TRACG Qualification for ESBWR

ACRS T H Subcommittee Meeting
Closed Session
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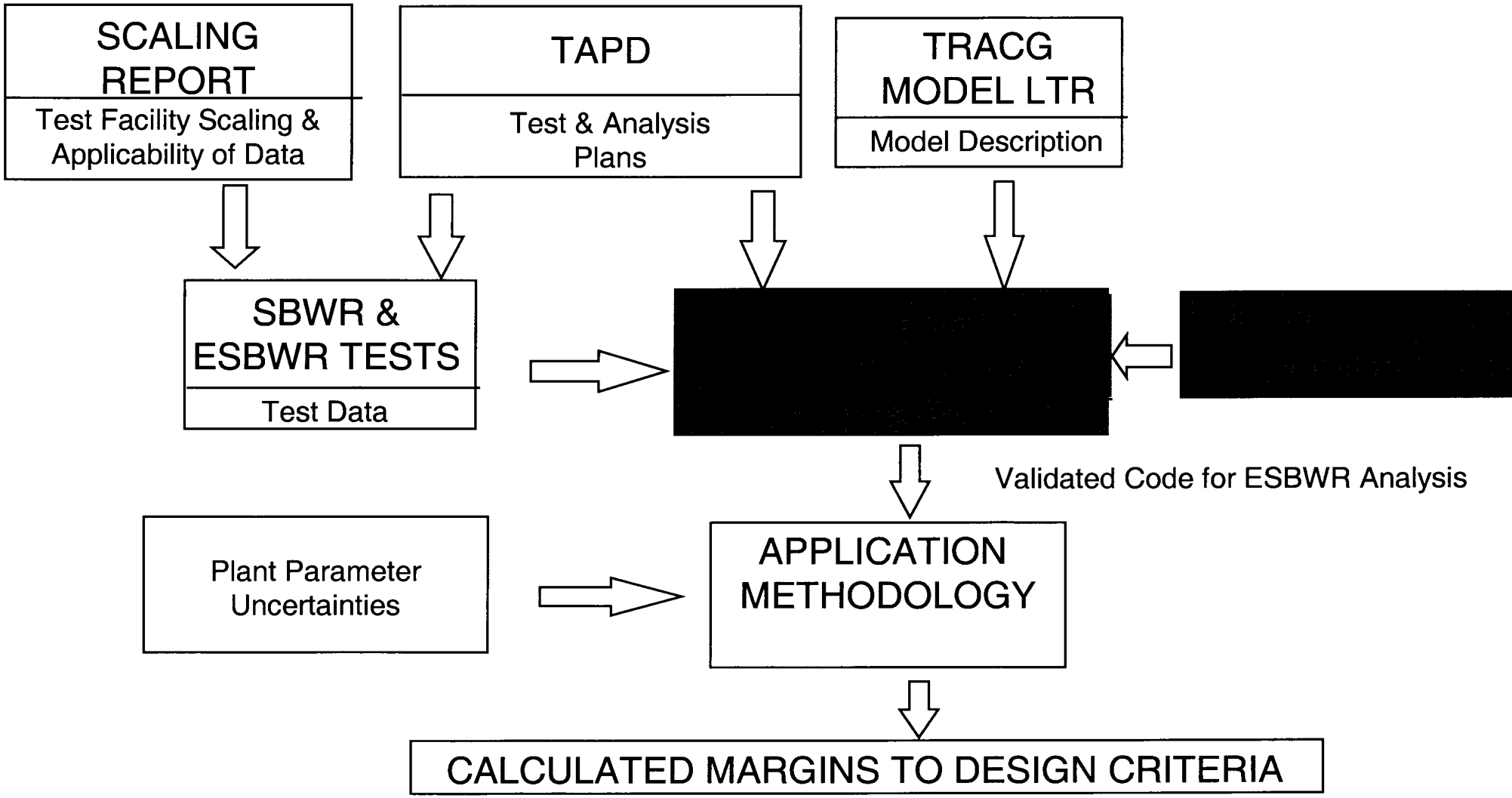
ESBWR Technology Program Elements



TRACG Qualification for ESBWR

- Comprised of three parts
  - Qualification studies relevant to all BWRs (NEDE-32177P)
    - Previously reviewed by NRC for other applications
    - Key results summarized in SBWR Qualification Report
  - SBWR-specific qualification relevant to passive BWRs (NEDC-32725P, Vol. 1 and 2)
    - Adds remaining qualification studies identified in TAPD
  - Additional qualification (NEDC-33080P)
    - Confirmatory results for ESBWR configuration (PANDA P-Series)
    - Other relevant tests performed after SBWR report was compiled (CRIEPI high pressure hydrodynamic stability tests)

Overview of TRACG Qualification

- ***TRACG has been systematically assessed against:***
  - ***Separate effects tests***
  - ***Component performance tests***
  - ***Integral system effects tests***
  - ***BWR plant data***

Base Qualification Report, NEDE-32177P, Rev.2

Base Qualification Report

Base Qualification Report

Assessment studies added in SBWR Qualification Report

Assessment studies added in SBWR Qualification Report

Tests added in ESBWR Qualification Report

Examples of TRACG Qualification Results for Passive Systems

- *Key Component Tests*
  - *PANTHERS PCC Heat Removal for Steam*
  - *PANTHERS PCC Performance with Noncondensibles*
  - *PANTHERS IC Heat Removal vs. Inlet Pressure*
- *Key Integral System Tests*
  - *GIRAFFE-SIT GDCS Line Break*
  - *PANDA Test M3 – Long Term Containment Response*
  - *PANDA Test M9 - Early start test*
  - *PANDA Test P1/8, P3, P4*

