Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

March 5, 1993

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Subject: LaSalle County Nuclear Power Station Units 1 and 2
Reply to Notice of Violations
Inspection Report Nos. 50-373/92023; 50-374/92023
NRC Docket Nos. 50-373 and 50-374

Reference: H.J. Miller letter to C. Reed dated December 16, 1992 transmitting NRC Inspection Report 50-373/92023; 50-374/92023

Enclosed is the Commonwealth Edison Company (CECo) response to the Notice of Violations (NOVs) which were transmitted with the reference inspection report.

The violations address the use of stall torque to determine operability of motor operated valves and the characterization of documents presented during the inspection.

If your staff has any questions or comments concerning this letter, please refer them to Sara Reece-Koenig, Compliance Engineer at (708) 663-7250.

Sincerely,

D.L. Farrar
Regulatory Services Manager

Attachment

cc: A.B. Davis, Regional Administrator - Region III
B. Stansky, Project Manager - NRR
D. Hills, Senior Resident Inspector

090008

SR/cah/ltr/1

JE01

Attachment A

RESPONSE TO NOTICE OF VIOLATION
NRC INSPECTION REPORT
50-373/92023; 50-374/92023

VIOLATION 1: (373/92023-01; 374/92023-01)

10 CFR 50, Appendix B, Criterion III requires, in part, that measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in 10 CFR 50.2, are correctly translated into specifications, drawings, procedures, and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in the design documents and that deviations from such standards are controlled.

Contrary to the above, as of November 20, 1992, an inappropriate equation (Limitorque's "stall torque" equation) was used to evaluate the design basis capability of safety-related MOVs. Appropriate technical justification for deviating from the vendor's recommendations was not presented.

This is a Severity Level IV Violation (Supplement I).

CECo's RESPONSE TO VIOLATION

Executive Summary

CECo agrees that the appropriate written documentation justifying CECo's application of the motor stall capability calculation was not readily available for review by the NRC inspectors present at the Lasalle MOV inspection. However, CECo was not using the Limitorque "stall torque" equation to define MOV design basis capability as stated in the violation. CECo's stall capability calculation is distinct from the Limitorque "stall torque" equation and is used for a different application. CECo's stall capability calculation is used in limited cases for establishing testing thrust windows and performing operability assessments on certain MOVs. The limited use of the stall capability calculation is appropriate for the circumstances for which it is applied at CECo. CECo's approach is consistent with the NRC operability guidance provided in GL 91-18.

The Limitorque "stall torque" equation referenced by the NRC in the inspection report is an equation used for calculating maximum output of a specified actuator in an overload analysis. All variables in this "stall torque" equation are set to maximize the thrust output of the actuator to evaluate the potential for MOV structural overload damage. This is distinct from the CECo stall capability calculation which assumes degraded voltage conditions and conservative stem friction factors. The ability of AC motors to generate greater than start torque

exists at the stall condition. CECo feels that it is appropriate to utilize this available "margin" to demonstrate valve operability. CECo's stall capability calculation is only applied in limited circumstances on a interim basis, taking into account all available MOV design margins. It is never used for permanent MOV design evaluation.

There is no "standard industry equation" for MOV sizing calculations, either for permanent design sizing or for determining operability. The MOV motor/gearing capacity equation is given in standard format in the Limitorque Selection Guides (Reference 1). However, the industry application of that motor/gearing equation for MOV sizing calculations is not consistent. It is CECo's understanding that some licensees are applying different values to the variables in the equation. This has been noted in previous NRC GL 89-10 inspection reports.

CECo's methodology for determining permanent MOV sizing is conservative. CECo's permanent sizing calculations incorporate conservative assumptions like locked rotor current (LRC) at design basis degraded voltage conditions, stem lubricant degradation, and inertial effects. Based on the conservative approach CECo utilizes for permanent MOV sizing, we believe that our use of motor stall torque to determine operability on certain valves is appropriate. In addition, CECo's GL 89-10 Program has taken an aggressive approach to addressing problem valves, including extensive MOV modification work at all six nuclear stations.

The remainder of this violation response contains a detailed technical justification of CECo's application of motor stall. In addition, it will be shown that the technical intent of the Limitorque Maintenance Updates, 89-1 and 92-1 (References 2 and 3), is incorporated in CECo's GL 89-10 Program.

