



EPRI Plant Engineering

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Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Attention: Lois James

Subject: Docket No. 99902021 – EPRI Comments on the Draft Safety Evaluation
for Topical Report 3002018337-P

References: 1. Use of Data Validation and Reconciliation Methods for Measurement Uncertainty
Recapture: Topical Report. EPRI, Palo Alto, CA: 2020. 3002018337-P.

EPRI has reviewed the Draft Safety Evaluation EPID NO. L-2021-TOP-0006 from the U.S. NRC on the Topical Report for the Use of Data Validation and Reconciliation Methods for Measurement Uncertainty Recapture provided in Reference 1. This letter transmits the consolidated comments and clarifications from EPRI following review of the Draft Safety Evaluation on Reference 1.

The comments on the Draft Safety Evaluation, which are provided in the attachment, do not contain proprietary information. The comments in the attachment are specific to content within the Draft Safety Evaluation that relate to non-proprietary sections in the Topical Report (Reference 1).

If you have any questions regarding this subject, please contact Kurt Crytzer at EPRI by telephone at 704.595.2877 or by e-mail at kcrytzer@epri.com.

Sincerely,

Kurt Crytzer, EPRI, Principal Project Manager

Attachment:

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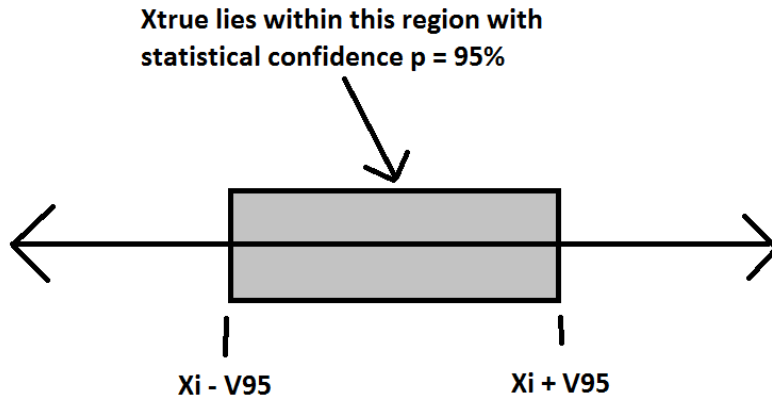
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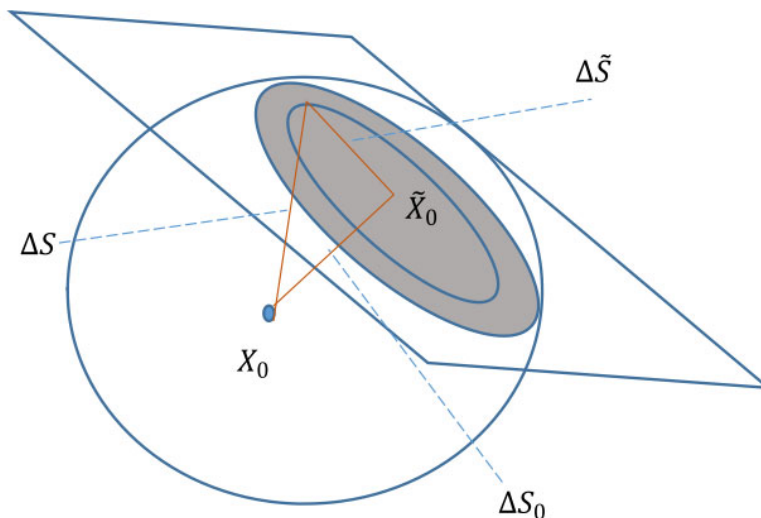
Comments on Draft Safety Evaluation for DVR Topical Report

- Page 1: Section 2, Opening Paragraphs - Term "measurement" is used several times to refer to the CTP value and CTP uncertainty. This may confuse or bother some readers because, of course, it isn't actually measured and is a calculated (or estimated) value. This is stated in the first paragraph; however, referring to a calculated/estimated value as a measurement is not ideal.
- Page 4: Section 2.1, second paragraph: we believe the phrase "if a lower CTP were used" should read "if a lower CTP *uncertainty* were used"
- Page 14: Equation 3.6 is not correct and doesn't align with TR Equation 3-43. The first term under the max() function in the denominator is the standard deviation of the correction, not the standard deviation of the reconciled value.
- Page 17: Failure Scenario 1 predicts the predicted (reconciled) uncertainty could be zero. We believe this is overly conservative. By review of VDI 2048 Equation (36), it is only possible for reconciled FW flow uncertainty to reach zero if there are zero system correlations AND all partial derivatives (sensitivity coefficients) for FW flow are zero. This can only happen if FW flow is set as constant value in model with zero auxiliary conditions.
- **Typo** - page 20, bottom of page, last sentence. "To ensure that the that these uncertainties were... "
- Page 25: Section 3.4, second paragraph: we believe the determination of major/minor contributor should depend on 0.5% of reconciled FW flow *uncertainty*, not value. We don't know that we can attribute percentage contributions to the FW flow values.
- Page 25: Per topical report the major contributors are the measurements that contribute greater than 0.5% to the CTP reconciled uncertainty, not the reconciled FW flow. Page 29 correctly states that "those with uncertainty influence of greater than or equal to 0.5% of CTP uncertainty". Recommend redefining the major and minor contributors on Page 25 to be consistent with the topical report.
- We struggle to see how the updated response to RAI-14 was incorporated to the draft SE and especially Appendix A. Specifically there are many mentions of using "tolerance intervals". The DVR method applies confidence intervals with the input uncertainty and the outputs are also confidence intervals. This may be a timing issue where this draft was finalized prior to the second RAI-14 response but wanted to confirm.
- Page 29: Equation 3.41 defines a tolerance interval. For DVR, the interval used to estimate the uncertainty is a confidence interval (see Figure below). The interval in DVR is the interval with 95% confidence where the true value lies. It is a not tolerance interval where 95% of measured values lie with certain confidence. See VDI-2048 Equations (25) – (27). This may become moot since it is conservative to estimate the standard deviation (i.e. what is used in the diagonal