PANTHERS PCC Heat Removal for Steam

PANTHERS PCC Performance with Noncondensibles

PANTHERS IC Heat Removal vs. Inlet Pressure

GIRAFFE-SIT GDCS Line Break – RPV Pressure

GIRAFFE-SIT GDCS Line Break – Chimney Level

PANDA Test M3 – Drywell and Wetwell Pressures

PANDA Test M3 – Drywell and Wetwell Temperatures

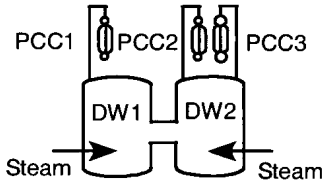
PANDA Test M3 – PCC Inlet Flows

PANDA Test M3 – PCC Pool Levels

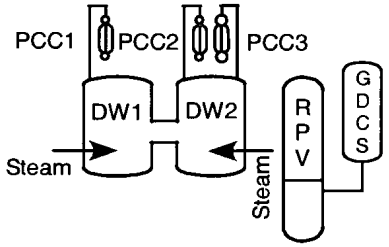
PANDA Test M9 – Drywell and Wetwell Pressures

PANDA P- Series Tests

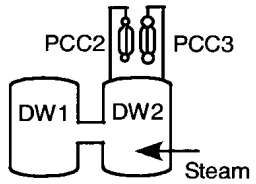
P1: Base Case
MSL Break + 1 hr
(long-term cooling phase)



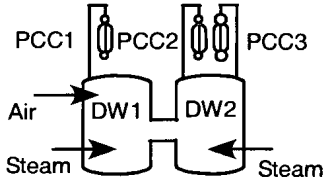
P2: Early Start
MSL Break + 20 min
(transition from GDCS
injection to long-term
PCCS cooling phase)



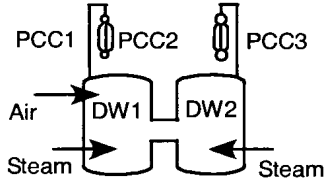
P3: PCCS Start-up
DW initially filled with air
(deomonstrate PCCS start-up
Under challenging conditions)



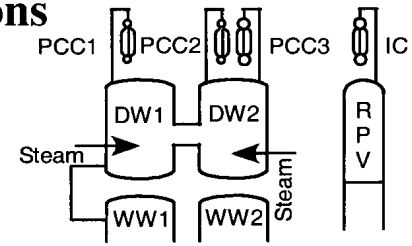
P4: Trapped Air in DW
Air released during transient
(investigation of how n/c gas
Affects PCCS performance)



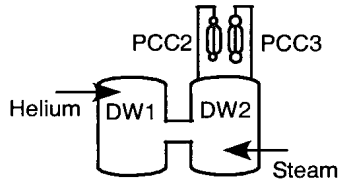
P5: Symmetric Case
PCC2 Isolated, air supply to
DW later in transient
(MV clearing phase caused by
Reduced PCC capacity)



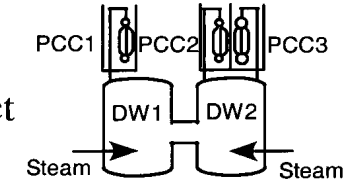
P6: Systems Interactions
ICs and PCCs in parallel,
DW1 to WW1 leakage
(is PCC performance
adverseley affected?)



P7: Severe Accident
All break flow to DW2,
PCC1 isolated,
He supply to DW later in transient
(simulation of hydrogen release
And reduced PCC capacity)



P8: PCC Pool Boil Down
Extension of Base Case, P1
(how do PCC pool levels affect
containment performance)



Drywell and Wetwell Pressures for Test P1/8

PCC Inlet Flows for Test P1/8

PCC Pool Levels for Test P1/8

Drywell and Wetwell Pressures for Test P3

Drywell and Wetwell Pressures for Test P4

Summary of TRACG/PANDA Qualification

Summary of TRACG/PANDA Qualification (contd.)

Quantitative Assessment of TRACG

- ***Assessment accuracy (error) compiled for all comparisons***
- ***Adequacy established by comparing against:***
  - ***Experimental uncertainty***
  - ***Design margin***
  - ***Engineering judgment***
- ***Examples in following charts***

TRACG Accuracy for Chimney Void Fraction

TRACG Accuracy for IC/PCC Heat Removal

TRACG Accuracy for Long Term Containment Pressure

TRACG Limitations and Treatment

Bounding TRACG Models

Summary

- *All qualification activities identified in TAPD have been satisfactorily completed*
  - *The "generic qualification" studies in NEDE-32177P, Rev. 2 have been reviewed and accepted by NRC for AOOs for operating plants*
  - *Significant amount of additional qualification has been performed, particularly for long term containment response*
  - *Accuracy of models has been quantified for prediction of key parameters*
- *Model limitations have been identified and bounding approaches developed to treat these limitations*
- *TRACG is qualified for passive BWR (SBWR/ESBWR) analysis with appropriate application procedures*