GE Nuclear Energy

TRACG Application

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Outline

- **Overview of TRACG application methodology**
- **Short-term Decay Heat Removal**
  - ECCS/LOCA Analysis (0-2000 seconds)
- **Long-term Decay Heat Removal**
  - Containment/LOCA Analysis (0-72 hours)
- **ESBWR Anticipated Operational Occurrences (AOO) Transients**
- **Summary**

Overview of ECCS/LOCA Application

Overview of Containment/LOCA Application

Overview of AOO Application

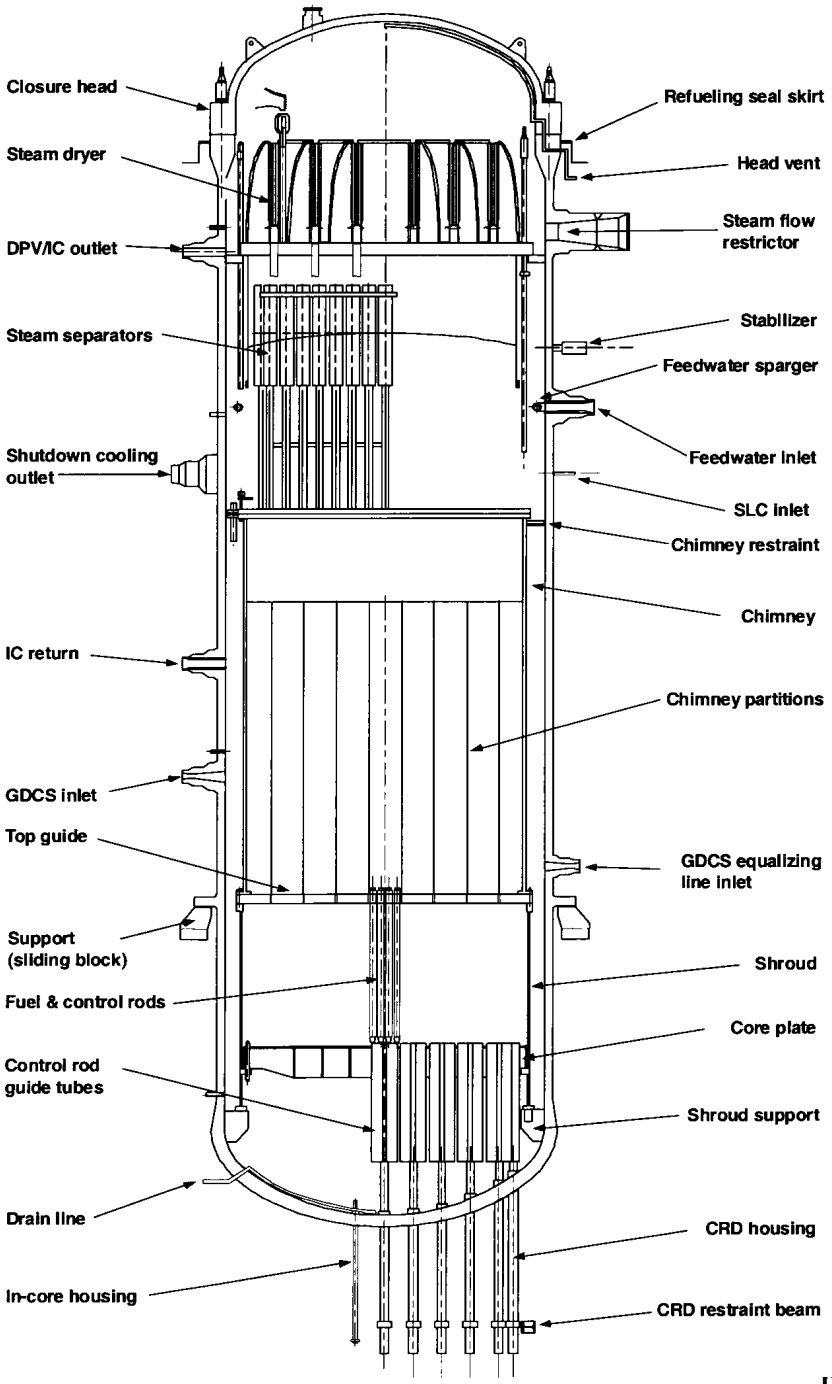
Decay Heat Removal During LOCA

- **For short-term Decay Heat removal**
  - **ECCS/LOCA Analyses (0 ~ 2000 seconds)**
  - **Key measures**: mixture level inside shroud and Peak Cladding Temperature
  - **Key systems:** initial water inventory inside RPV and GDCS
- **For long-term Decay Heat removal**
  - **Containment/LOCA Analyses (0 to 72 hours)**
  - **Key measure**: Long term containment pressure
  - **Key systems:** PCCS, Drywell, Wetwell, suppression pool, and GDCS draindown volume

