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TRACE UNCERTAINTY METHOD DEVLEOPMENT

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Background

- TRACE Version 5.0 and its supporting documentation was completed in 3Q/2007. Since that time, main efforts have been:
  - Development of plant decks
  - Assessment and applicability reports for new reactors
    - ESBWR
    - EPR
    - AP1000
    - APWR
  - Maintenance and error corrections

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Uncertainty Method for TRACE

- TRACE will be used for audit calculations and resolution of safety issues for all light water reactors. Currently, TRACE "realistic" calculations, without uncertainties are used.
- A "cleaner" comparison between TRACE and industry calculations would be to compare 95/95 estimates.
- We expect the industry to continue the trend towards Best Estimate (statistical) and opposed to conservative Appendix K analyses. Very likely BE Methods to extend beyond LOCA (RIA, BWR Stability, Containment, LTC, etc.)
- Gas cooled reactors will be analyzed with MELCOR/PARCS, but a Best Estimate approach has been proposed.
- Reaching a consensus standard on uncertainty methods may make TRACE development more efficient & effective, and save re-thinking on similar problems in years to come.

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Approach

- Automate the sampling and ranging process using the staff's SNAP interface. SNAP is used to develop, modify and submit input decks. It currently has capability to automatically sample and change input deck for some parameters.
- Plan is to use SNAP as the "front-end" in sampling process and use it to automatically modify and submit calculations in an uncertainty method.
- TBD are parameters to be sampled for a given plant type, the set of parameters to be ranged for a given scenario, and the range/distribution for those parameters.

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Approach

Analyst

Select plant type:

PWR / BWR / AP1000 / ESBWR / etc.

Select transient :

LBLOCA / SBLOCA / MSLB / etc.

Modify:

Add or Turn off Parameters
Change range or distribution

SNAP

(Recommended) Parameter List

On/Off	PARAMETER	Min	Max	Dist.
X	Fuel Conductivity	-20%	+20%	Uniform
X	Gap Conductance	-50%	+50%	Normal
X	Wall HT Coefficient	-30%	+10%	Uniform
X	ACCUM Init. Temp.	-20	+20	Uniform
X	Tmin	na	na	Bound
	etc.			

(Modified) Parameter List

On/Off	PARAMETER	Min	Max	Dist.
X	Fuel Conductivity	-20%	+20%	Uniform
X	Gap Conductance	-50%	+50%	Normal
X	Wall HT Coefficient	-30%	+10%	Uniform
X	ACCUM Init. Temp.	-20	+20	Uniform
X	Tmin	-50	+50	Normal
	etc.			

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Approach

SNAP

Sample Parameter List

On/Off	PARAMETER	Sampled Value
X	Fuel Conductivity	+ 3%
X	Gap Conductance	-10%
X	Wall HT Coefficient	-4%
X	ACCUM Init. Temp.	+ 6
X	Tmin	-15
	etc.	

↓

Cases Sufficient ?

No

↓ Yes

Determine 95/95 Value(s)

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Questions 1/3

- What is the minimum number of calculations on which a 95/95 uncertainty should be based if the output parameter(s) of interest are:
  - (a) PCT, MLO, CWO
  - (b) Min. water level, Peak pressure, or other (single) output parameter

- For each output parameter, what set of input parameters should be sampled and ranged for each scenario? Does the input parameter set for a single output parameter (PCT) sufficiently cover other output parameters (MLO and CWO) ?

- What parameters should NOT be ranged:
  - (a) Time in life ?
  - (b) Break area ?
  - (c) Some plant parameters (SI temperature ?)
  - (d) LOOP, or should there be separate 95/95 values for LOOP and non-LOOP ?

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Questions 2/3

- BE methodologies range parameters based on various code models and correlations, such as heat transfer coefficient, and interfacial drag. These are often regime dependent and are based on experimental data from numerous sources:
  - (a) To what extent should regime dependence be accounted for in the ranging. (Acceptable to range single phase convection the same as film boiling ?)
  - (b) When ranging a specific model, should its effect be ranged <u>locally</u> (as in ranging heat transfer in the core only or interfacial drag in the chimney region only) or <u>globally</u> throughout a given model ??
  - (c) How sufficient must the assessment database be to determine a code bias and the type of distribution and limits over which to range a certain model/correlation ?

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Questions 3/3

- How should uncertainties due to things like nodalization, time step size, and other convergence parameters be included a BE methodology ?
- If a plant initial condition is ranged as part of an uncertainty methodology, when is it appropriate to use Tech Spec limiting values , and when can or should plant performance data be used to establish the range and distribution ?
- Are there parameters that because of their “first-order” importance (LCP, PLHR, DH uncertainty, etc.) should be bounded or ranged between nominal & an upper limit ?
- Can recommendations be established for BE analyses using coupled codes ? Examples: TRACE/CONTAIN for containment pressure feedback, and TRACE/PARCS for cases where 3D kinetics may be needed.