NRC FORM 658
(9-1999)

U.S. NUCLEAR REGULATORY COMMISSION

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DATE OF MEETING
08/15/2002

The attached document(s), which was/were handed out in this meeting, is/are to be placed in the public domain as soon as possible. The minutes of the meeting will be issued in the near future. Following are administrative details regarding this meeting:

Docket Number(s)	**PROJECT NUMBER 723**
Plant/Facility Name	**SWR-1000**
TAC Number(s) (if available)	
Reference Meeting Notice	**July 31, 2002**
Purpose of Meeting (copy from meeting notice)	**To discuss certain aspects of the technology base being established for the SWR-1000**

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
Joseph M. Sebrosky	**Senior Project Manager**

OFFICE
NRR

DIVISION
NRLPO

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Agenda

I.	Introduction and Meeting Objective	Sandra Sloan
II.	Technology Base for SWR 1000 *Safety approach, review of passive safety features, analysis methods/software, supporting R&D, documentation, and review of test program*	Roger Stoudt
III.	NRC/FRA-ANP interactions during test programs	FRA-ANP/NRC
IV.	Entry into the Pre-Application phase	FRA-ANP/NRC
V.	Summary/Closeout	FRA-ANP/NRC

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Meeting Objective

> Present the **process** Framatome ANP will use to establish the technology base necessary for design certification of the SWR 1000 by the USNRC.

Framatome ANP also solicits feedback from the NRC regarding the acceptability of the intended process.

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Technology Base for SWR 1000

August 15, 2002
U. S. Nuclear Regulatory Commission
Rockville, MD

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Presentation Overview

> Safety approach

> Review of SWR 1000 Passive Safety Features

> Discuss our approach to establishing the SWR 1000 technology base needed for SWR 1000 Certification

- Analysis Methods/Software
- Supporting R&D
- Documentation

> Review of Existing Test Program

> Summary

Safety Approach

> All active systems have passive safety-related backup to perform nuclear safety functions

> SWR 1000 defense-in-depth design incorporates safety-related passive systems that are designed to meet all nuclear safety criteria without reliance on active systems

Review of SWR 1000 Passive Safety Features

> Passive Safety Concept

> Passive Safety System Features

- Passive Pressure Pulse Transmitter (PPPT)
- Emergency Condenser (EC)
- Containment Cooling Condenser (CCC)
- Passive Outflow Reducer (POR)
- RPV Flooding Lines
- Exterior Cooling of RPV for Severe Accidents

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SWR 1000 Passive Safety Concept

Containment cooling condensers for containment heat removal (4)

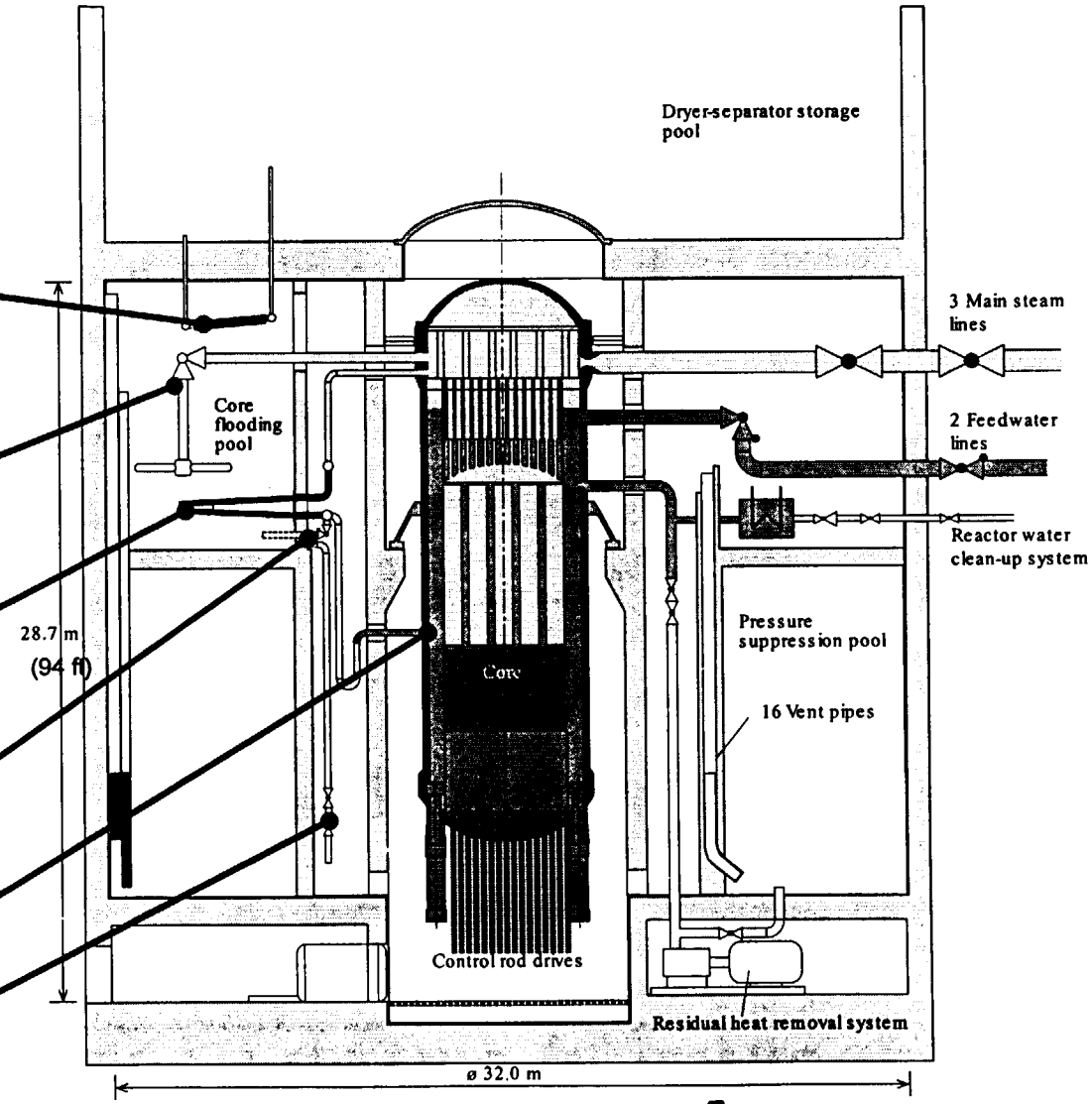
SRV for reactor over-pressure protection and reactor depressurization (6)