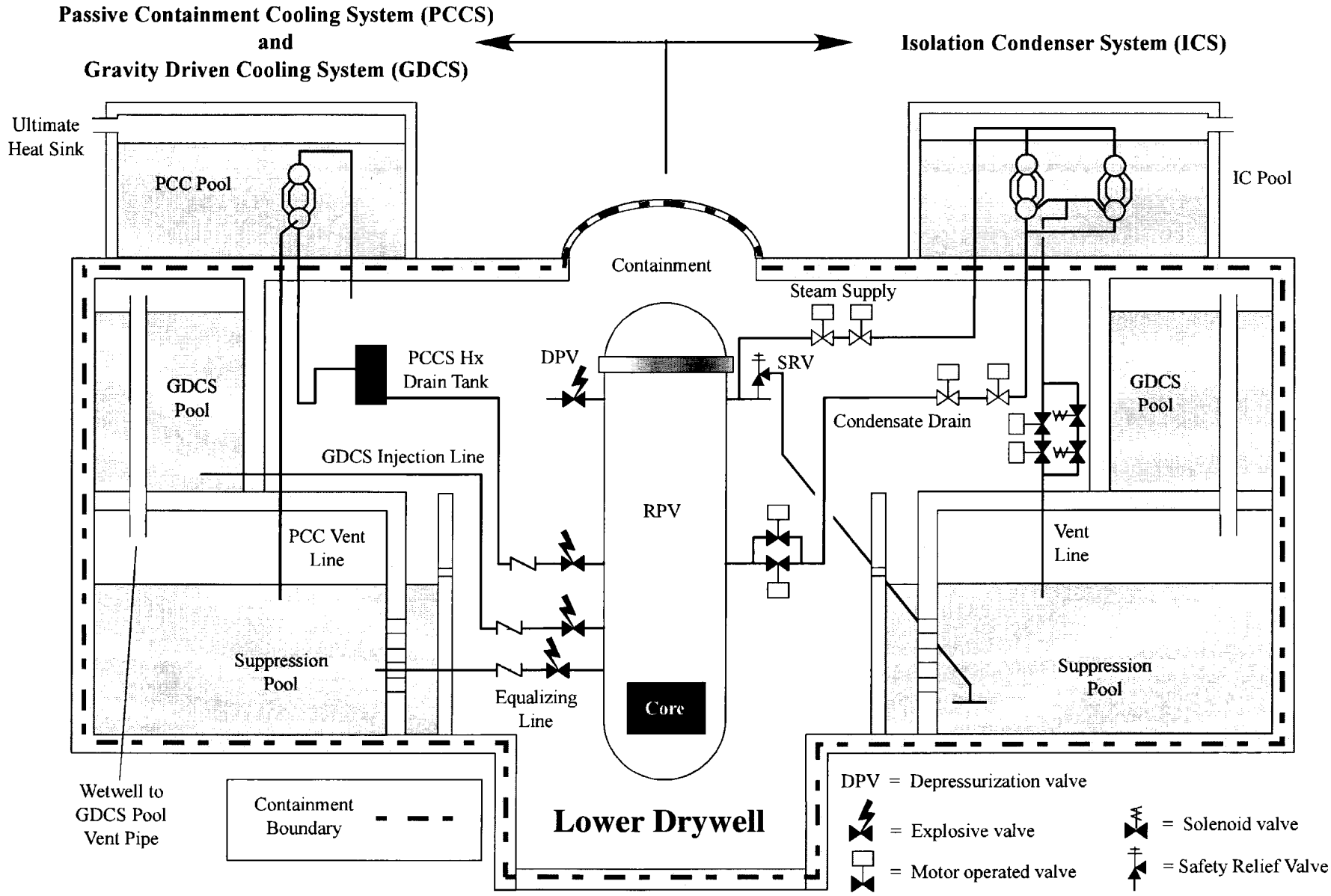
ECCS/LOCA Analyses

- **Short-term Decay Heat removal (0 ~ 2000 seconds)**
- **Key design objectives**
  - Core covered by mixture at all time
  - No core heatup
- **Outline**
  - Nodalization
  - Baseline Analysis
  - Break spectrum analyses
  - Limiting Analysis
  - Summary

