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January 17, 2000
PY-CEI/NRR-2449L

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Perry Nuclear Power Plant
Docket No. 50-440
Response to Request for Additional Information Related to a License Amendment Requesting a 24-Month Operating Cycle (TAC No. MA5930)

Ladies and Gentlemen:

On June 17, 1999, the Perry Nuclear Power Plant (PNPP) staff submitted a license amendment request (PY-CEI/NRR-2398L) to the NRC requesting an extension of various surveillance requirements to support a 24-month operating cycle. The PNPP staff received a Request for Additional Information (RAI) from the NRC dated November 23, 1999 regarding this license amendment request. The response to the RAI is contained in Attachments 1 and 2.

If you have questions or require additional information, please contact Mr. Gregory A. Dunn, Manager - Regulatory Affairs, at (440) 280-5305.

Very truly yours,

John K. Wood

Attachments

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III
State of Ohio

A001/1

Perry Nuclear Power Plant Responses to an NRC Request for Additional Information (RAI)

The Perry Nuclear Power Plant (PNPP) staff received a Request for Additional Information (RAI) from the NRC dated November 23, 1999. The RAI deals with questions associated with the PNPP license amendment request regarding the extension of various surveillance requirements to support a 24-month operating cycle. The responses to the RAI are contained in the following paragraphs.

NRC QUESTION

1. Attachment 1, Page 5, PNPP Evaluation, second paragraph states that for many of the instances, where the drift exceeded the allowable value, it was due to a Rosemount transmitter oil loss problem. Please provide the cause(s) and justify the surveillance interval extension for the other instances where the drift exceeded the allowable value for the instruments.

RESPONSE

There were 19 times since 1990, where the as-found values were determined to have been outside the Allowable Value (AV), that were not associated with the Rosemount oil loss syndrome. This exceedance of the AV is considered to be very limited based on the total number of calibrations performed during the 8-year period of data reviewed [approximately 1160 valid calibrations were performed (valid calibrations are defined as the calibrations where the data was used in the drift evaluation)]. Exceeding the allowable value for these 19 times was considered to be due to instrument drift. Due to the statistical nature of the setpoint calculations and the use of 95%/95% confidence intervals for the calculated values, there is an expectation that the measured drift may be outside the predicted value for some small percentage of time.

Generic Letter 91-04 states: "The surveillance and maintenance history for instrument channels should demonstrate that most problems affecting instrument operability are found as a result of surveillance tests other than the instrument calibration. If the calibration data show that instrument drift is beyond acceptable limits on other than rare occasions, the calibration interval should not be increased because instrument drift would pose a greater safety problem in the future."

The 19 times where the as-found loop calibration setting exceeded the AV are considered to be rare occurrences, and do not have a significant affect on the availability of the system to perform it's safety function.

NRC QUESTION

2. Attachment 1, Page 6, second line states that there is one Rosemount transmitter that has 49 months to maturity. Since maturity determines the acceptability of the extension of the surveillance interval, explain the basis for the extension of surveillance interval for this transmitter.

RESPONSE

The justification for the extension of each Technical Specification line item is based on the failure history for the instruments associated with the loop function, the results of the drift analysis, and the impact of the analyzed drift on the plant setpoint and allowable value. During the failure review portion of the evaluation, it was noted that the root cause for some transmitter failures was the Rosemount Loss of Fill-Oil problem. A further review of the impact of this generic industry problem (Information Notice No. 89-42, and NRC Bulletin No. 90-01) indicated that almost all of the identified at-risk transmitters installed in the PNPP had either been replaced or been in service for a sufficient time period to eliminate the Loss of Fill-Oil Syndrome as a plant issue. There was only one transmitter (Main Steam Line High Flow Isolation trip function), that still had a failure potential due to the Loss of Fill-Oil Syndrome. Based upon the discussion in NRC Bulletin No. 90-01, Supplement 1, the NRC became concerned about the Loss of Fill-Oil issue because the failure could occur and remain undetected while the transmitter was in service and could be a common mode failure. With only one transmitter not at maturity, there is no concern for a common mode failure. In light of the following facts: 1.) application of the transmitter (one channel of a multi-channel system), 2.) the likelihood that an oil loss failure could be identified by channel checks or other operator means, and 3.) it does not constitute a common mode failure, the overall impact on system availability is negligible.

NRC QUESTION

3. Attachment 1, Page 6, Step 2, PNPP evaluation: Since the NRC staff has not approved the EPRI TR-103335, "Guidelines for Instrument Calibration Extension / Reduction Programs" Rev. 1, dated October, 1998, confirm that the EXCEL spreadsheets which were used to do additional analysis covers the analyses recommended by the NRC. Also the second paragraph states that conservative assumptions were made in extrapolating current drift values to new drift values. Please provide the list of the main conservative assumptions used in the evaluation.

RESPONSE

The PNPP staff understands the NRC had comments on the EPRI Topical Report (TR)-103335, Revision 0. The PNPP staff interpretation of the NRC comments was that the NRC did not find the evaluation of time dependency and the extrapolation of the drift by regression to be acceptable. Therefore, to resolve these issues at PNPP, the PNPP staff used Excel spreadsheets to perform several different evaluations for time dependency, and bounding calculations for drift based on the time dependency considerations.