Emergency condensers for heat removal from the RPV (4)

Flooding lines for passive core flooding in the event of LOCA (4)

Passive Outflow Reducer

Drywell flooding line (event of a core melt accident)



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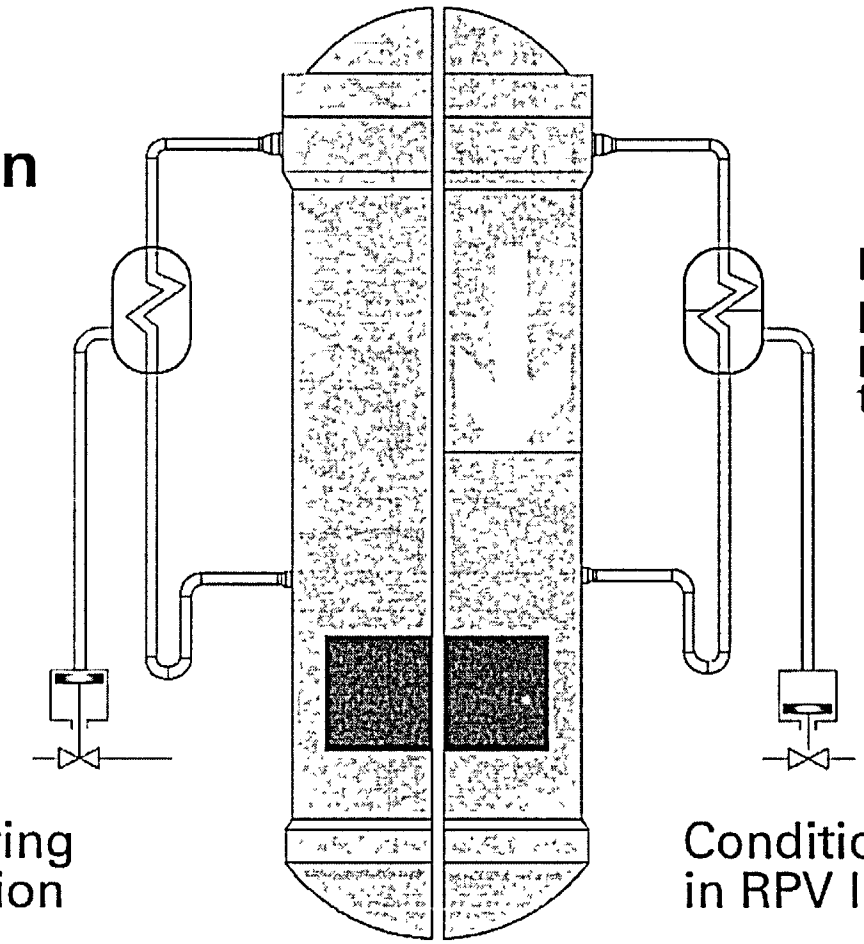
Passive Pressure Pulse Transmitter: Passive Safety System Actuation Device (Patented)

PPPT actuates
- Reactor Scram
- MSIV
- Depressurization



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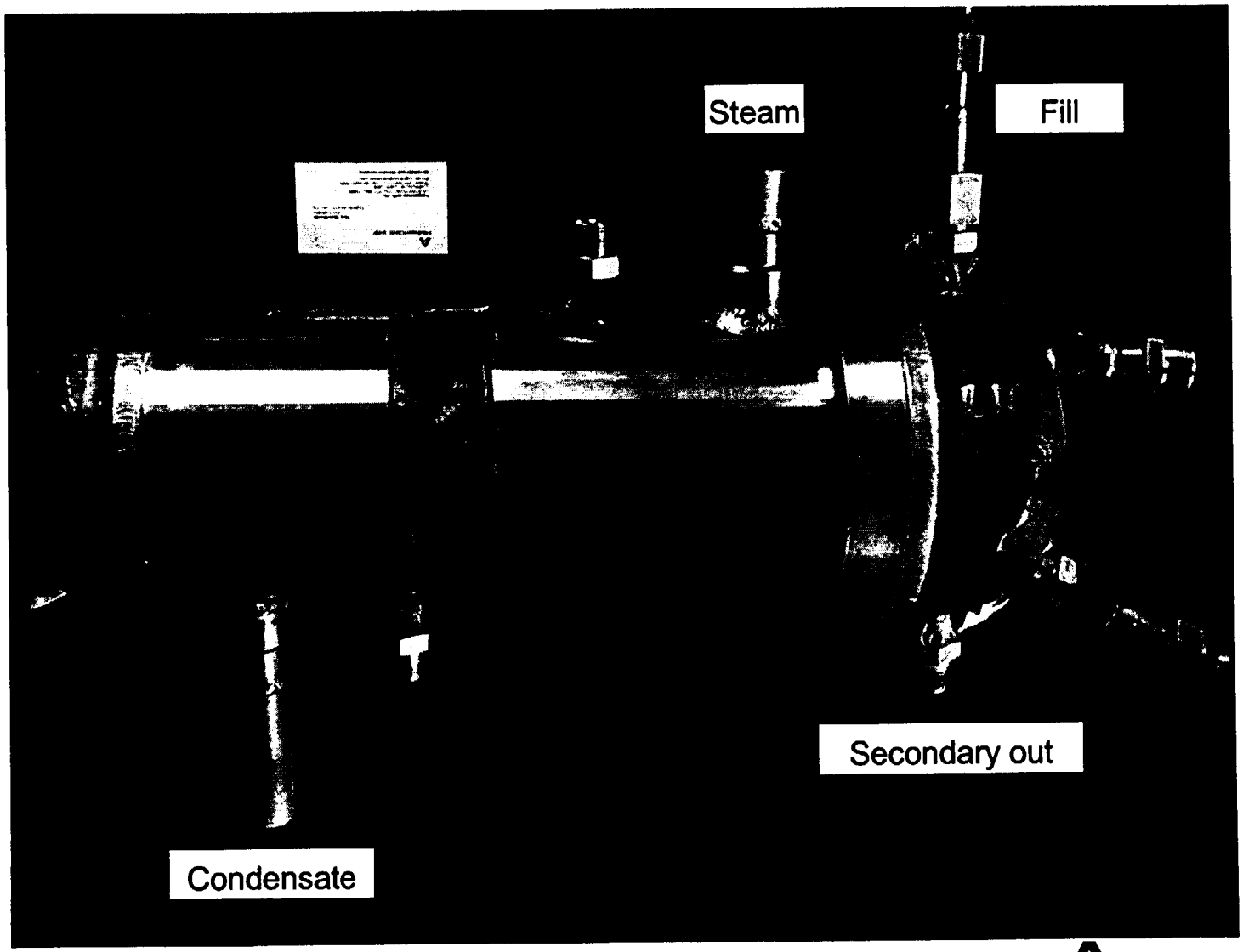
Passive Pressure Pulse Transmitter



