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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Subject: Additional Information Supporting Main Steam Safety Valve Setpoint Tolerances and Tolerance Uncertainty Treatment Methodology

References:

1. Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Main Steam Safety Valve Setpoint Tolerances and Tolerance Uncertainty Treatment Methodology," dated October 29, 2004

2. Letter from M. Banerjee (U. S. NRC) to C. M. Crane (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 (TAC Nos. MC5018 and MC5019)," dated April 1, 2005

In Reference 1, Exelon Generation Company, LLC (EGC) requested NRC approval of a Monte Carlo statistical analysis of the main steam safety valve (MSSV) network for Dresden Nuclear Power Station, Units 2 and 3. The Monte Carlo statistical analysis was performed to determine an upper tolerance limit for MSSVs and safety/relief valves that more accurately predicts the distribution of pressures that result in the valves opening. The intent of the analysis was to demonstrate a statistically based technically valid alternative to traditional deterministically applied setpoint drift, which assumes that all of the valves drift to the highest possible setpoint.

In Reference 2, the NRC requested additional information regarding the Monte Carlo analysis. The attachment to the letter provides the requested information.

Should you have any questions concerning this letter, please contact Mr. Kenneth M. Nicely, at (630) 657-2803.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager – Licensing

Attachment: Response to Request for Additional Information

ATTACHMENT
Response to Request for Additional Information

NRC Request 1

In the October 29, 2004, submittal, the licensee used a Monte Carlo analysis method to assess the main steam safety valve setpoint uncertainty effects on the plant overpressure protection analysis. The method uses a random sampling technique to assess the effects of setpoint variation. The setpoint values are sampled individually about the mean values using variances determined by the available test data. The setpoint values are considered to be independent of each other, such that a high setpoint on one MSSV does not bias any of the other MSSV setpoints. However, operational experience at several facilities has shown that in some cases, there have been safety valves which have drifted in the upward direction due to common cause effects (e.g., due to excessive friction or bonding). A review of the Dresden and Quad Cities MSSV setpoint test data indicates there is such a common cause effect. Specifically, it is noted that when any one MSSV had drifted high by approximately +1.75% or greater, then all other MSSVs which were tested at that time, had also drifted in the high direction (reference data from tests performed in October 1999 for Dresden and in June 1994, April 1997, and September 2001 for Quad Cities). This indicates that the proposed Monte Carlo sampling should model a bias in the positive direction when any setpoints have drifted high, above a threshold value. Please provide an analysis of the effects of common causes on the MSSV setpoint modeling.

Response

Exelon Generation Company, LLC (EGC) has reviewed the examples cited above and concludes that the data suggest a positive bias has been experienced at various times. The September 2001 data for Quad Cities Nuclear Power Station (QCNPS) Unit 1, in which all eight valves were changed out and tested, provides the strongest case for a potential to experience a systematic positive drift. The other QCNPS examples and the Dresden Nuclear Power Station (DNPS) example need to be considered in light of the standard practice of changing and testing 50% of the valves in each refueling outage.

To account for this practice, the data for the valves tested during refueling outages both prior to and following the valve replacements were evaluated to determine if the Monte Carlo methodology should include the possible effects of systematic positive drift. The following table provides the statistical parameters associated with data cases for the refueling outages cited above, as well as additional cases that include data for valves tested during refueling outages prior to and following the valve replacements.

Data Case	Number of Data Points	Mean % of Setpoint	Standard Deviation, Percent of Setpoint
QCNPS Unit 1: September 2001	8	0.798	0.61
QCNPS Unit 1: June 1994	4	0.936	0.959
QCNPS Unit 2: April 1997	4	0.899	0.576
DNPS Unit 2: October 1999	4	0.794	0.867
QCNPS Unit 1: June 1994 + February 1993	8	0.354	0.991
QCNPS Unit 1: June 1994 + April 1996	8	0.408	1.058
QCNPS Unit 2: April 1997 + May 1995	8	0.198	1.092
QCNPS Unit 2: April 1997 + March 1999	12	0.129	1.232
DNPS Unit 2: October 1999 + March 1998	8	0.203	1.28
DNPS Unit 2: October 1999 + October 2001	8	0.009	1.057