Refer to Attachment 2 for an evaluation of the NRC comments contained in the Status Report on the NRC staff review of EPRI TR-103335.

NRC QUESTION

4. GL 91-04 allows the surveillance test interval from 18 months to 24 months operating cycle. However, the licensee's submittal in two instances (SR 3.3.4.1.6 and SR 3.8.4.8) has asked for the extension of surveillance interval from 60 months to 72 months based on the drift analysis. Since the staff has not accepted the extension of surveillance beyond 24 months except in an emergency relaxation, provide the basis for the extension to 72 months.

RESPONSE

Based upon several discussions held in December 1999 between the NRC staff and the PNPP staff, the PNPP staff hereby withdraws the request to extend SR 3.3.4.1 and SR 3.8.4.8 from 60 months to 72 months. Both SRs will remain at the 60 month performance frequency.

NRC QUESTION

5. Attachment 5, Page 9, Section 4.4.2, Rigor Levels: This section classifies instruments/components into three levels of rigor. However, since a typical instrument whether it belongs to rigor level 1, 2, 3 or 4 will perform the same, we question the validity of this approach as this has the potential of forcing the data into smaller groups, thus diminishing the power of the statistical tests to discern real trends. Provide the justification for the use of these smaller groups of data.

RESPONSE

The rigor level discussion is provided to allow the application of a graded approach for the analysis of non-Technical Specification related drift values. The rigor level is only applied after the total set of devices (e.g., Rosemount 1153DB3s) are evaluated and the raw statistics determined. At this point, based on the sample size, a Tolerance Interval Factor (TIF) based on the desired tolerance interval (e.g., 95/95, 90/95, or 75/95) is used

to determine the calculated drift. For the evaluation of devices associated with the PNPP Technical Specifications only Rigor level 1 was utilized. The tolerance interval factors used were all based on a 95/95 desired tolerance interval and all applicable data was included in the evaluation.

NRC QUESTION

6. Attachment 5, Page 11, Section 4.5.2.4 states that: "For each grouping, a large number of components should be randomly selected from the population so that there is assurance that the evaluated components are representative of the entire population." Please state what is that assurance, how many components were eventually selected and how was the randomization achieved. Please present a table for each grouping and for each rigor level showing the number of instruments in the population and number/percent of instruments selected.

RESPONSE

In this case, the design guide was drawing directly from the EPRI TR-103335 to allow variations for future drift analyses. The PNPP staff could not determine a sampling technique that would adequately address the spread of data, spread of calibration intervals, and still be random in any sense of the term. Therefore, no sampling technique was used. All available data for the last 96 months for each Technical Specification line item was collected, evaluated for inclusion, and as appropriate included in the drift analysis.

NRC QUESTION

7. Attachment 5, Page 14, Equation for t': The equation for t' is not the typical Student "t" statistic, but what is often called Welch's and sometimes Satterthwalte's approximation. This approximation also has a specific formula for the calculation of the associated degrees of freedom. This formula should also be included in the submittal.

RESPONSE

The degree of freedom formula defined in Microsoft Excel has been used to determine the proper evaluation point. The equation is provided below. This equation was used for each of the evaluations performed and was inadvertently left out of the drift analysis described in Attachment 5 of the submittal (PY-CEI/NRR-2398L, dated June 17, 1999).

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

NRC QUESTION

8. Attachment 5, Pages 15-16, Outlier Analysis and Outlier Expulsion: Please indicate whether the actual test excluded any observation on purely statistical criteria. If so, identify these points and their magnitude, and state whether their exclusion rendered the analysis more conservative. Also provide the justification for removal of outlier outside 3.5 sigma for the sample set.

RESPONSE

Only one analysis removed outliers without specific justification as defined in Section 4.4.2 of the NRC status Report on EPRI TR-103335. This was in the analysis of Rosemount Transmitter Model 1153DB. There were 6088 data points in this analysis. The ±1 standard deviation contained 5727 of the 6088 data points. Therefore 94.07% of the data points were within 1 standard deviation of the mean. The ±1.5 standard deviation contained 5914 of the 6088 data points. However, the tolerance interval was skewed by two instances of extreme drift. One test (nine-point calibration test) conducted on two different instruments accounted for 40% of the tolerance interval magnitude. Both of these transmitters were later designated as failed and replaced. If the transmitters were replaced at the time of the initial determination of extreme drift, the data from these transmitters would have been removed from the initial data set. The removed data points constituted less than 0.3% of the data. The magnitude of the analyzed drift became less conservative with the removal of these two calibrations. The standard deviation with these calibrations removed ranged from 0.381% at the zero point of calibration to 0.478% at the 100% point of calibration. With these calibrations in the data set the standard deviation was 0.615% at the zero calibration point and 1.110% at the 100% calibration point. Based on the evaluation of the coverage and the performance of the majority of the transmitters, it was determined that these calibrations were not representative of the pool of calibrations. Further, the inclusion of these calibrations into the final data set would have added substantial conservatism to the setpoint and AV calculations. This unrepresentative margin would have masked the detection of problems during the trending process. It was determined that the long-term value of the trending program had a larger impact on plant safety than the inclusion of these data points in the drift analysis. Therefore, these data points were eliminated from the drift analysis. No other observations were removed on a purely statistical criteria (i.e., no outlier outside of 3.5 sigma were removed).