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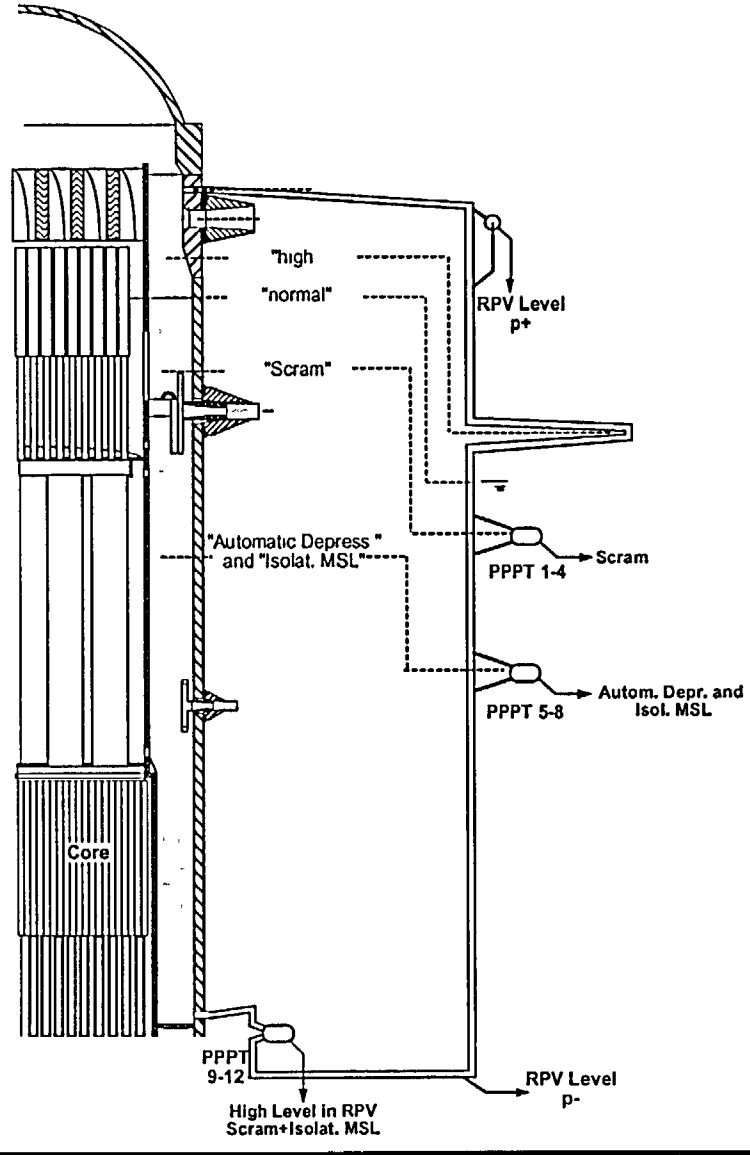
Passive Pressure Pulse Transmitters