Context of CECo's Use of Stall Capability Calculations

The calculation of stall torque capability by Commonwealth Edison is appropriate and justifiable, in the context in which it is used.

CECo has reviewed the methodology and variables presented in the Limitorque Selection Guides (Reference 1) and the Limitorque Maintenance Updates, 89-1 and 92-1, (References 2 and 3) and has concluded that our stall capability methodology is appropriate for assessing the capabilities of selected MOVs on an interim basis only. It is not appropriate for use as permanent design input. Specifically, the stall capability calculations are being used on certain MOVs to support testing and to establish interim torque switch settings until modifications to enhance margin can be completed or test data outside of our standard MOV calculational assumptions is reconciled.

Because the MOV torque switch setpoints within CECo's GL 89-10 program are established considering locked rotor current at degraded voltage conditions, degradation of stem lubrication, instrument tolerances, and inertia effects, the concerns documented in the referenced Limitorque Maintenance Updates with respect to MOV sizing are addressed.

Stall Torque Used on an Interim Basis Only

Stall capability calculations have been used only on a limited basis, in some cases to establish testing thrust windows. These testing thrust windows take into account degraded voltage, proper use of diagnostic test equipment, degraded stem to stem nut coefficients of friction, and inertia effects. The limited use of the stall capability calculation preserves the margin inherent in the consideration of these phenomena, thus permitting a deliberate and systematic approach to CECo's MOV Program. The established testing windows determined through the use of stall calculations preserves the overall margin for MOVs until such time as final MOV disposition is completed.

Necessary permanent MOV modifications are not precluded by CECo's motor stall capability application.

Testing Thrust Windows Were Set to Avoid Stall

In establishing the thrust windows for testing, the windows specified for MOVs are such that the valves will accomplish their design function without the motors reaching a stall condition. That is, the torque switches are set below the calculated stall capability, so that the motor will not reach a stall condition, even under the conditions of degraded voltage and/or degraded stem to stem nut coefficients of friction.

Limitorque Selection Guide and Maintenance Updates 89-1 and 92-1

The Limitorque Selection Guide, (Reference 1), SEL-3 page 4 of 4, provides a stall equation at 100% voltage to verify that the resultant MOV thrust does not exceed 2.5 times the actuator thrust rating. This calculation is part of a sizing procedure to assure inherent mechanical survivability in the event the control devices fail. EPRI Guide NP-6660-D, Reference 4, provides a more detailed but similar discussion of the use of the stall equation in sizing and/or evaluation of the actuator for stall conditions.

The intent of the Limitorque "stall torque" equation is to maximize the delivered thrust to the valve and actuator for mechanical overload analysis. For this specific

overload analysis, the variables of standard MOV sizing are maximized. For the overload analysis, the changes in the variables of the normal sizing equation are as follows:

- The *application factor*, which is typically set to 0.9 or less, is taken to be 1.0.
- The voltage supplied to the motor is assumed to be *full rated voltage*, instead of *degraded voltage*.
- The *start torque* of the motor is replaced by the *stall torque* (or 110% of the start torque if the stall torque is not available from generic motor curves).
- The *pullout efficiency* is replaced by the *stall efficiency*. Note that the pullout efficiency is related to motor speed of 0 rpm, (Reference 2, Section 6.1.2.2, page 6-4).
- The *stem factor* at a low assumed coefficient of friction is assumed.

Each of the above changes in the value of the variables in the sizing equation has the effect of increasing the final thrust output of the actuator, and thus is conservative for evaluating an overload condition.

The focus of Limitorque Maintenance Update 89-1 (Reference 2) was not stall calculations, but the use (or discontinued use) of limiter plates. Within the context of the discussion in 89-1 on limiter plate use and function, the potential misuse of stall calculations in determining the maximum output of the actuator and the maximum torque switch setting was included. The concern was specifically addressed to the possibility that even with diagnostic test equipment, field personnel could set the torque switch at a level corresponding to a higher torque output than the motor/gearing was capable of producing under degraded voltage and degraded stem/stem nut coefficient of friction conditions.

The concern with the use of stall calculations is that the motor would stall and the torque switch would never be activated. Under these conditions, the thermal overload would be required to protect the motor, or the motor insulation would fail. The motor would reach stall conditions upon valve seating following flow isolation. Note that the opening stroke at CECo nuclear stations is controlled by limit switches, with the torque switches being by-passed for pullout.

