

**GE Nuclear Energy**

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***TRACG Qualification for ESBWR***

***ACRS T H Subcommittee***

***Meeting***

***Closed Session***

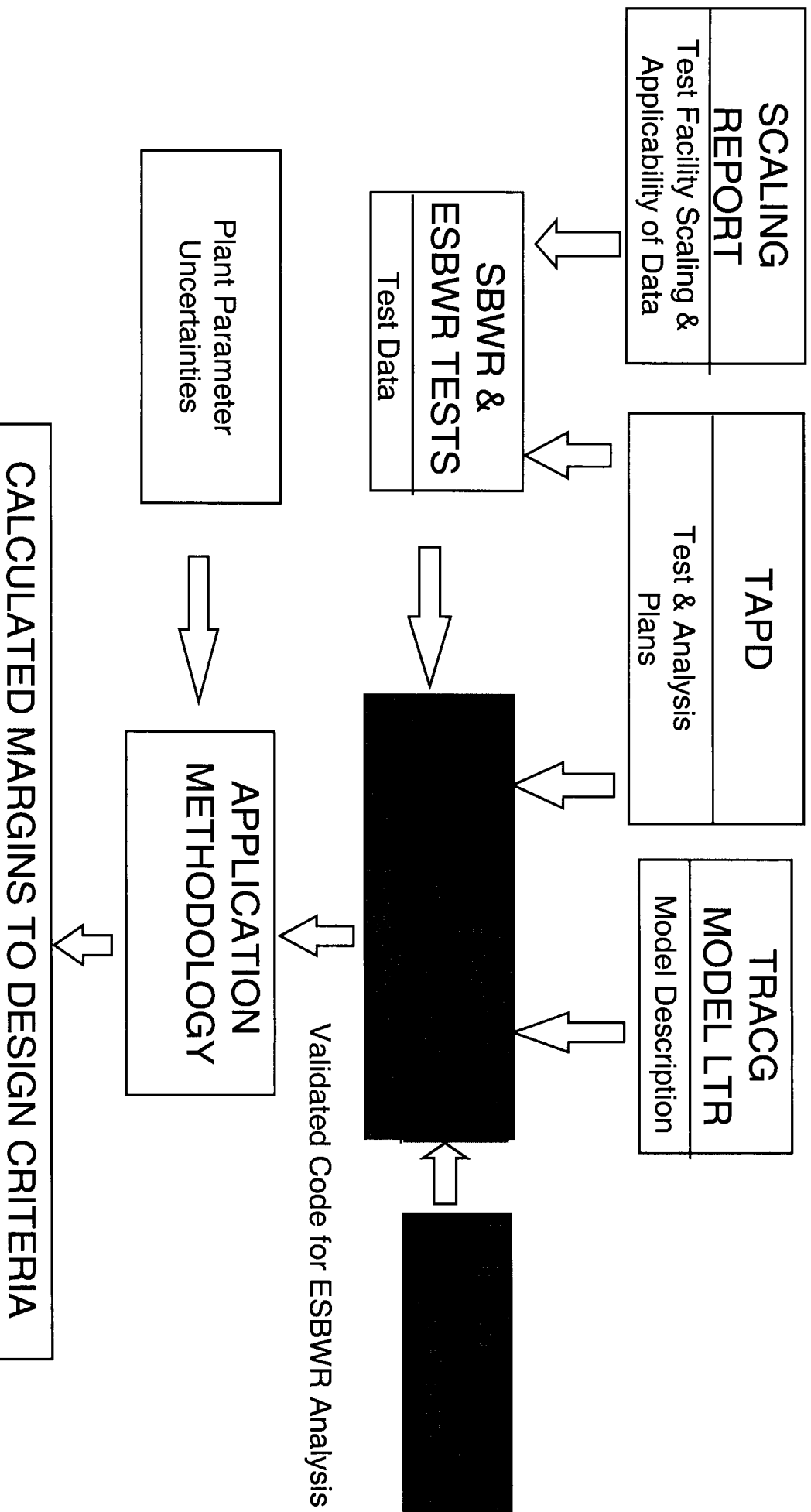
***July 8, 2003***

***Bharat Shiralkar***



# ESBWR Technology Program Elements

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# ***TRACG Qualification for ESBWR***