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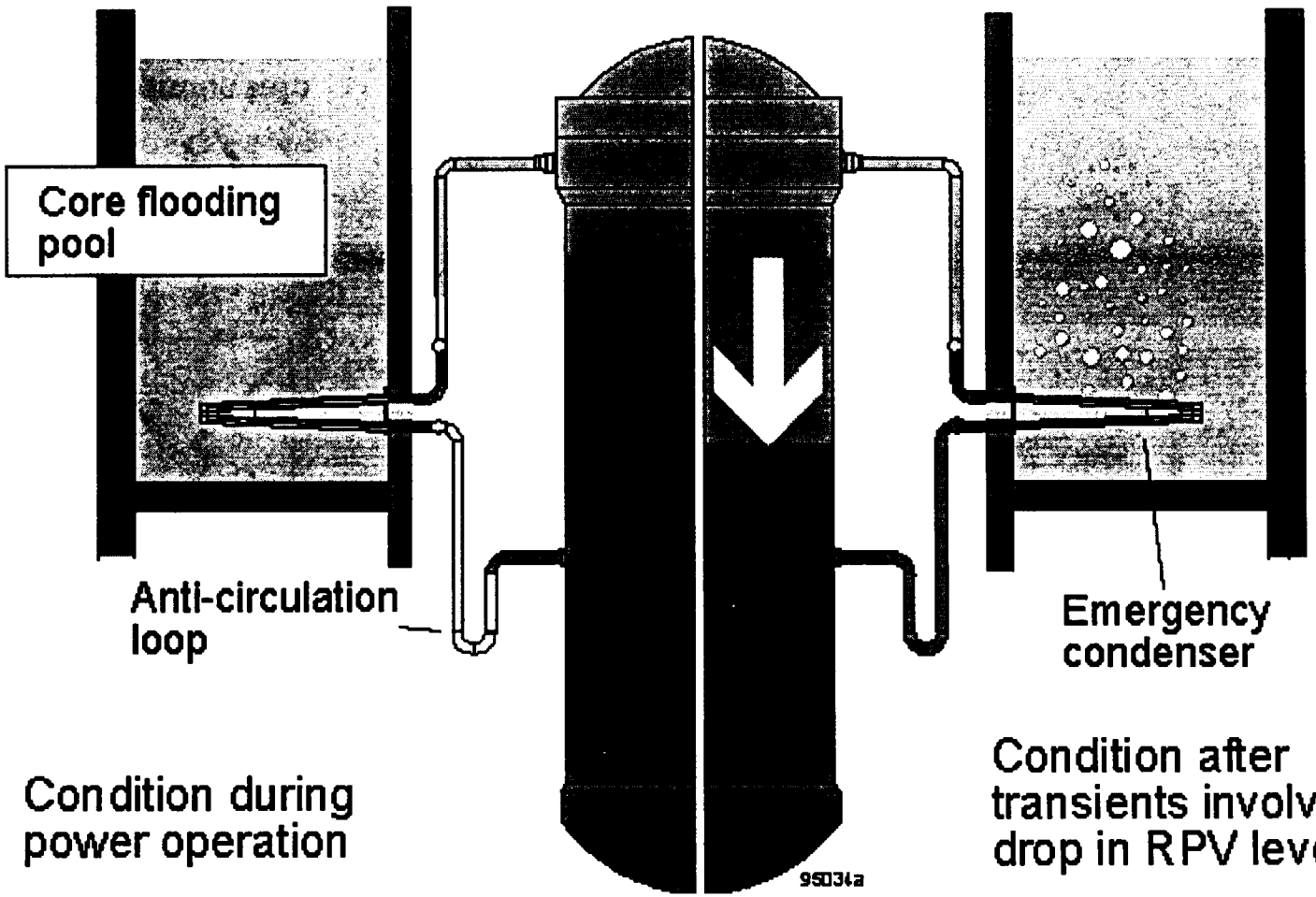
Passive Safety Systems: Emergency Condenser



Condition during power operation

Condition after transients involving drop in RPV level

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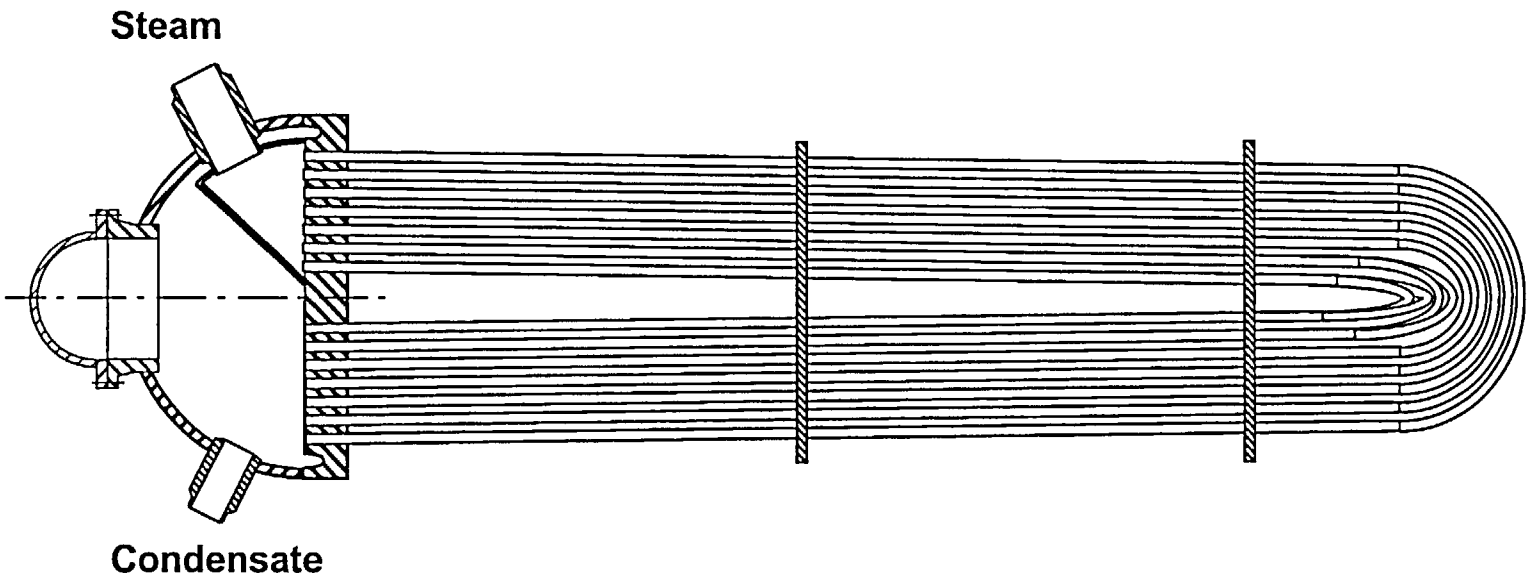
Emergency Condenser