NRC QUESTION

9. Attachment 5, Page 18, Step 3: Division of data into bins leads to the concern that the number and size of the bins are arbitrary. Also, the procedure is invalid if the binning is determined after the data are collected and observed. Please justify the division of the data into bins.

RESPONSE

To assist in determining if there was time dependence between the magnitude of the mean or the standard deviation several different tests were attempted. One of these tests consisted of attempting to evaluate the standard deviation for different calibration intervals, and then perform a regression analysis of the standard deviations. The data was collected for the defined calibrations for a specific manufacture and model number (e.g., Rosemount 1153DB4 transmitters). This data was entered into the spreadsheet or the Instrument Performance Analysis Software System (IPASS) program and a normal statistical analysis was performed. After the mean, standard deviation, and other statistics had been calculated, the data was reviewed to determine if calibrations had been performed on different time intervals (e.g., monthly, quarterly, annually, refueling outage). If the calibrations had been performed on different frequencies, the data was divided based on frequency into bins. Where there appeared to be several samples for a given frequency, an analysis of mean and standard deviation was performed. The means and standard deviations for the various bins were graphed to see if there were indications of a change in drift error over time. As such, binning was not used for grouping of instruments to calculate drift. Rather, it was used only for evaluation of time dependency.

NRC QUESTION

10. Attachment 5, Page 18, Step 4: It appears that the denominator of the equation for "x^2" is incorrect.

RESPONSE

The equation for x^2 was incorrectly written in Attachment 5 of the submittal. The equation used is defined in EPRI TR-103335, and the correct equation was incorporated into the Microsoft Excel 97, Service Release 2, which was used in the analysis. The correct equation is:

$$x^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

NRC QUESTION

11. Attachment 5, Page 19, Step 1: Equation for "T" is correct, but it should be pointed out that X_i represents the data when presented in ascending order of magnitude.

RESPONSE

The IPASS analysis and the verification calculations were performed using the data in ascending order of magnitude.

NRC QUESTION

12. Attachment 5, Page 19, Step 2: The expression for $S^2=(n-1)s^2$ is misleading. "S" is not defined and "s" is defined as standard deviation of all sample data points whereas on page 18 it is defined as the standard deviation of all sample points.

RESPONSE

The definitions for the expression were taken directly from the EPRI TR-103335, Revision 0. The definition of "S^2" (the Sum of the Squares about the mean) has been added to the design guide. The "s" term is defined in the Chi Square discussion on page 18 of Attachment 5 (PNPP letter PY-CEI/NRR-2398L, dated June 17, 1999) as the standard deviation, and "s^2" is defined as the sample population variance on page 19 of the same attachment. These definitions agree with the conventions used on pages C-3, C-9, and C-11 of EPRI TR-103335, Revision 0.

NRC QUESTION

13. Attachment 5, Page 20, Binomial Pass/Fail Analysis: Please justify the use of the failure proportion as a meaningful statistic as the procedure does not account for the "degree of failure" (size of excursion).

RESPONSE

The Binomial Pass/Fail discussion is referenced directly from EPRI TR-103335, any specific application of a pass/fail analysis would be required to initially establish and justify a limit of excursion to classify as a failure. It is assumed that this limit of excursion would be small enough to provide a high level of confidence of acceptable performance. However, the Binomial Pass/Fail Analysis was not used to justify the extension of any surveillance associated with this license amendment request.

NRC QUESTION

14. Attachment 5. page 20, Bottom equation: Since this is a normal approximation and is valid only when $x \geq 5$, please indicate if any analysis did not meet this criterion

RESPONSE

The equation in question is part of the Binomial Pass/Fail Analysis discussion. The Binomial Pass/Fail Analysis was not used to justify any PNPP calibration extension.

NRC QUESTION

15. Attachment 5, Page 24, Table 4: All numbers appear to be on the non-conservative side. The formula for X_{crit} is correct but when the formula is applied to example 1 on page 24, the maximum value for mean is calculated as 0.337%, however, Table 4 lists the value of X_{crit} to be only 0.258%.

RESPONSE

Table 4 actually produces a conservative result in the setpoint analysis. The table would require any value greater than 0.258% to be treated as a bias value. The bias value is not combined with other errors in a Square Root Sum of the Squares combination but is held outside and algebraically summed at the end. Application of the formula to the example would allow a value up to and including 0.337% to be treated as a part of the random component. Therefore, the table is conservative for the application of bias to the setpoint.

Assuming a value for accuracy of 0.5% and a value for setting tolerance of .9% and the drift as defined in Example 1, there are two possible formulas for calculating the Total Loop Uncertainty (TLU):

Assuming the 0.337% is a bias mean:

$$TLU = \sqrt{0.5\%^2 + 0.9\%^2 + 1.150\%^2} + 0.337\%$$

Assuming the 0.337% is a non-biased mean:

$$TLU = \sqrt{0.5\%^2 + 0.9\%^2 + 1.150\%^2}$$

The lower value for the selection of the mean as a bias will give the more conservative value for Total Loop Uncertainty.