The specific recommendations made in the Limitorque Maintenance Update 89-1 are as follows:

Recommendations

1. Limitorque does not recommend removal of the torque switch limiter plate.

2. The maximum torque switch settings should be based on the criteria we've outlined including the maximum pullout torque capability of the actuator based on the minimum voltage.

3. Stall torque calculations should only be used for overload analysis.

4. Diagnostic thrust testing should not be used as justification for increasing the maximum torque switch setting.

5. Training should be provided for engineering and maintenance personnel concerning the torque switch limiter plates with particular emphasis on the reduced voltage affect on in-plant test data."

CECo has evaluated all the recommendations in Limitorque Maintenance Update 89-1 within the context of CECo's GL 89-10 program. In CECo's MOV Program, use of limiter plates is not mandatory, gear run efficiency is used for the closing stroke on AC powered MOVs, stall capability calculations have been performed only on a selective basis, and diagnostic test equipment which measures thrust is used for setting torque switches. Degraded voltage is considered and appropriate training of both maintenance and engineering personnel has been performed. In essence, the Limitorque 89-1 recommendations have all been addressed in CECo's GL 89-10 Program.

As stated in the executive summary, CECo's calculation of stall capability is distinct from the Limitorque "stall torque" calculation referred to in Recommendation #3 above. The technical acceptability of CECo's specific calculation of stall capability is contained further in this document.

Limitorque Maintenance Update 92-1 (Reference 3) elaborates on the discussion provided in Maintenance Update 89-1 regarding stall torque calculations. The discussion highlights three issues: 1) the application of degraded voltage, 2) an assumed coefficient of friction between the stem and stem nut for stall event assessments, and 3) the use of stall efficiencies.

The section on stall torque calculations is summarized as follows:

"In summary, Limitorque recommends that Stall torque calculations should only be used for overload analysis and not for determining maximum torque switch settings [see Maintenance Update 89-1].

"Also Engineering personnel should be aware that the Stall efficiencies in Limitorque SEL guides include inertial effects seen in a stall condition. Finally, in making stall calculations, assumptions about the motor terminal voltage and the stem nut coefficient of friction must be made."

In this case, Maintenance Update 92-1 addresses assessment for stall events, specifically for MOV overthrust evaluations. As stated previously, the stall capability calculations performed by CECo are for establishing testing thrust windows and performing operability assessments on certain valves, not for determining maximum allowable torque switch settings.

Therefore, while specific cautions are given in 92-1 against using the overthrust equation for establishing the maximum allowable torque switch settings, CECo is 1) not currently performing overthrust evaluations and 2) the stall capability calculations performed are primarily being used to establish testing thrust windows, which seek to preserve MOV design margin.

Technical Acceptability of Calculating the Stall Torque Capability

Calculation of stall capability is technically appropriate and justifiable, in the context in which it is performed at CECo. As stated previously, there is no standard industry equation for taking credit for motor stall. In the absence of such an equation, CECo has developed a reasonable approach and technical basis for its limited use.

The motor/gearing capacity is determined from the equation provided in the Limitorque Selection Guides (Reference 1):

$$\text{Total Thrust} = \frac{MT*OAR*EF*AF*DV}{FS}$$

where,

MT = Motor Torque, ft-lbs
OAR = Unit Ratio, dimensionless
EF = Unit Efficiency, dimensionless
AF = Application Factor, dimensionless
DV = Degraded Voltage Ratio, dimensionless
(Ratio of degraded to rated voltage, squared for AC, simple ratio for DC)
FS = Stem Factor, ft

As noted previously, motor torque, gear efficiency, terminal voltage, and application factor are maximized to perform an overload analysis, i.e. the Limitorque "stall torque" equation. In the case of the normal sizing analysis or CECo's stall capability analysis, the total thrust resulting from the motor/gearing is calculated using the same equation, only the values of the variables differ. The specific justification for the value of each factor in CECo's stall capability analysis is presented below.

Motor Stall Torque (MT)

In analyzing the stall capacity of an actuator, the motor start torque is replaced with the stall torque of the motor. The Limitorque Selection Guides in performing an overload analysis would use either the stall torque or 110% of the motor start torque.