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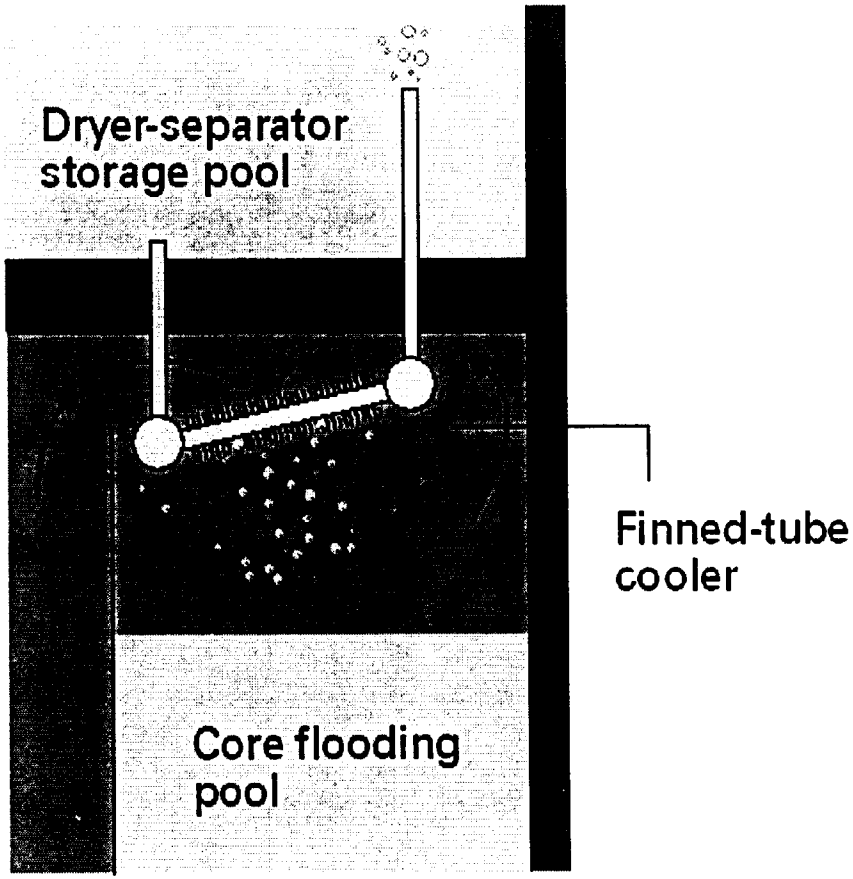
Passive Safety Systems: Containment Cooling Condenser



Containment Cooling Condenser

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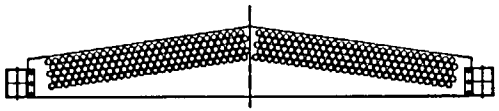
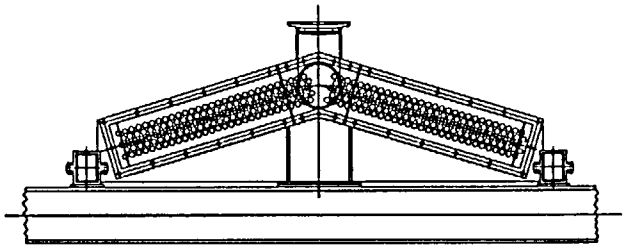
Containment Cooling Condenser

