

BWROG ECCS Suction Strainers

TRACG Presentation

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Outline



1. **TRACG**
2. **TRACG-LOCA Methodology**
3. **TRACG vs. SAFER**

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2. **TRACG-LOCA Methodology**
3. **TRACG vs. SAFER**

TRACG



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- ❑ **TRACG is a GE Hitachi Nuclear Energy Company (GEH) proprietary version of the **T**ransient **R**eactor **A**nalysis **C**ode (**TRAC**).**
- ❑ **It is a best-estimate code for analysis of boiling water reactor (BWR) transients, based on**
 - a multi-dimensional two-fluid model for the reactor thermal-hydraulics, and
 - a three-dimensional neutron kinetics model for the reactor core.
- ❑ **In addition to the basic thermal-hydraulic models, TRACG contains a set of component models for**
 - recirculation pumps, jet pumps, fuel channels, steam separators, & dryers.
- ❑ **TRACG also contains a control system model capable of simulating major BWR control operations.**

Past Applications

- ❑ **LOCA** - Benchmark tool for qualification of SAFER
- ❑ Transients - Time varying axial power shape
- ❑ Stability - Δ CPR for BWROG Option III
- ❑ ATWS stability for BWROG and ABWR
- ❑ Assessment of time-temperature criterion for an internal-pump BWR
- ❑ Rod drop accident analysis, reactivity insertion accidents
- ❑ Containment annulus pressurization & Acoustic loads
- ❑ Reactor internal pressure differences
- ❑ ESBWR design and analysis: **LOCA**, AOO, ATWS, Stability
- ❑ ABWR Startup testing
- ❑ **ABWR LOCA**: Beyond Design Basis Accidents (*N-2 evaluations*)
- ❑ Special Evaluations:
 - KKL Inadvertent ADS Initiation (*non-LOCA LOCA*)
 - Fukushima Simulations
- ❑ Nordic Applications - ATWS, RIA, Transients, **LOCA**, Special Evaluations
- ❑ KKM TRACG **LOCA** and ATWS
 - Licensing Evaluations
 - Beyond Design Basis Evaluations
 - Plant Capacity and Robustness Evaluations

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TRACG-LOCA Methodology



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TRACG-LOCA: Overview



- ❑ “TRACG Application for Emergency Core Cooling Systems / Loss-of-Coolant-Accident Analyses for BWR/2-6”, **NEDE-33005P**
- ❑ Developed to analyze LOCA/ECCS performance in compliance with requirements of **10CFR50.46** and **Reg. Guide 1.157**.
- ❑ Realistic Evaluation Methodology (EM)
a Best-Estimate + Uncertainties (**BEPU**) method
- ❑ Similar to previously approved TRACG-based methodologies, follows **CSAU**.

CSAU: Code Scaling, Applicability, and Uncertainty

TRACG-LOCA: **Current Applications**



- ❑ NMP1 TRACG LOCA
 - Licensing Evaluations
- ❑ UK ABWR TRACG LOCA
 - Beyond Design Basis Evaluations
- ❑ KKM TRACG LOCA
 - Plant Capability and Robustness Evaluations

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TRACG vs. SAFER



SAFER/CORCL		TRACG
Assumptions	Appendix K	Best Estimate
Decay Heat	20% adder	1979 (1994)
Metal Water Reaction	Conservative Baker Just Correlation	Realistic Correlation
SCRAM	DELETED	DELETED
Power	102% Power	100% Power

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TRACG vs. SAFER



SAFER/CORCL		TRACG
Channels	2 Channels: 1 Hot & 1 Average	N Channels: M Hot & (N-M) Average
Core	10 axial nodes	N axial nodes (LTR : 25)
Part Length Rod (PLR)	DELETED	DELETED
Water Rod	Adiabatic WR	Capable of modeling WR heat transfer
Water Rod	Fixed WR shape	Flexible to model axially varying water rod.
Axial Power Shape	Fixed APS	Flexible APS modeling (even within the same model & with the correct PLR impact)

TRACG vs. SAFER



SAFER/CORCL		TRACG
Pipe Modeling and Pipe Effects	N/A	Capable of modeling any vessel connection & piping (FeedWater line, ECCS line, Recirculation Line, BHD line, ...) and hence capable of capturing pipe effects more accurately (inventory , flashing; potential impact on ADS timing, ECCS initiation timing, heatup time,...)
Breaks	Conservatively models as an opening at the vessel boundary (at corresponding elevation)	Capability to model both SPLIT and DEG (Double Ended Guillotine) Breaks at the relevant pipe location
Break in ECCS lines	No credit for ECCS flow in the broken ECCS line	No credit for ECCS flow in the broken ECCS line but capable of modeling realistic ECCS flow (ECCS flow in to vessel is calculated)
Jet Pump Modeling	DELETED	

TRACG vs. SAFER



- ❑ Spray Heat Transfer
 - More accurate spray heat transfer (TRACG)
- ❑ Part Length Rod (PLR) Modeling
 - More accurate modeling of PLRs (TRACG)
- ❑ Hot Channel Modeling
 - More accurate APS modeling (TRACG)
 - More detailed hot channel modeling
- ❑ Blockage Modeling
 - Channel Exit Blockage modeling capability: **DELETED**

TRACG vs. SAFER



- ❑ Radiation Heat Transfer (TRACG)
 - SAFER model is simplified: **DELETED**
- ❑ Quench Front model (TRACG)
- ❑ More Detailed vessel (bypass), core, and channel modeling capability (TRACG)
 - 1D SAFER vessel vs 3D TRACG vessel
 - More detailed nodalization
- ❑ More accurate Long Term Cooling capability (TRACG)

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Thank You



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