Perry Nuclear Power Plant Staff Evaluation of the NRC Status Report on the Staff Review of EPRI Technical Report-103335, "Guidelines for Instrument Calibration Extension/Reduction Programs"

The following are excerpts or paraphrases from the NRC Status Report on the Staff review of EPRI Technical Report (TR)-103335, "Guidelines for Instrument Calibration Extension /Reduction Programs", dated March, 1994. These excerpts are followed by the Perry Nuclear Power Plant (PNPP) staffs' interpretation of the EPRI TR. The PNPP interpretations were used to determine if additional information and analyses were warranted.

STATUS REPORT

Item 4.1, Section 1, "Introduction", Second Paragraph:

"The staff has issued guidance on the second objective (evaluating extended surveillance intervals in support of longer fuel cycles) only for 18-month to 24-month refueling cycle extensions (GL 91-04). Significant unresolved issues remain concerning the applicability of 18 month (or less) historical calibration data to extended intervals longer than 24 months (maximum 30 months), and instrument failure modes or conditions that may be present in instruments that are unattended for periods longer than 24 months."

PNPP EVALUATION

Extensions for longer than 24 months were not requested for any instrument calibrations. However, since the statement relates only to instruments, requests were made to extend the surveillance interval for two non-instrument components to greater than 24 months. Both of the surveillances are currently performed on a 60 month basis, so the concern for applicability to greater than 24 months should not be an issue. Neither of these line items (breaker spark suppression and battery performance testing) are considered instrument functions.

STATUS REPORT

Item 4.2, Section 2, "Principles of Calibration Data Analysis", First Paragraph:

"This section describes the general relation between the as-found and as-left calibration values, and instrument drift. The term 'time dependent drift' is used. This should be clarified to mean time dependence of drift uncertainty, or in other words, time dependence of the standard deviation of drift of a sample or a population of instruments."

PNPP EVALUATION

Both the EPRI TR, Revisions 0 and 1 failed to adequately determine if there existed a relationship between the magnitude of drift and the time interval between the calibration process. The drift analysis performed for the PNPP looked at the time to magnitude relationship using several different statistical and non-statistical methods. First, during the evaluation of data for grouping, data was grouped for the same or similar manufacturer, model number, and application combinations even though the t' statistical test may have shown that the groups were not necessarily from the same population if the groups were performed on significantly different frequencies. This test grouping was made to ensure that the analysis did not cover-up a significant time dependent bias or random element magnitude shift. After the standard deviation and other simple statistics were calculated, the data was evaluated for the time to magnitude relationship. Two separate regression type of analyses were performed; the first, a simple regression calculation based on the scatter of the raw "drift" values and the absolute value "drift" regression. Second, a regression of the calculated standard deviation and mean for the different calibration frequencies was performed if sufficient samples were available. Additionally, if these analyses did not contain sufficient samples for the regression of standard deviations, then different analyses may have been used or the samples may have conservatively been assumed to have a time dependent relationship, and the drift value extrapolated based on a time dependent relationship.

STATUS REPORT

Item 4.2, Section 2, "Principles of Calibration Data Analysis", Second Paragraph:

"Drift is defined as as-found – as-left. As mentioned in the TR this quantity unavoidably contains uncertainty contributions from sources other than drift. These uncertainties account for variability in calibration equipment and personnel, instrument accuracy, and environmental effects. It may be difficult to separate these influences from drift uncertainty when attempting to estimate drift uncertainty but this is not sufficient reason to group these allowances with a drift allowance. Their purpose is to provide sufficient margin to account for differences between the instrument calibration environment and its operating environment see Section 4.7 of this report for a discussion of combining other uncertainties into a 'drift' term."

PNPP EVALUATION

The drift determined by analysis was compared to the equivalent set of variables in the setpoint calculation. The variables for the comparison were all associated with the calibration process (Measurement and Test Equipment error, Setting Tolerance error, etc.). The errors associated with the environment were not considered in the comparison, with the exception of the Drift Temperature Effect. The use of the Drift Temperature Effect term has been previously approved as part of the General Electric (GE) Setpoint Methodology (NEDC 31336).

STATUS REPORT

Item 4.2, Section 2, "Principles of Calibration Data Analysis", Third Paragraph:

"The guidance of Section 2 is acceptable provided that time dependency of drift for a sample or population is understood to be time dependent [sic] of the uncertainty statistic describing the sample or population; e.g., the standard deviation of drift. A combination of other uncertainties with drift uncertainty may obscure any existing time dependency of drift uncertainty, and should not be done before time-dependency analysis is done."

PNPP EVALUATION

Time dependency evaluations were performed on the basic as-left/as-found data. Obviously other error contributors are contained in this data and it is impossible to separate the contribution from drift from the contribution due to Measurement and Test Equipment, Setting Tolerance or other errors associated with the calibration process. Using the raw values appears to give the most reliable interpretation of the time dependency for the calibration process, which is the true value of interest. No other uncertainties are combined with the basic as-left/as-found data for time dependency determination.

STATUS REPORT

Item 4.3, Section 3, "Calibration Data Collection", Second Paragraph:

"When grouping instruments, as well as manufacturer make and model, care should be taken to group only instruments that experience similar environments and process effects. Also, changes in manufacturing method, sensor element design, or the quality assurance program under which the instrument was manufactured should be considered as reasons for separating instruments into different groups. Instrument groups may be divided into subgroups on the basis of instrument age, for the purpose of investigating whether instrument age is a factor in drift uncertainty."