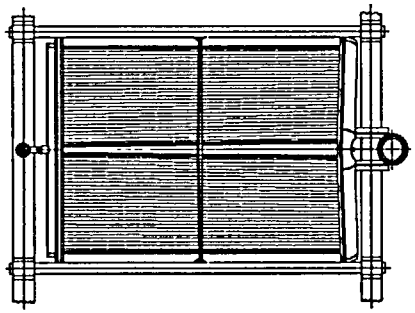


Cross Section
Mid-Bundle

Cross Section
Parallel to Tubes



Cross Section
Bundle Outlet End



Top View

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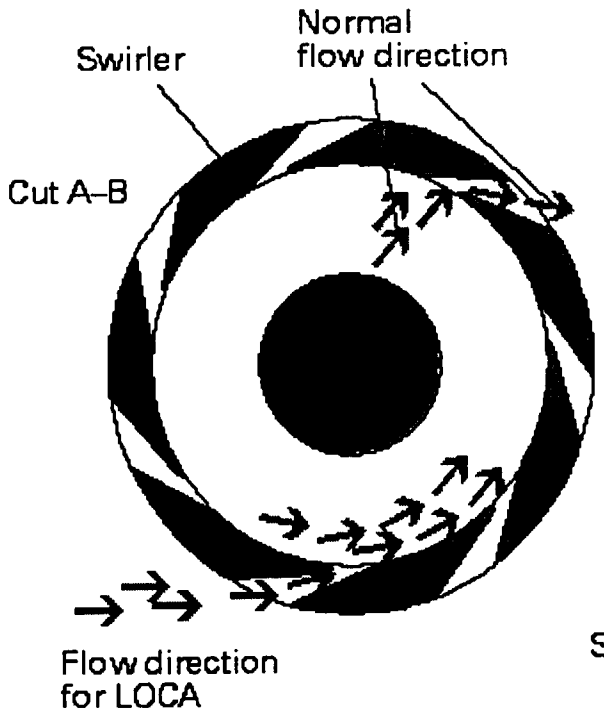
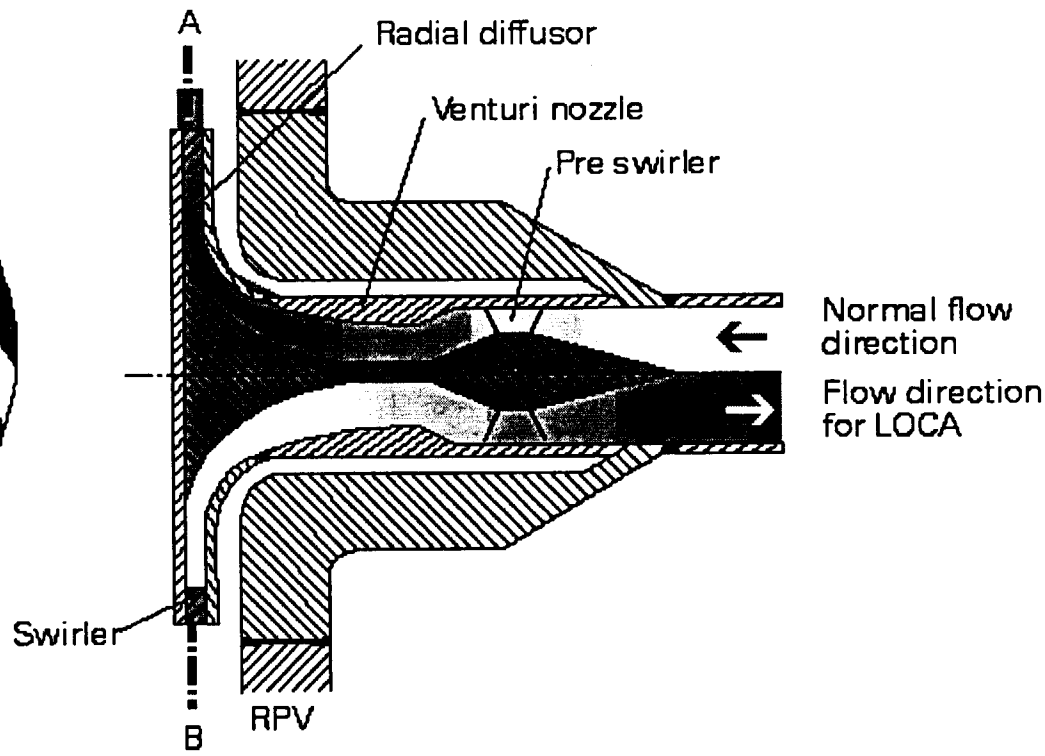
Passive Outflow Reducer





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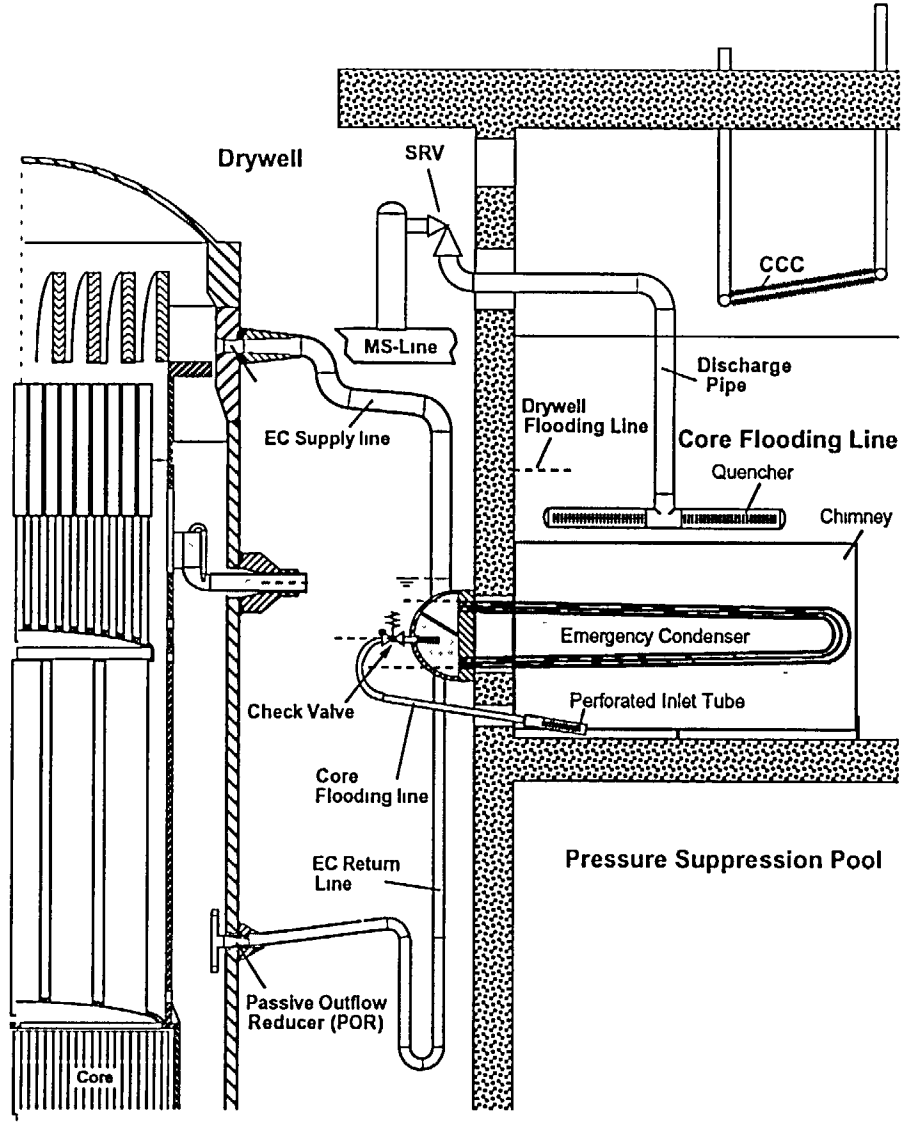
Arrangement of EC, CCC, and Flooding System