elements of the Covariance matrix) based upon the V95 estimated uncertainty interval. SE equation 3.41 is the general form of the equation used to estimate the standard deviations, therefore the DVR method as proposed in TR is conservative.



- Page 32: Section 3.5.2, second paragraph of page 32, the document switches here from discussing 0.5% of FW flow uncertainty to 0.5% of CTP uncertainty. Previously, the document made a distinction between what DVR calculates (FW flow) and what the plant computer estimates from that value (CTP). This paragraph should be consistent with section 3.4, paragraph 2, since it is referencing major/minor contributors. Consistency throughout would be useful, but not necessarily mandatory
- Page 36 states “an inherent assumption in applying the results from DVR is that the error in the reconciled means is smaller than the error in the measured means”. We don’t believe the topical report makes this assumption, so this should be revised to remove the phrase in quotations. However, this could possibly be proven mathematically. By inspection of (see Figure 6 and equation 3.10),



$$\Delta S^2 = \Delta S_0^2 + \Delta \tilde{S}^2$$

the true value lies on the plane (i.e. constraint equations) “slicing” through the ellipsoid. As shown on the figure, any point on the plan forms a right triangle. If the true value lies on the grey plane, the hypotenuse ΔS would be the measured error and $\Delta \tilde{S}$ would be the reconciled error. By using basic geometry, the hypotenuse will always be largest side on a right triangle. Therefore, the reconciled error will always be smaller than measured error. We don’t recall this question as an RAI, so this level of detail was never submitted to the NRC.

- Page 38: Typo - Equation 3.59 – the (df/dZ) terms should be squared
- Pages 38-40: Equation 3.60 (also 3.62, 3.63, 3.64)
 - the (dDVR/dx) terms should be squared - **Typo**
 - We understand that this is a simplification, but this equation has a vector matrix on the left and an algebraic expression on the right. When someone looks at this it may not be apparent how the different results in the left side are calculated. Maybe “dDVR/dx” term needs a better description. The “dDVR” is actually supposed to be a dy_i term and changes with each “row” on the lefthand side.
 - Equation 3.60 provides an equation to calculate the uncertainties of the reconciled values. This equation should be valid for systems with zero correlations and all measurement are independent. However, this is not the method proposed by the TR. See Appendix A, section A.1.2.2 for calculation of uncertainties of the reconciled values. There are additional terms missing from this equation (see VDI-2048 Equation (36)). EQ 3.60 is only valid for systems with zero correlations and all measurements are independent. Appendix A, Section A.1.2.2 provides a calculation of uncertainties of the reconciled values.
- Section 3.5.5
 - Bottom of page 41 – “Application of DVR assumes that every measurement uses the same number of samples when calculating its mean.”
 - As discussed in the RAI-14 response, application of DVR assumes that there is a sufficient number of measurements to estimate the mean value for the stated time period. Suggest rewording to “Application of DVR assumes that there is a sufficient number of measurements to estimate the mean value for the stated time period.”
 - Bottom of page 41 – “Further, the method assumes that this same number of samples are the “number of samples of the reconciled measurements” used in converting the standard error which is the outcome of the TSM uncertainty propagation into a standard deviation of the reconciled measurement which is used in determining the CTP uncertainty.”

- This statement is inaccurate; the DVR process does not make any assumptions about the “number of samples of the reconciled measurements.” Making this assumption is adding something to the DVR process that is not described in the Topical Report or in VDI-2048. Ending with “which may be used in determining the CTP uncertainty” is a more accurate statement.
- Page 41: Section 3.5.6, needs to specify if this applies to only one parameter (e.g. FW flow), or to all parameters. “value” is singular, suggesting this applies to only one parameter. If it applies to more than one parameter, we recommend this applying only to “major contributors”
- Pages 50, 51 and 55: Use “prediction” instead of “predication”.
- Suggested reword Condition Limitation 10 to reflect the “number of samples for each measurement should be sufficient to ensure that mean values are well represented, and random uncertainty is minimized.”