PNPP EVALUATION

Instruments were originally grouped based on manufacturer make, model number, and specific range of setpoint or operation. The groups were then evaluated, and combined based on Section 4.6 of the design guide. The appropriateness of the grouping was then tested based on a t-Test (two samples assuming unequal variances). The t-Test defines the probability, associated with a Student's t-Testm, that two samples are likely to have come from the same two underlying populations that have unequal variances. Instrument groups were not divided into subgroups based on age.

STATUS REPORT

Item 4.3, Section 3, "Calibration Data Collection", Second Paragraph (continued):

"Instrument groups should also be evaluated for historical instrument anomalies or failure modes that may not be evident in a simple compilation of calibration data. This evaluation should confirm that almost all instruments in a group performed reliably and almost all required only calibration attendance."

PNPP EVALUATION

A separate surveillance test failure evaluation was performed for surveillance test performances. This evaluation identified calibration-related and non-calibration-related failures for single instruments, and groups of instruments supporting a specific function. After all relevant device and multiple device failures were identified, a cross check of failures across manufacturer make and model number was also performed to determine if common mode failures could present a problem for the cycle extension. This evaluation confirmed that almost all instruments in a group (associated with extended Technical Specification line items) performed reliably and most failures were detected by more frequent testing.

STATUS REPORT

Item 4.3, Section 3, "Calibration Data Collection", Third Paragraph:

"Instruments within a group should be investigated for factors that may cause correlation between calibrations. Common factors may cause data to be correlated, including common calibration equipment, same personnel performing calibrations, and calibrations occurring in the same conditions. The group, not individual instruments within the group, should be tested for trends."

PNPP EVALUATION

Instruments were only investigated for correlation factors where multiple instruments appeared to have been driven out of tolerance by a single factor. Correlation may exist between the specific type of test equipment (e.g., Fluke 863 on the 0-200 mV range) and the personnel performing calibrations for each plant. This correlation would only affect the measurement if it caused the instrument performance to be outside expected boundaries, e.g., where additional errors should be considered in the setpoint analysis or where it showed a defined bias. Because Measurement and Test Equipment (M&TE) is calibrated more frequently than most process components being monitored, the effect of test equipment between calibrations is considered to be negligible and random. The setting tolerance, readability, and other factors which are more personnel based, would only affect the performance if there was a predisposition to leave or read settings in a particular direction (e.g., always in the more conservative direction). Plant training and evaluation programs are designed to eliminate this type of predisposition. Therefore, the correlation between M&TE and instrument performance, or between personnel and instrument performance has not been evaluated. Observed as-found values outside the allowable tolerance [Leave-As-Is-Zone (LAIZ) or Allowable Value] were evaluated to determine if a common cause existed as a part of the data entry evaluation.

STATUS REPORT

Item 4.3, Section 3, "Calibration Data Collection", Fourth Paragraph:

"TR-103335, Section 3.3, advises that older data may be excluded from analysis. It should be emphasized that when selecting data for drift uncertainty time dependency analysis it is unacceptable to exclude data simply because it is old data. When selecting data for drift uncertainty time dependency analysis, the objective should be to include data for time spans at least as long as the proposed extended calibration interval, and preferably, several times as long, including calibration intervals as long as the proposed interval. For limited extensions (e.g., a GL 91-04 extension), acceptable ways to obtain this longer interval data include obtaining data from other nuclear-plants or from other industries for identical or close-to-identical instruments, or combining intervals between which the instrument was not reset or adjusted. If data from other sources is used, the source should be analyzed for similarity to the target plant in procedures, process, environment methodology, test equipment, maintenance schedules and personnel training. An appropriate conclusion of the data collection process may be that there is insufficient data of appropriate time span for a sufficient number of instruments to support statistical analysis of drift uncertainty time dependency."

PNPP EVALUATION

Data was selected for the last 90 months (5 cycles). This data allowed for the evaluation of data with various different calibration spans over several calibration intervals to provide representative information for each type of instrument. Data from outside the PNPP data set was not used to provide longer interval data. In most cases the time dependency determination was based on calibrations performed at or near 18 months and data performed at shorter intervals (monthly, quarterly, or semiannually). There did not appear to be any time based factors that would be present from 18 to 24 months that would not have been present between 1, 3, 6, or 12 and 18 months. In some cases multiple intervals were evaluated (where the instrument was not reset) to simulate a longer calibration interval. When intervals were combined, the sample set size was reduced to account for the combination of data points into longer calibration intervals. In some cases, it was determined that there was insufficient data to support statistical analysis of drift time dependency. For these cases, a correlation between drift magnitude and time was assumed and the calculation reflects time dependent drift values.