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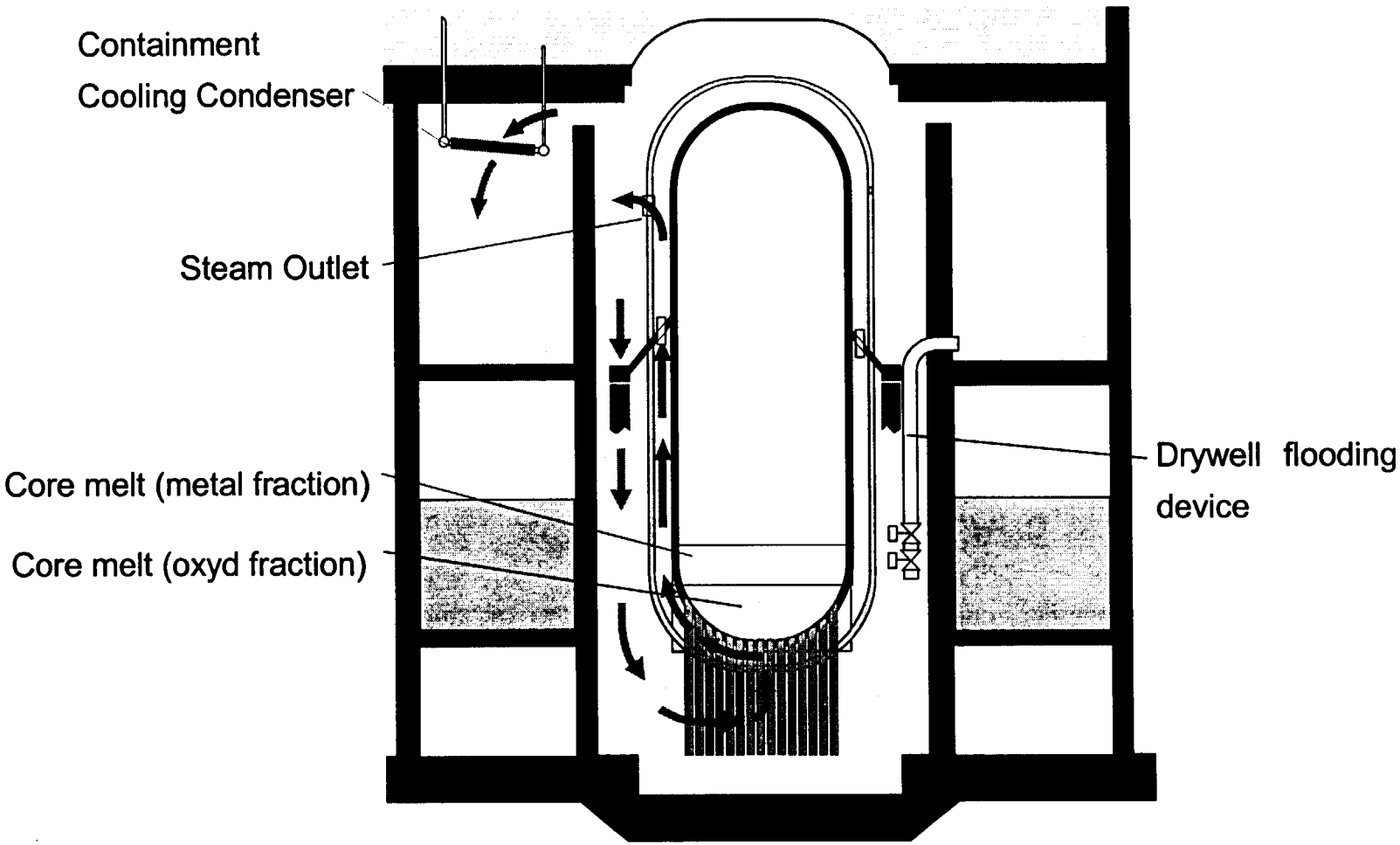
Severe Accident Control
Core Melt Retention in the RPV



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Analysis Methods/Software

Analysis	***Operating Plant Methods (Approved)***	***Operating Plant Methods (Future)***	***SWR 1000 Methods (Future)***
>Core T/H	XCOBRA(T)	S-RELAP5	S-RELAP5
>AOOs	COTRANSA2	S-RELAP5	S-RELAP5
>LOCA	RELAX	S-RELAP5	S-RELAP5
>ATWS	----------	S-RELAP5	S-RELAP5
>Stability	STAIF	STAIF	STAIF
>Containment	----------	GOTHIC (If needed)	S-RELAP5 or GOTHIC

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Analysis Methods Qualification

> Determine initial list of AOOs and postulated accidents (use NUREG-0800)

> Establish safety criteria

> Develop event scenarios

> Develop the PIRT

> Determine code applicability

> Define required tests and test matrices

> Assess scaling effects

> Specify/perform tests and obtain data

> Qualify methods using data; determine uncertainties

Testing Objectives

> Characterize component and/or system performance; assist in component/system optimization

> Assess interaction between components/systems

> Obtain data for computer code qualification

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Testing Process

> Preparation of test requirements document

- Test objectives
- Test geometry and scale
- Test conditions/test matrix
- Data to be acquired
- Instrumentation accuracy
- Quality requirements
- Reporting requirements

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Testing Process (continued)

> Preparation of a test plan

- Description of the experimental apparatus
- Demonstrates how the planned experiment satisfies the test requirements
- Contains the test matrix
- Defines procedures for performing the test
- May reference existing laboratory procedure

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Testing Process (continued)