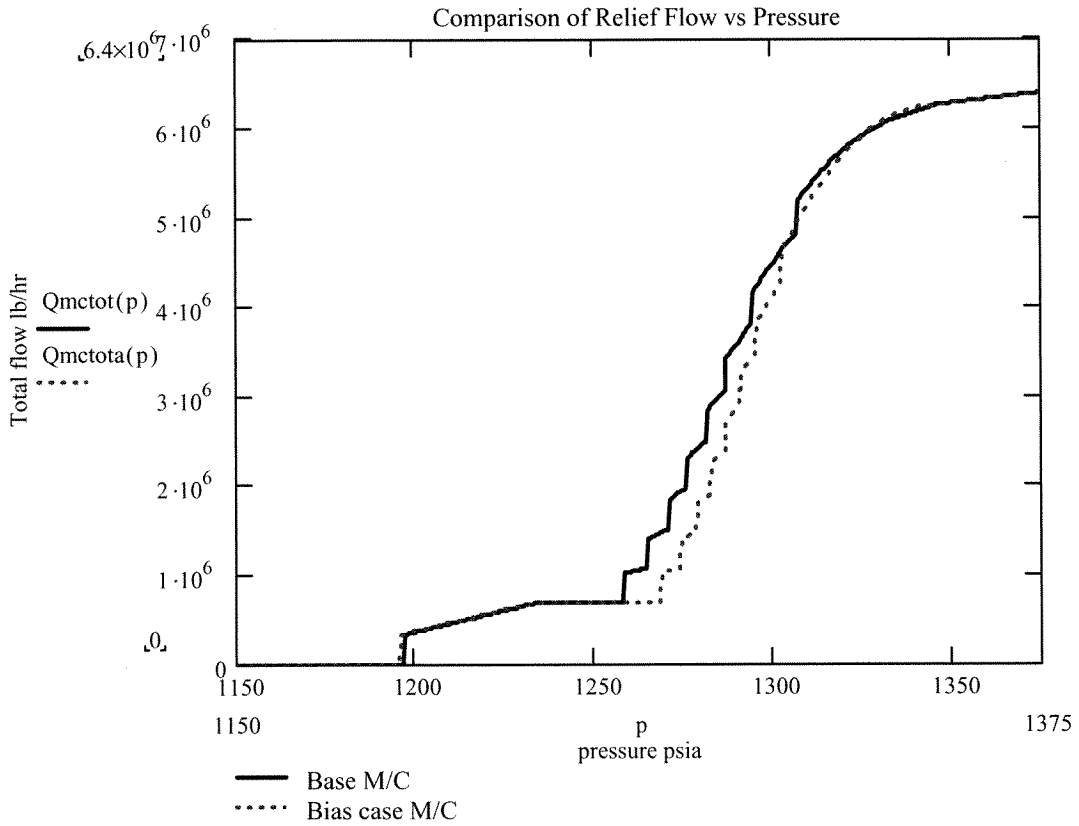
When the full data set is included (i.e., including data from refueling outages both prior to and following the valve replacements), the bias is considerably smaller than in the examples cited. However, since the bias is not zero, EGC has evaluated the need for a bias correction.

The Monte Carlo approach was modified to apply the bias and standard deviation data as measured, and then the results were compared to the base calculation. QCNPS Unit 1 data from September 2001 was used for this comparison.

The following table provides the valve setpoints, the base Monte Carlo calculation with broadened 1σ values and zero bias (i.e., Monte Carlo 95 Percentile Opening Point), and the results of the re-analysis using the actual bias (i.e., 0.798) and standard deviation (0.61 percent of setpoint) of the safety valve data (i.e., Monte Carlo 95 Percentile Based on 2001 Data). The Target Rock safety/relief valve setpoint and bias was not changed for this re-analysis.

Valve/Nominal Setpoint (psia)	1% Drift Analysis Setpoint (psia)	Monte Carlo 95 Percentile Opening Point (psia)	Monte Carlo 95 Percentile Based on 2001 Data (psia)
T/R /1150	1161.35	1196.2	1195.9
MSSV GR1 / 1255	1267.4	1258.1	1268.9
MSSV GR1 / 1255	1267.4	1265.0	1274.2
MSSV GR2 / 1265	1277.5	1270.7	1278.9
MSSV GR2 / 1265	1277.5	1275.8	1282.9
MSSV GR3 / 1275	1287.6	1281.1	1286.9
MSSV GR3 / 1275	1287.6	1286.9	1290.8
MSSV GR3 / 1275	1287.6	1294.4	1295.3
MSSV GR3 / 1275	1287.6	1307.2	1302.6

As can be seen, the bias case (i.e., Monte Carlo 95 Percentile Based on 2001 Data) yields higher lift points for all the valves except the last opening valve. This is reasonable given the relatively large bias applied, compared to the change in the standard deviation. The net change in delivered flow is shown in the following plot.