STATUS REPORT

Item 4.3, Section 3, "Calibration Data Collection", Fifth Paragraph:

"TR-103335, Section 3.3 provides guidance on the amount of data to collect. As a general rule, it is unacceptable to reject applicable data, because biases in the data selection process may introduce biases in the calculated statistics. There are only two acceptable reasons for reducing the amount of data selected: enormity, and statistical dependence. When the number of data points is so enormous that the data acquisition task would be prohibitively expensive, a randomized selection process, not dependent upon engineering judgment, should be used. This selection process should have three steps. In the first step, all data is screened for applicability, meaning that all data for the chosen instrument grouping is selected, regardless of the age of the data. In the second step, a proportion of the applicable data is chosen by automated random selection, ensuring that the data records for single instruments are complete, and enough individual instruments are included to constitute a statistically diverse sample. In the third step, the first two steps are documented. Data points should be combined when there is indication that they are statistically dependent on each other, although alternate approaches may be acceptable. See Section 4.5, below, on 'combined point' data selection and Section 4.4.1 on '0%, 25%, 50%, 75%, and 100% calibration span points'."

PNPP EVALUATION

A time interval of 90 months was selected as representative based on the PNPP operating history. No data points were rejected from this time interval, and no sampling techniques were used.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem, 4.4.1, Sections 4.3 and 4.4, Data Setup and Spreadsheet Statistics, First Paragraph:

"The use of spreadsheets, databases, or other commercial software is acceptable for data analysis provided that the software, and the operating system used on the analysis computer, is under effective configuration control. Care should be exercised in the use of Windows or similar operating systems because of the dependence on shared libraries. Installation of other application software on the analysis machine can overwrite shared libraries with older versions or versions that are inconsistent with the software being used for analysis."

PNPP EVALUATION

The project used the EPRI Instrument Performance Analysis Software System (IPASS) software, Revision 2, Beta release. Since this was a Beta release, the software was not treated as QA software. Therefore, calculations were verified using other software products and hand calculations to verify the values generated by the IPASS software. Additionally, to perform the time dependency evaluations and display the histograms with the normal distribution line superimposed, Microsoft Excel was used. These calculations were also confirmed using alternate software or hand calculations.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem, 4.4.1, Sections 4.3 and 4.4, Data Setup and Spreadsheet Statistics, Second Paragraph:

"Using either engineering units or per-unit (percent of span) quantities is acceptable. The simple statistic calculations (mean, sample standard deviation, sample size) are acceptable. Data should be examined for correlation or dependence to eliminate over-optimistic tolerance interval estimates. For example, if the standard deviation of drift can be fitted with a regression line through the 0%, 25%, 50%, 75%, and 100% calibration span points, there is reason to believe that drift uncertainty is correlated over the five (or nine, if the data includes a repeatability sweep) calibration data points. An example is shown in TR-103335, Figure 5.4, and a related discussion is given in TR-103335 Section 5.1.3. Confidence/tolerance estimates are based on (a) an assumption of normality (b) the number of points in the data set, and (c) the standard deviation of the sample. Increasing the number of points (utilizing each calibration span point) when data is statistically dependent decreases the tolerance factor k, which may falsely enhance the confidence in the predicted tolerance interval. To retain the information, but achieve a reasonable point count for confidence/tolerance estimates, the statistically dependent data points should be combined into a composite data point. This retains the information but cuts the point count. For drift uncertainty estimates with data similar to that in the TR example, an acceptable method requires that the number of independent data points should be one-fifth (or one ninth) of the total number of data points in the example and a combined data point for each set of five span points should be selected that is representative of instrument performance at or near the span point most important to the purpose of the analysis (i.e., trip or normal operation point)."

PNPP EVALUATION

The analysis for the PNPP used either engineering units or percent of calibrated span as appropriate to the calibration process. As an example, for switches which do not have a realistic span value, the engineering units were used in the analyses; for analog devices, normally percent of span is used. The data was evaluated for dependence, normally dependence was found between points (0%, 25%, 50%, 75%, and 100%) for a single calibration. However, due to the changes in M&TE and personnel performing the calibrations, independence was found between calibrations of the same component on different dates. To ensure conservatism, the most conservative simple statistic values for the points closest to the point of interest were selected or the most conservative values for any data point were selected. The multiplier was determined based on the number of actual calibrations associated with the worst case value selected. Selection of the actual number of calibrations is equivalent to the determination of independent points (e.g., one fifth or one ninth of the total data point count). Selection of the worst case point is also more conservative than the development of a combined data point.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem 4.4.2, Section 4.5, Outlier Analysis:

"Rejection of outliers is acceptable only if a specific, direct reason can be documented for each outlier rejected. For example, a documented tester failure would be cause for rejecting a calibration point taken with the tester when it had failed. It is not acceptable to reject outliers on the basis of statistical tests alone. Multiple passes of outlier statistical criterion are not acceptable. An outlier test should only be used to direct attention to data points, which are then investigated for cause. Five acceptable reasons for outlier rejection provided that they can be demonstrated, are given in the TR: data transcription errors, calibration errors, calibration equipment errors, failed instruments, and design deficiencies. Scaling or setpoint changes that are not annotated in the data record indicate unreliable data, and detection of unreliable data is not cause for outlier rejection, but may be cause for rejection of the entire data set and the filing of a licensee event report. The usual engineering technique of annotating the raw data record with the reason for rejecting it, but not obliterating the value, should be followed. The rejection of outliers typically has cosmetic effects: if sufficient data exists, it makes the results look slightly better; if insufficient data exists, it may mask a real trend. Consequently, rejection of outliers should be done with extreme caution and should be viewed with considerable suspicion by a reviewer."

