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EPRI-MRP Meeting with NRC

Treatment of Surveillance Data in the Alternate PTS Rule

Nathan A. Palm, Fellow Engineer
Aging Management and License Renewal Services
Nuclear Services Division
Westinghouse Electric Company, LLC

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Treatment of Surveillance Data

- Background Information
  - Technical Basis
  - Alternate PTS Rule Implementation
- Evaluation of Statistical Tests
  - Results of Evaluation
- Adjustments for Mean and Outlier Tests
- Treatment for Slope Test
- Westinghouse Recommendations

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Background Information

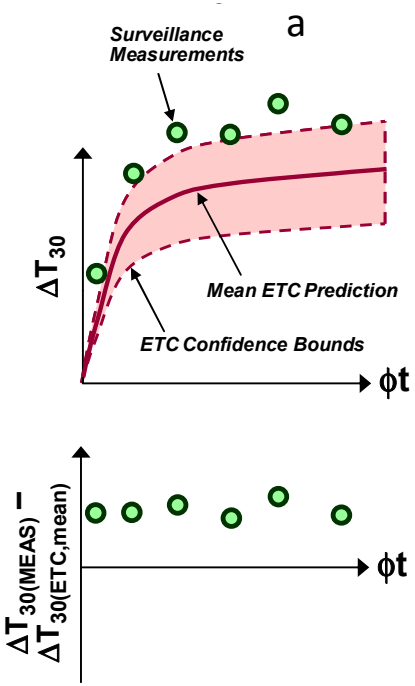
- Reviewers of Risk-Informed PTS Rule asked that applicability of surveillance capsule data to embrittlement trend curve (ETC) be shown.
- *Report, Statistical Procedures for Assessing Surveillance Data for 10CFR50.61a,* completed by NRC in June 2008 (ADAMS ML081290654).
- Surveillance capsule data statistical procedures (SCD Tests) incorporated into the Alternate PTS Rule 10CFR 50.61a.

Technical Basis

Surveillance Check (Alternate Rule)

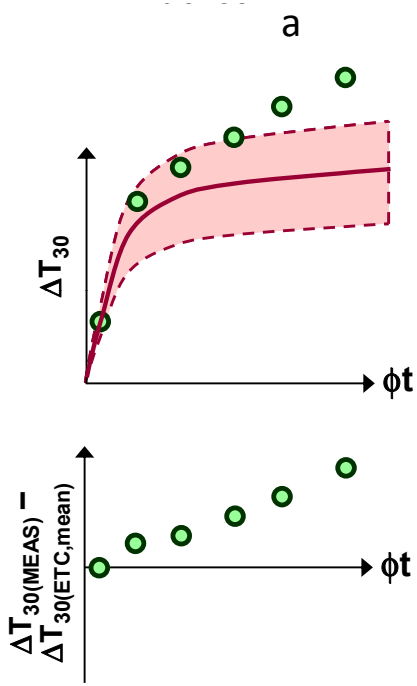
Type A

Mean Test



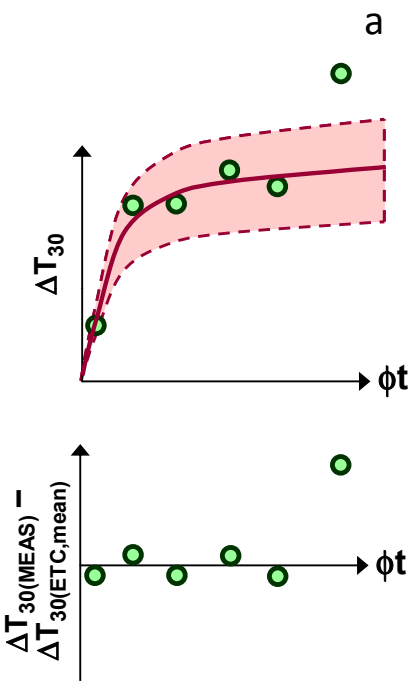
Type B

Slope Test



Type D

Outlier Test



Only types A, B, and D adopted

Technical Basis

Surveillance Check (Alternate Rule) - Implementation

- Mean, slope, and outlier tests are required for all surveillance data sets with 3 or more ΔT_{30} values
  - Check only for non-conservative predictions
  - All tests passed: Use generic ΔT_{30} values
  - 1 test failed: Submit recommended treatment to Director of NRR for approval

- Approach recognizes that
  - Standard and accepted procedures **to assess the statistical significance** of differences between individual data sets and models exist
  - Standard and accepted procedures **to assess the practical importance** of such differences are not available