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- ***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**

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- ***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***

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# ***Base Qualification Report***

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# ***Base Qualification Report***

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BSS-7

# ***Assessment studies added in SBWR Qualification Report***

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BSS-8



# ***Assessment studies added in SBWR Qualification Report***

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## ***Tests added in ESBWR Qualification Report***

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# ***Examples of TRACG Qualification Results for Passive Systems***

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- ***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***

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# ***PANTHERS PCC Performance with Noncondensibles***

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# ***PANTHERS IC Heat Removal vs. Inlet Pressure***

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# ***GIRAFFE-SIT GDCS Line Break – RPV Pressure***

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# **GIRAFFEE-SIT GDCCS Line Break – Chimney Level**

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## ***PANDA Test M3 – Drywell and Wetwell Pressures***

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# ***PANDA Test M3 – Drywell and Wetwell Temperatures***

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# ***PANDA Test M3 – PCC Inlet Flows***

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# ***PANDA Test M3 – PCC Pool Levels***

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## ***PANDA Test M9 – Drywell and Wetwell Pressures***

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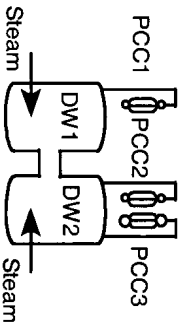
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# PANDA P-Series Tests

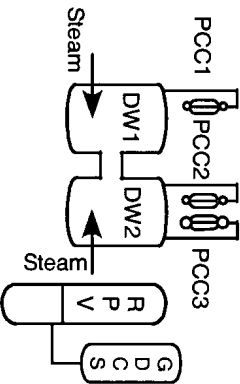
## P1: Base Case

MSL Break + 1 hr  
(long-term cooling phase)



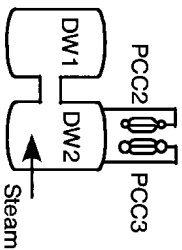
## P2: Early Start

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



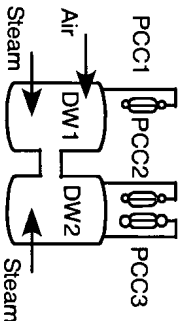
## P3: PCCS Start-up

DW initially filled with air  
(demonstrate PCCS start-up  
Under challenging conditions)



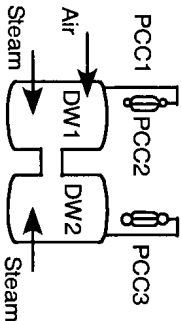
## P4: Trapped Air in DW

Air released during transient  
(investigation of how n/c gas  
Affects PCCS performance)



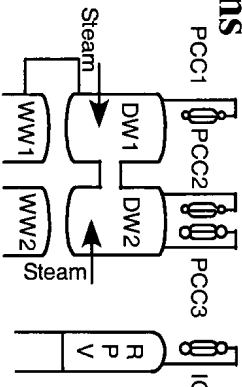
## P5: Symmetric Case

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



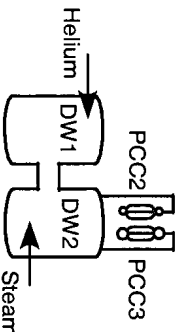
## P6: Systems Interactions

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



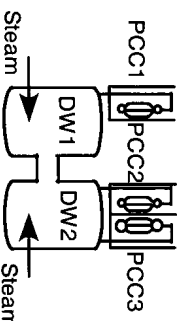
## P7: Severe Accident

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***

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# ***PCC Inlet Flows for Test P1/8***

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## ***PCC Pool Levels for Test P1/8***

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## ***Drywell and Wetwell Pressures for Test P3***

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## ***Drywell and Wetwell Pressures for Test P4***

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# ***Summary of TRACG/PANDA Qualification***

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## ***Summary of TRACG/PANDA Qualification (contd.)***

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# ***Quantitative Assessment of TRACG***

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- ***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***

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# ***TRACG Accuracy for IC/PCC Heat Removal***

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# ***TRACG Accuracy for Long Term Containment Pressure***

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## ***TRACG Limitations and Treatment***

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## ***Bounding TRACG Models***

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# **Summary**

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- ***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***