PNPP EVALUATION

With the exception of two calibrations, all rejected data points were based on the five acceptable reasons for data removal discussed above. The removal of these data points is discussed in detail in Attachment 1, the response to Question 8.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem 4.4.3, Section 4.6, "Verifying the Assumption of Normality":

"The methods described are acceptable in that they are used to demonstrate that calibration data or results are calculated as if the calibration data were a sample of a normally distributed random variable. For example, a tolerance interval which states that there is a 95% probability that 95% of a sample drawn from a population will fall within tolerance bounds is based on an assumption of normality, or that the population distribution is a normal distribution. Because the unwarranted removal of outliers can have a significant effect on the normality test, removal of significant numbers of, or sometimes any (in small populations), outliers may invalidate this test."

PNPP EVALUATION

The methods that were found acceptable were used for the PNPP analysis. As previously stated only data meeting one of the five acceptable reasons for rejection defined in TR-103335 were removed from the analysis.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem 4.4.4, Section 4.7, "Time-Dependent Drift Considerations", First through Ninth Paragraphs:

"This section of the TR discusses a number of methods for detecting a time dependency in drift data, and one method of evaluating drift uncertainty time dependency. None of the methods uses a formal statistical model for instrument drift uncertainty, and all but one of them focus on drift rather than drift uncertainty. Two conclusions are inescapable: regression analysis cannot distinguish drift uncertainty time dependency, and the slope and intercept of regression lines may be artifacts of sample size, rather than being statistically significant. Using the results of a regression analysis to rule out time dependency of drift uncertainty is circular reasoning: i.e., regression analysis eliminates time dependency of uncertainty; no time dependency is found; therefore, there is no time dependency."

PNPP EVALUATION

Several different methods of evaluation for time dependency of the data were used for the analysis. One method was to evaluate the standard deviations at different calibration Intervals. This analysis technique is the most recommended method of determining time-dependent tendencies in a given sample pool. The test consists simply of segregating the drift data into different groups (bins) corresponding to different ranges of calibration or surveillance intervals, and comparing the standard deviations for the data in the various groups. The purpose of this type of calculation is to determine if the standard deviation tends to become larger as the time between calibration increases. Simple regression lines, regression of the absolute value of drift, as well as F significance tests were generated and reviewed. Where there was not sufficient data to perform the detailed evaluation, the data was assumed time dependent. Most data was assumed to have some level of time dependence in the projection of drift over the 30-month calibration interval.

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem 4.4.4, Section 4.7, "Time-Dependent Drift Considerations", Thirteenth and Fourteenth Paragraphs:

"A model can be used either to bound or project future values for the quantity in question (drift uncertainty) for extended intervals. An acceptable method would use standard statistical methods to show that a hypothesis (that the instruments under study have drift uncertainties bounded by the drift uncertainty predicted by a chosen model) is true with high probability. Ideally, the method should use data that include instruments that were unreset for at least as long as the intended extended interval, or similar data from other sources for instruments of like construction and environmental usage. The use of data of appropriate time span is preferable; however, if this data is unavailable, model projection may be used provided the total projected interval is no greater than 30 months and the use of the model is justified. A follow-up program of drift monitoring should confirm that model projections of uncertainty bounded the actual estimated uncertainty. If it is necessary to use generic instrument data or constructed intervals, the chosen data should be grouped with similar grouping criteria as are applied to instruments of the plant in question, and Student's "t" test should be used to verify that the generic or constructed data mean appears to come from the same population. The "F" test should be used on the estimate of sample variance. For a target surveillance interval constructed of shorter intervals where instrument reset did not occur, the longer intervals are statistically dependent upon the shorter intervals; hence, either the constructed longer-interval data or the shorter-interval data should be used, but not both. In a constructed interval, drift = as-left$_{(0)}$ – as found$_{(LAST)}$, the intermediate values are not used.

When using samples acquired from generic instrument drift analyses or constructed intervals, the variances are not simply summed, but are combined weighted by the degrees of freedom in each sample."

PNPP EVALUATION

The General Electric interval extension process was used because the PNPP is committed to the General Electric Setpoint Methodology. Where it could be demonstrated that there was no correlation between component drift for different calibration intervals, the calculated drift error for the specified tolerance interval was used unchanged as the expected 30-month drift value. Where the drift could not be proven to be time independent, the calculated drift value was extended based on the formula:

$$\text{Drift}_{30} = \text{Drift calculated} * (30/\text{calculated drift time interval})^{1/2}.$$

Where there is a strong indication of drift, the following formula was used:

$$\text{Drift}_{30} = \text{Drift calculated} * (30/\text{calculated drift time interval}).$$

STATUS REPORT

Item 4.4, Section 4, "Analysis of Calibration Data":

Subitem 4.4.5, Section 4.8, "Shelf Life of Analysis Results":

"The TR gives guidance on how long analysis results remain valid. The guidance given is acceptable with the addition that once adequate analysis and documentation is presented and the calibration interval extended, a strong feedback loop must be put into place to ensure drift, tolerance and operability of affected components are not negatively impacted. An analysis should be re-performed if its predictions turn out to exceed predetermined limits set during the calibration interval extension study. A goal during the re-performance should be to discover why the analysis results were incorrect The establishment of a review and monitoring program, as indicated in GL 91-04, Enclosure 2, Item 7 is crucial to determining that the assumptions made during the calibration interval extension study were true. The methodology for obtaining reasonable and timely feedback must be documented."