> Preparation of a quality plan

- As appropriate, uses the standard laboratory quality program
- May contain special quality procedures associated with unique test features
- Demonstrates how the quality requirements of 10CFR50 Appendix B are satisfied

> Perform Testing

- Documentation produced in accordance with the test plan
- Final report contains qualified data and as-built dimensions of the experimental apparatus

Reporting

> Typical documentation for in-house use (done for each test)

- Test Requirements Document
- Test Plan & Quality Plan
- Final Report

> Documents for NRC submittal

- Design Description for the SWR 1000
- Test Program Description
  - Identify Events and event scenarios for AOOs, ATWS, LOCA
  - PIRT results
  - Required tests

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Reporting (continued)

> Documents for NRC submittal

- Scaling Report for SWR 1000 Tests
  - Scaling methodology
  - Application and results for each test
- Analysis Methods Qualification Report
  - Test summaries and results
  - Comparison of code predictions to test data
  - Uncertainty assessments
  - Models used for Analyses of SWR 1000

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Tests Performed

> Emergency Condenser (EC)

- Transfers heat from RPV to the core flooding pools
- Tested in the NOKO facility at Jülich Research Center (Germany)
- Similar to EC used at Unit A of Gundremmingen Nuclear Power Station
- Investigated
  - Effects of design changes
  - Heat removal capacity as function of operating conditions
  - Effects of non-condensable gases

Tests Performed

> Containment Cooling Condenser (CCC)

- Transfers heat from the containment to the dryer-separator storage pool
- Tested in PANDA facility at Paul Scherrer Institute (Switzerland)
- Investigated
  - CCC performance during simulated LOCAs and non-LOCAs.
  - Influence of nitrogen and non-condensable gases on primary side heat transfer
  - Secondary side stability

Tests Performed

> Passive Pressure Pulse Transmitter (PPPT)

- Initiates reactor scram, closure of main steam line valves, depressurization of RPV
- Tested in the NOKO facility at Jülich Research Center
- Investigated
  - Functional capability and design optimization
  - Response times as a function of various primary side pressures

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Tests Performed

> Passive Outflow Reducer (POR)

- Reduces discharge flow in the event of a break in an EC condensate return line
- Tested in the GAP facility at FANP Karlstein (Germany)
- Investigated
  - Flow resistance in operational (inflow) direction
  - Flow resistance in break (outflow) direction
  - Range of inlet pressures and fluid temperatures/phases

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Tests Performed

> RPV Flooding Line Dynamics

- Automatically transfers water from core flooding pools to the RPV
- Tested in the NOKO facility at the Jülich Research Center
- Investigated
  - Process dynamics compared to theoretical predictions
  - Potential for condensation shocks in the flooding line after opening of the check valve

Tests Performed

> Reactor Pressure Vessel Exterior Cooling

- Controls severe accidents by retaining molten core within RPV
- Testing at FANP Erlangen (Germany)
- Investigated
  - Global flow conditions over lower head using air/water experiments (1:10 scale)
  - Flow conditions over a section of the lower head (section modified until flow behavior matched global model flow behavior, 1:10 scale)
  - Heated section using water/steam to determine CHF (Testing not completed, 1:1 scale)

Tests Performed

> CONGA - Containment Behavior in the Event of Core Melting with Large Gaseous and Aerosol Releases

- Containment conditions affect performance of passive heat removal equipment and catalytic recombiners during a severe accident
- Test program conducted at PSI, Ispra (Italy), CISE (Italy), CIEMAT (Spain)
- Investigated
  - Effects of aerosol deposition on condensation heat transfer of the CCC
  - Efficiency of catalytic recombiner system with aerosol deposition
  - Pressure suppression pool scrubbing of aerosols

Tests Performed

> SCRAM Tank

- Steam pressurized tank used to hydraulically scram the reactor
- Tested at Lappeenranta University of Technology (LUT) (Finland)
- Investigated
  - Accumulator design changes needed to accommodate steam pressurization
  - Tank pressure response after actuation

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Future Tests

> FABIS - Fast Acting Boron Injection System

- Used to shutdown the reactor in the event of CRD failure
- Testing will be done at FANP Erlangen and LUT
- To be investigated
  - Mixing of the boron solution with reactor coolant (Erlangen)
  - Flow between boron solution tank and RPV (LUT)

Future Tests

> Spring Supported Check Valve

- Automatically opens core flooding lines
- Testing will be done at FANP Karlstein
- To be investigated
  - Valve function
  - Opening pressure differential

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Future Tests

> Vent Pipes and Quenchers

- Vent pipes direct steam and noncondensables from the dry well to the pressure suppression pool
- Quenchers direct steam from the steam relief valves (and the RPV) into the core flooding pools
- Testing will be done at FANP Karlstein
- To be investigated
  - Flow hydrodynamics
  - Resulting forces

Future Tests

> Control Rod Drives

- Testing will be done at FANP Karlstein
- To be investigated
  - Mechanical aspects of various components

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Summary

> Use CSAU methodology to qualify computer codes for non-LOCA and LOCA events

> PIRT development will identify test data required for code qualification

- Utilize data from completed or planned tests
- Plan additional tests if needed

> Tests of SWR 1000 passive safety features have shown that the features function as intended with acceptable performance

NRC/FRA-ANP Interactions During Test Programs

> Type of interaction expected by NRC

> Lead time required for NRC observation of Framatome tests

> NRC approach for conducting independent tests

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Entry into the Pre-Application Phase

> Framatome ANP plans to provide its first substantive documents for NRC review in mid-2004

> Between now and then, discussions with NRC will continue

- To identify and clarify issues related to the certification process
- To identify and clarify issues unique to the SWR 1000 design

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Summary/Closeout

> Summarize NRC comments and suggestions regarding the process for establishing the technology base for SWR 1000

> Identify preliminary documentation requested by NRC

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