The difference between the two curves is a 6.2% reduction in delivered flow for the biased case.

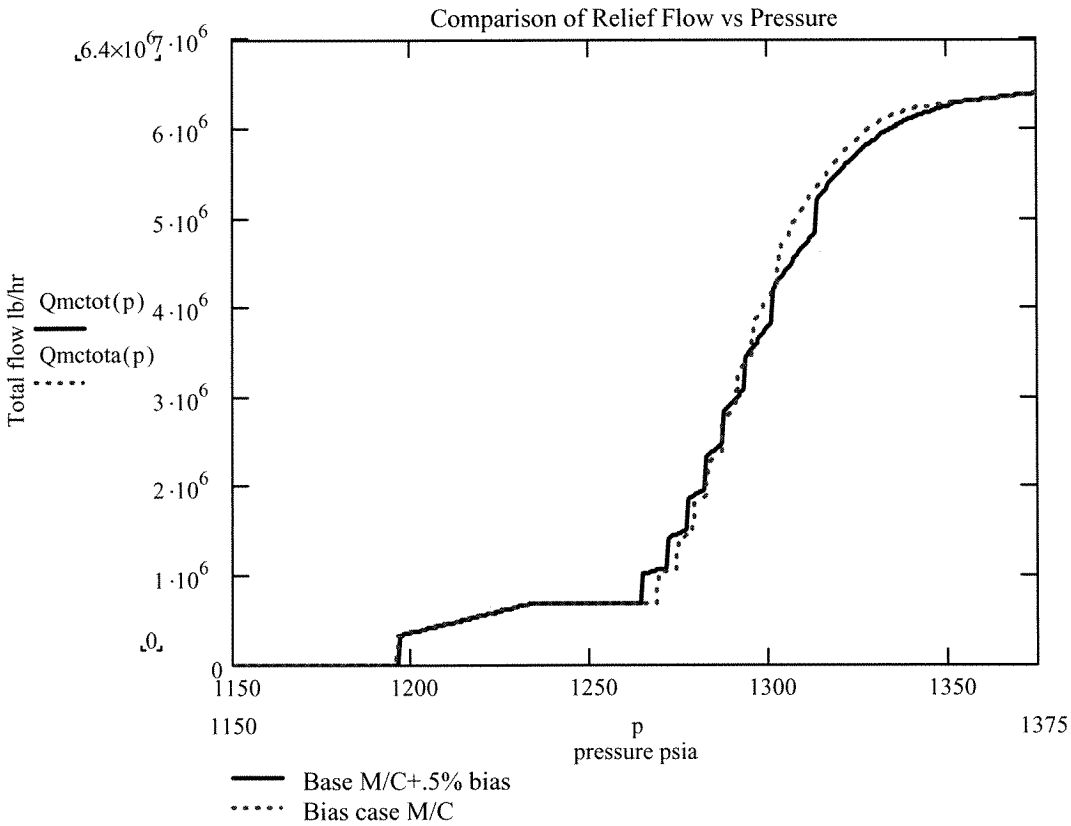
Based on the above discussion, the potential for some positive bias to occur periodically cannot be ruled out. The instances of positive bias, when accounting for a full set of valve data, tend to be relatively small. The worst case was analyzed and yields a potential non-conservative network flow that would be approximately 6.2% less than the base case. Historically, the valve data, taken as a whole, yields a slight negative bias, which is not included in the base analysis. The conservatively broadened 1σ values easily encompass the spread of data, but do not compensate fully for a systematic bias, as demonstrated above.