Alternate PTS Rule – Surveillance Data

- Evaluated using three statistical tests
  - Mean test
  - Slope test
  - Outlier test
- If any test fails, an evaluation of the data and its impact on ΔT_{30} and RT_{MAX} values is required
- No prescriptive methodology for calculating ΔT_{30} when tests are failed

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Evaluation of Statistical Tests

- Application of SCD Tests to the Database for Eason-2007 ETC (ΔT_{30}) equation development showed they are overly conservative.
  - Since all the SC data were actually used in the development of the ETC equations, they should have passed all the statistical tests.
  - Source of conservatism is that same uncertainty for populations of SC data in the database (~60-300 points) is also used for plant samples (3-8 points).
- Therefore, any needed adjustments to ΔT_{30} and RT_{MAX} for failing the SCD statistical tests should be minimal.

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Heats of Material in Currently Operating PWRs That Exhibit Statistically Significant Deviations

Plant Name	Heat ID	Product Form	Population σ [°F]	Number of ΔT_{30} Values	Heat Fails these Deviation Tests		
					A - Mean Test	B - Slope Test	D - Outlier Test
San Onofre 3	PSO301	Plate	18.6	3	FAIL		FAIL
D.C. Cook 2	PCK201	Plate	21.2	8	FAIL		
Beaver Valley 1	PBV101	Plate	21.2	8	FAIL		FAIL
Callaway	WCL101	Weld	18.6	4	FAIL		FAIL
Surry 1	WSU101	Weld	26.4	3	FAIL		FAIL
Indian Point 2	PIP203	Plate	21.2	3	FAIL		
Sequoyah 1	FSQ101	Forging	19.6	8	FAIL		
Sequoyah 1	WSQ101	Weld	26.4	4	FAIL		
Sequoyah 1	WSQ201	Weld	26.4	4			FAIL

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Results of Evaluation

- Eight heats of material failed the mean test:
  - Four plate heats,
  - Three weld heats,
  - One forging heat.
- No heats of material failed the slope test.
- Five heats of material failed the outlier test:
  - Two plate heats,
  - Three weld heats,
  - Four of the heats also failed the mean test.

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Adjustments for Mean and Outlier Tests

- Calculate the adjustment temperature X to just satisfy the mean or outlier statistical tests.
- Add the value of X to all the predicted SCD values , which would also reduce the residual values by the same amount, and show that all three statistical tests are now satisfied.
- Add the same adjustment temperature value of X to the predicted values of ΔT_{30} and RT_{MAX} for those vessel components with the same material heat as that in the surveillance capsule.
  - Because different ETC equations were used to select the capsule materials, the adjusted values of RT_{MAX} for the surveillance capsule materials may not be the most limiting for the vessel belt line.

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Treatment for Slope Test

- One reason the Slope Test is not failed with the current surveillance capsule database could be that the accumulated fluence level of the surveillance capsule materials is not high enough.
- In the future, with high-fluence surveillance capsule data, it is possible that the new data could fail the slope test, and possibly the mean and outlier tests.
- In this case, the treatment would be to calculate the predicted values of ΔT_{30} for all the surveillance capsule data using the latest high-fluence ETC equations that are presented by NRC Research at public ASTM meetings.

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Westinghouse Recommendations

- NRC Research incorporate adjustments for surveillance capsule data that fail the mean and/or outlier tests and the treatment for failing the slope test into the Draft Regulatory Guide on Application of the Alternate PTS Rule.
- Utilities making applications to use the Alternate PTS Rule follow the surveillance capsule data guidance in the Draft Regulatory Guide.
- NRC Regulation accept Utility applications using this guidance on surveillance capsule data.

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Backup Slide

Statistical Factors for 99% Confidence Level (α = 1%)

T(0.99,n) = deviations above mean, T(0.99,infinite) = 2.33,
and Sqrt[F(0.99,n_s,n_p)] = maximum ratio of sample
to population deviations for statistical equivalency.

Number of Points N	3	4	6	8	10	12
T(0.99,N-1)	6.96	4.54	3.36	3.00	2.82	2.72
T(0.99,10N)	2.46	2.42	2.39	2.37	2.36	2.36
Sqrt[F(0.99,N-1,60)]	14.12	6.49	3.52	2.70	2.33	2.11
Sqrt[F(0.99,N-1,300)]	14.12	6.47	3.49	2.67	2.29	2.07

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