PNPP EVALUATION

As discussed in the submittal documents the plant is committed to establish a trending program to provide feedback on the acceptability of the drift error extension. This program will evaluate any as-found condition outside the LAIZ and perform a detailed analysis of as-found values outside the Allowable Value. The drift analysis will be re-performed when the root cause analysis indicates drift is a probable cause for the performance problems.

STATUS REPORT

Item 4.5, Section 5, "Alternative Methods of Data Collection and Analysis":

"Section 5 discusses two alternatives to as-found/as-left (AFAL) analysis, combining the 0%, 25%, 50%, 75% and 100% span calibration points, and the EPRI Instrument Calibration Reduction Program (ICRP).

Two alternatives to AFAL are mentioned: as-found/setpoint (AFSP) analysis and worse case as-found/as-left (WCAFAL). Both AFSP and WCAFAL are more conservative than the AFAL method because they produce higher estimates of drift. Therefore, they are acceptable alternatives to AFAL drift estimation.

The combined-point method is acceptable, and in some cases preferable, if the combined value of interest is taken at the point important to the purpose of the analysis. That is, if the instrument being evaluated is used to control the plant in an operating range, the instrument should be evaluated near its operating point. If the instrument being evaluated is employed to trip the reactor, the instrument should be evaluated near the trip point. The combined-point method should be used if the statistic of interest shows a correlation between calibration span points, thus inflating the apparent number of data points and causing an overstatement of confidence in the results. The method by which the points are combined (e.g., nearest point interpolation, averaging) should be justified and documented."

PNPP EVALUATION

The worst case as-found/as-left method was used where there was insufficient data to perform even simple statistics. The WCAFAL were evaluated against current allowances, and where the value had not exceeded the allowance, this was used as a limiting drift value for the calibration cycle time interval. This value was then extrapolated to the 30-month interval assuming a positive time dependence correlation.

STATUS REPORT

Item 4.6, Section 6, "Guidelines for Calibration and Surveillance Interval Extension Programs":

This section presents an example analysis in support of extending the surveillance interval of reactor trip bistables from monthly to quarterly.

PNPP EVALUATION

The PNPP submittal did not extend any bistables from monthly to quarterly. Therefore, this section was not evaluated.

STATUS REPORT

Item 4.7, Section 7, "Application to Instrument Setpoint Programs":

"Section 7 is a short tutorial on combining uncertainties in instrument Setpoint calculations. Figure 7-1 of this section is inconsistent with ANSI/ISA-S67.04-1994, Part 1, Figure 1. Rack uncertainty is not combined with sensor uncertainty in the computation of the allowable value in the standard. The purpose of the allowable value is to set a limit beyond which there is reasonable probability that the assumptions used in the setpoint calculation were in error. For channel functional tests, these assumptions normally do not include an allowance for sensor uncertainty (quarterly interval, sensor normally excluded). If a few instruments exceed the allowable value, this is probably due to instrument malfunction. If it happens frequently, the assumptions in the setpoint analysis may be wrong. Since the terminology used in Figure 7-1 is inconsistent with ANSI/ISA-S67.04-1994, Part I, Figure 1, the following correspondences are suggested: the 'Nominal Trip Setpoint' is the ANSI/ISA trip setpoint; ANSI/ISA value 'A' is the difference between TR 'Analytical Limit' and 'Nominal Trip Setpoint' [sic]; 'Sensor Uncertainty' is generally not included in the 'Allowable Value Uncertainty' and would require justification, the difference between 'Allowable Value' and 'Nominal Trip Setpoint' is ANSI/ISA value 'B'; the 'Leave-As-Is-Zone' is equivalent to the ANSI/ISA value 'E' and the difference between 'System Shutdown' and 'Nominal Trip Setpoint' is the ANSI/ISA value 'D'. Equation 7-5 (page 7-7 of the TR) combines a number of uncertainties into a drift term, D. If this is done, the reasons and the method of combination should be justified and documented. The justification should include an analysis of the differences between operational and calibration environments, including accident environments in which the instrument is expected to perform."

PNPP EVALUATION

Application of the drift values to plant setpoints was performed in accordance with the GE Setpoint Methodology. The Allowable Value defined for the GE Setpoint Methodology is defined as the operability limit when performing the channel calibration. Therefore, the Allowable Value placed in Technical Specification includes the sensor drift for the refueling cycle and the trip unit drift (for transmitter/trip unit combinations) for the quarter. The only environmental term that is ever combined in the drift value is Drift Temperature Effect as defined in the GE Setpoint Methodology.

STATUS REPORT

Item 4.8, Section 8, "Guidelines for Fuel Cycle Extensions":

"The TR repeats the provisions of Enclosure 2, GL 91-04, and provides direct guidance, by reference to preceding sections of the TR, on some of them."

PNPP EVALUATION

A specific discussion of how the PNPP evaluations met the guidance of GL 91-04 was provided in the licensing submittal (PY-CEI/NRR-2398L dated July 17, 1999).