<u>Discussion of potential modification to the base analysis</u>

The inclusion of a bias term on the analyzed valve setpoints can be performed to increase the likelihood that testing bias comparable to those observed above can be accommodated without penalty. A revision to the base case was performed employing the broadened 1σ values previously developed and applying a 0.5% positive bias to all MSSV setpoints. The results of this case are shown below along with the QC 2001 case discussed above:

Valve/Nominal Setpoint (psia)	1% Drift Analysis Setpoint (psia)	Monte Carlo 95 Percentile Opening Point (psia) +0.5% Bias	Monte Carlo 95 Percentile Based on 2001 Data
T/R /1150	1161.35	1196.3	1195.9
MSSV GR1 / 1255	1267.4	1264.2	1268.9
MSSV GR1 / 1255	1267.4	1271.3	1274.2
MSSV GR2 / 1265	1277.5	1276.9	1278.9
MSSV GR2 / 1265	1277.5	1282.0	1282.9
MSSV GR3 / 1275	1287.6	1287.4	1286.9
MSSV GR3 / 1275	1287.6	1293.2	1290.8
MSSV GR3 / 1275	1287.6	1300.7	1295.3
MSSV GR3 / 1275	1287.6	1313.5	1302.6

The valve network performance for the base case with 0.5% bias and the QCNPS Unit 1 2001 case is shown below.



Numerical integration of the curves shows that the base case with 0.5% bias is within 2% of the QCNPS Unit 1 2001 case.

Therefore use of a 0.5% bias is a reasonable approach to ensure conservatism for potential bias conditions in the future, based on past experience. Use of statistically based setpoint methodology implies that new data will be examined and added to the database. That examination should include the calculation of bias, variance, and changes in normality. Trends, adverse or favorable, need to be recognized and included in future analyses. Use of a 0.5% bias is reasonable given the existing data.

The revised analysis, accounting for the positive 0.5% bias, shows that the amount of main steam pressure/flow relieved through the valve network modeled for the Monte Carlo analysis exceeds the amount of main steam pressure/flow relieved when an upper tolerance of 1.5 percent is applied to all valves. Therefore, the assumed setpoint drift of 1.5% applied to all valves remains valid.

NRC Request 2

The Target Rock safety/relief valves are found to be susceptible to common cause vibration related wear that affects its setpoint. Please indicate how this finding affects the data distribution and the uncertainty treatment methodology. Please also provide an update of the

final design change including when it will be implemented and if their schedule will support implementation of the proposed overpressure analysis method.

Response

Evaluations have identified that vibration-related wear may cause drift in either the positive or negative direction, and that the Target Rock Safety/relief valves exhibited this condition in both pre-EPU and post-EPU conditions at DNPS and QCNPS. Therefore, the current test data reflects the impact of common cause vibration-related wear. In cases where there is a specific intent to include a tolerance deviation on one valve, the tolerance deviation can be used as an input in the Monte Carlo uncertainty treatment methodology. This approach was used in the Monte Carlo methodology to support a QCNPS operability evaluation that was performed assuming the Target Rock safety/relief valve upper tolerance was +7.0%. Therefore, the Monte Carlo methodology is capable of adequately accounting for the affects of common cause issues that affect the valve setpoint.

As a result of shaker table testing, modifications to improve the pressure adjusting spring straightness tolerance and to harden the bellows assembly cap with an electrolyzing coating were identified as solutions for minimizing significant wear. These modifications have been installed at DNPS and QCNPS Unit 1, and are scheduled for installation at QCNPS Unit 2 during a maintenance outage currently planned for May 2005. An analysis has been performed for QCNPS Unit 2 to support operation until the modifications are installed.

NRC Request 3

Given that some of the test data are reflective of pre-EPU operation, please provide assurance that a necessary penalty is being applied to the methodology to account for a possible post-EPU bias.

Response

With the EPU test data available, there is no evidence that EPU operation has a direct impact on the MSSV or S/RV set pressures during as-found testing. There is no analytical model indicating that such an impact is expected, and therefore, no model that would state either a magnitude or a direction of possible set pressure deviation. The number of sample points available is small, and is considered inadequate to establish any meaningful controls.

For the Target Rock safety/relief valve, the degradation originally attributed to EPU vibrations was found, via testing and other EGC data points, to be present prior to EPU with lesser vibration magnitudes. Again, there are a limited number of data points available post-EPU related to this valve.

Therefore, no basis for penalty exists from an analytical standpoint, and insufficient valve data exists to establish any statistical findings related to EPU. The Monte Carlo methodology is capable of accounting for the possibility of post-EPU effects by inclusion of additional data in the analysis.