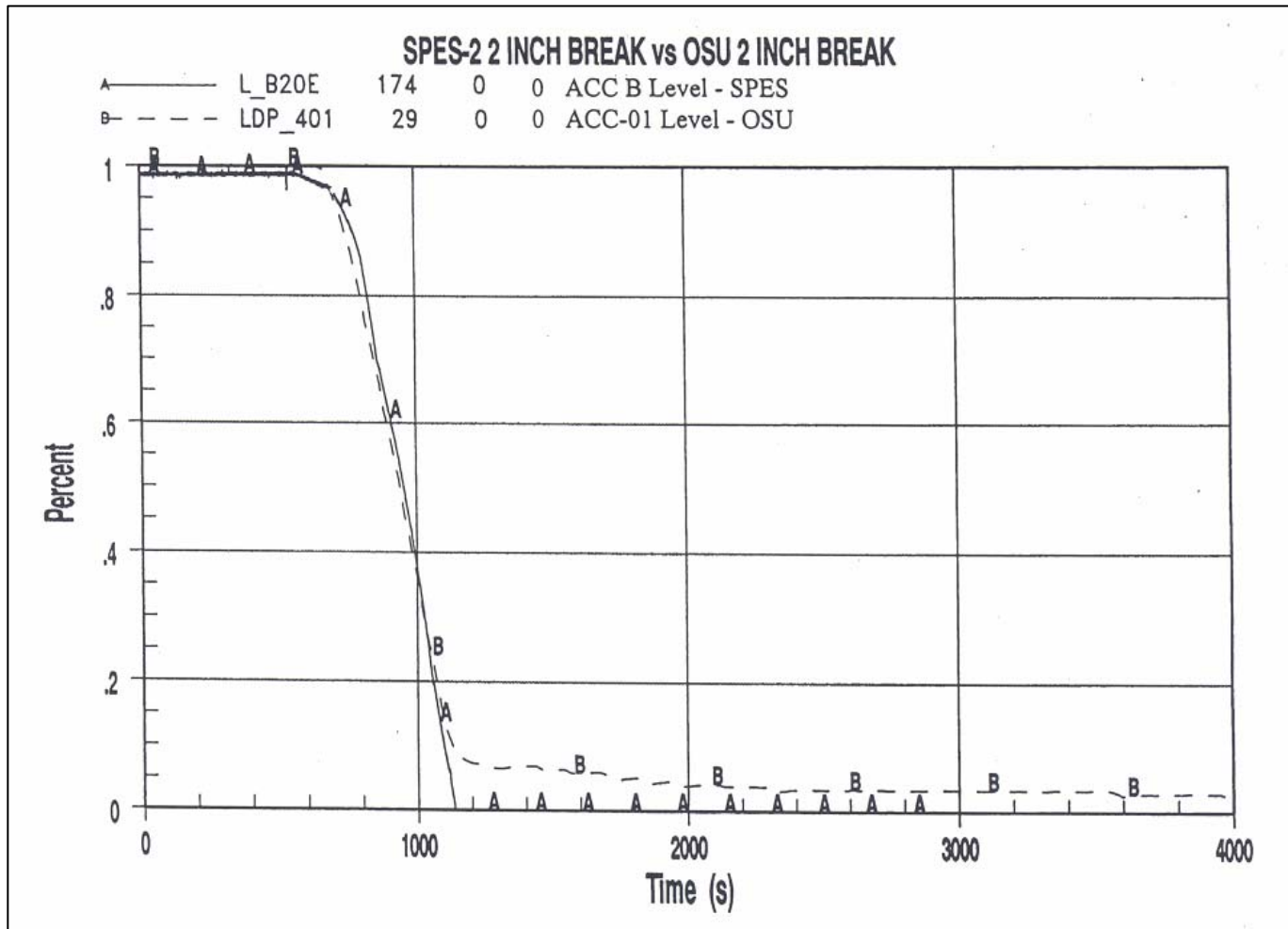
Comparison of Core Makeup Tank Liquid Levels (AP600 Testing)