RPV Key Features



Containment Key Features



ECCS/LOCA
Nodalization

Substantial Initial Water Inventory inside RPV

ECCS/LOCA Baseline Case

- **GDCS line break with 1 GDCS injection valve failure**
  - Nominal plant/initial conditions
  - 4 PCCS
  - No credit for ICs
  - Assumed 1 GDCS injection valve fail to open

RPV Pressure Response (Base Case)

Two-Phase Levels in Downcomer and Inside Core Shroud (Base Case)

Two-Phase Level and Static Head Inside Shroud (Base Case)

Two-Phase Level and Static Head Inside Shroud (Cont.)

Scoping ECCS/LOCA Break Spectrum Analysis

Limiting ECCS/LOCA Analysis

- **GDCS line break**
  - Same assumptions for Baseline case, except
  - Bounding Plant/initial conditions
  - Significant modeling parameters
    - **lower plenum wall heat transfer**
    - **interfacial heat transfer in the core**
    - **interfacial shear in the downcomer**
    - **interfacial heat transfer in the downcomer**
    - **interfacial shear in the chimney**
    - **channel to bypass leakage flow**

Two-Phase Levels in Downcomer and Inside Core Shroud (Limiting Case)

Two-Phase Level and Static Head Inside Shroud (Limiting Case)

ECCS/LOCA Analyses - Summary

Containment/LOCA Analyses

- **Long-term decay heat removal (0 – 72 hours)**
- **Key design objectives**
  - Peak DW pressure below the design value (60 psia)
- **Outline**
  - Nodalization
  - Baseline Analysis
  - Sensitivity Study
  - Bounding Analysis
  - Summary

Containment/ LOCA Nodalization

Containment/LOCA – Baseline Analyses

- **Main Steam Line Break**
  - Minimum effective Wetwell volume

  => Highest containment pressure
- **Case assumptions**
  - 4 PCCs
  - No credit for the ICs
  - Nominal value for plant parameters
  - Small leakage path was assumed between DW and WW
- **Conservative modeling assumptions**
  - suppression pool stratification, wetwell gas space stratification

Results for Baseline Containment/LOCA Analysis
Containment Pressure Response (Base Case)

PCCS Heat Removal vs. Decay Heat (Base Case)

Suppression Pool Temperatures (Base Case)

Containment/LOCA – Bounding Analyses

- **Main Steam Line Break**
- **Case assumptions**
  - Same as the baseline case, except
  - Bounding value for plant parameters
- **Bounding Case**
  - Bounding value for model parameters used
    - Critical flow
    - decay heat multiplier
    - surf. H.T
    - PCC inlet loss (k/A^2)
    - PCC H.T.
    - V.B. Loss, (k/A^2)

Results for Bounding Containment/LOCA Analysis

Drywell Pressure Response vs. Design Limit

Containment/LOCA Analyses Results

Containment/LOCA Analyses - Summary

ESBWR Anticipated Operational Occurrences (AOO) Transients

- **Overall analysis approach**
  - Consistent with the Code Scaling Applicability and Uncertainty (CSAU) methodology
  - Identical to the approved process for operating BWRs
- **Large steam volume in ESBWR chimney region, resulting in milder transient responses comparing to operating plants**
  - And smaller ΔCPR
- **Sample Pressurization Transient Analysis presented here**
  - Generator load rejection with failure of all bypass valves to open (LRNB)
  - Used an earlier core design of ESBWR
    - 4000 MWth, 1132 fuel bundles, GE12 10x10 fuel
    - 9ft active core height
- **AOO calculations using ESBWR specific conditions are on going**

Generator load rejection with failure of all bypass valves to open (LRNB)

Generator load rejection with failure of all bypass valves to open (LRNB)

ESBWR AOO Transients - Summary

- **Comparing to operating plants, ESBWR has larger steam volume, milder transient responses**