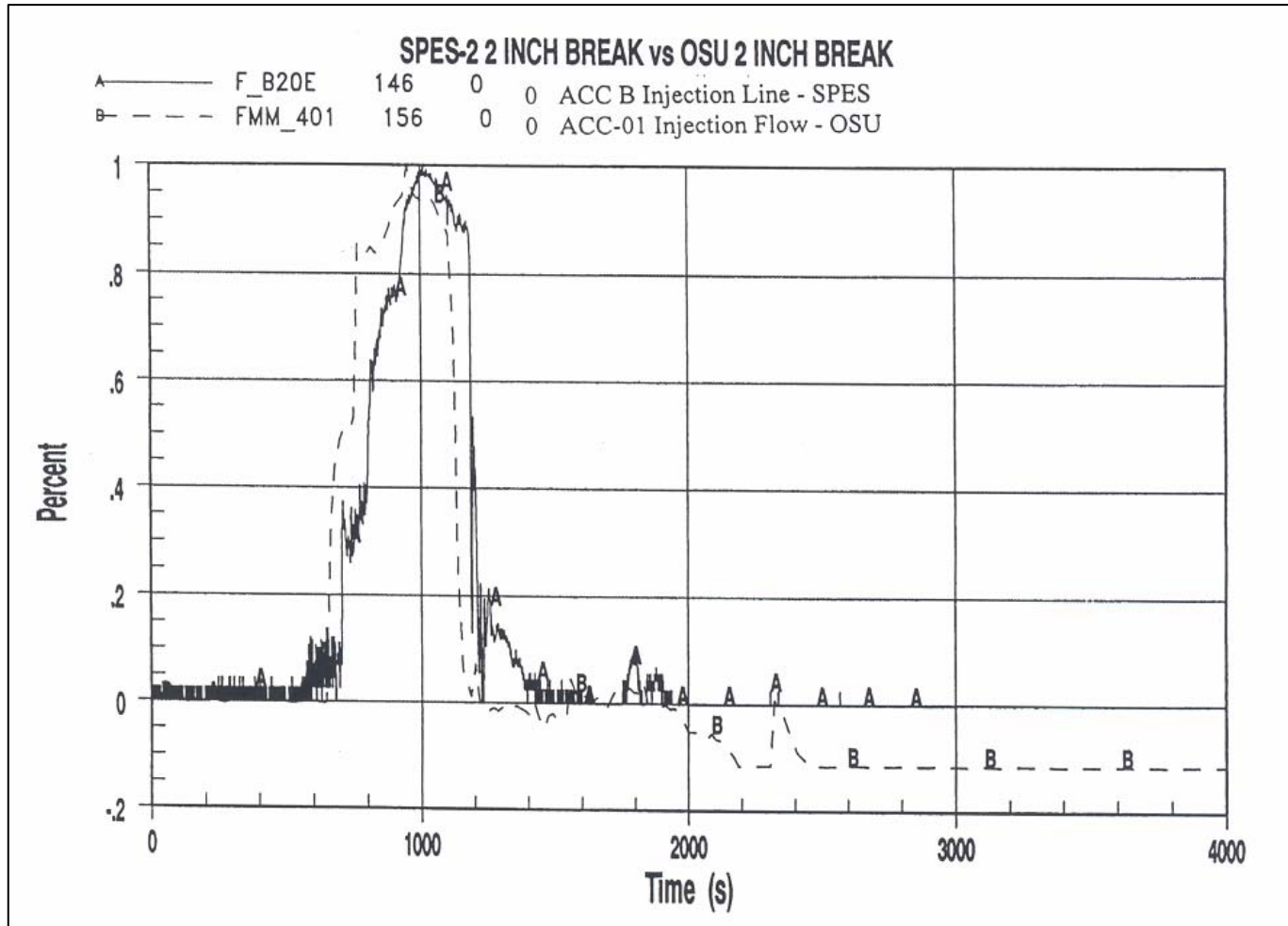
Comparison of Core Makeup Tank Injection Flow Rates (AP600 Testing)



Comparison of Accumulator Tank Liquid Levels (AP600 Testing)



Comparison of Accumulator Tank Flow Rates (AP600 Testing)



Future of the APEX Integral System Test Facility

- AP1000 Certification Testing is completed.
- APEX continues to be used for NRC test programs.
 - Steam Condensation in Steam Generator Tubes, Woods, OSU (FY 05-07)
- Possible NRC Training Programs:
 - Passive Safety Systems
 - Design Certification Test Programs