Stall capability calculations performed for CECo utilize the stall torque of the motor when available from the generic motor curves. CECo believes that there is ample evidence that the motor capacity exceeds 110% of the motor start torque and that it is appropriate to use the stall torque developed by the motor in place of the motor start torque. The Limitorque Selection Guide SEL-3 (Reference 1, page 3 of 4), states:

"Limitorque motors will produce whatever torque is demanded <u>up to and including the locked rotor torque rating;</u>"

The generic motor curves themselves represent expected, though not guaranteed, motor performance. In Reference 2, it states,

"However, motor stall torque is better estimated by using the motor curves. If the correct motor curve can be identified, the speed vs. torque curve can provide a generic stall torque value for a specific design motor."

In separate EPRI documents, the stall capacity of the motors provided with Limitorque actuators are clearly described as exceeding 110% of motor start torque. From Reference 4, Section 3.4.1, Page 3-24:

"The rated starting torque of the motor is usually 65% to 90% of the motor stall torque."

From the section for DC motors, Section 3.4.3, Page 3-27:

"The rated starting torque (10 ft-lb) is 63% of the locked-rotor torque (16 ft-lb). This margin is larger than in an AC motor."

From Reference 5, Section 7, Page 7-15,

"Motor Stall Torque

These values normally exceed nominal motor ratings by as much as 40% for AC motors (120% for DC motors) at rated voltages."

CECo has also independently performed testing of DC motors and has found that the Peerless DC motors meet or exceed the stall torque values documented on the

Limitorque generic motor curves. The testing has also dem[illegible] voltage ratio relationship for degraded voltage is valid at volta[illegible] 10% of the motor's rated voltage, (Reference 6).

In summary, it is CECo's position that the stall torque of the mo[illegible] as documented in the generic motor curves may be used within a stall capability calculation.

In addition, please note that this is consistent with the assumption of using locked rotor current to determine the voltage drop from the motor control center to the motor terminals.

Application Factor (AF)

The application factor is described in Reference 2 (Section 6.1.2.2, Page 6-4) as accounting for:

"losses in efficiency not otherwise included in the calculation."

The application factor is purely a term used to provide design margin for effects or phenomena not explicitly defined.

It is CECo's position that in using stall capacity calculations for interim testing and operability assessments, this additional design margin need not be provided, i.e., the application factor is to provide margin for permanent sizing purposes.

Degraded Voltage (DV)

The degraded voltage term in CECo's stall capability calculations is used in the same way as CECo's normal sizing calculations. The motor terminal voltage is conservatively calculated at locked rotor conditions. The ratio of the motor terminal voltage to rated voltage at degraded voltage conditions is squared for AC motors and is used as a simple ratio for DC motors. However, this is distinct from the Limitorque "stall torque" equation which uses rated voltage, i.e., the ratio of voltages is 1.0.

Overall Gear Ratio and Efficiencies (OAR & EF)

The gear ratios are physical constants related to the actual physical dimensions of the gears. There are no adjustments taken for the gear ratios.

The efficiencies used in CECo's stall capability calculations are based on the specific gear set, the motor rpm, and the actuator model. CECo test data has

shown that the motor attains full motor speed before the gears are engaged in pullout. This phenomenon is physically attributed to a relaxation of the gears after the closing stroke, whereupon a gear backlash occurs in pullout. In addition, the motor and gearing are not loaded until the stem is placed in tension from its compressed state. Furthermore, in the case of gate valves, loading does not occur until the hammer blow feature on gate valves has impacted and engaged the drive sleeve and the T-head clearance between the stem and the disc is taken-up.
In the closing stroke, the motor speed is maintained even when considering stall capacity calculations, because the torque switches are set below the calculated motor stall condition, i.e., the MOV is set up to complete its design function (flow isolation) before the torque switch would trip. The stall capacity calculation simply verifies that sufficient margin is available to trip the torque switch under conditions of degraded voltage and stem lubricant degradation.

The use of the stall efficiencies in place of the pullout and run efficiencies, by definition, take credit for the inertia effects expected in opening and closing strokes. It is CECo's position, that in closing and opening, sufficient speed has developed in the motor/gearing assemble such that inertia effects are present.

Stem Factor

The stem factor is directly related to the coefficient of friction between the stem and stem nut. Specific analytical equations are available for calculating the stem factor for given coefficients of friction for a given stem thread.

CECo's GL 89-10 program allows for lubrication degradation of the stem coefficient of friction when evaluating MOV performance. The assumptions for stem factors are the same for the stall application as used during CECo's normal sizing calculations.

Conclusions

CECo is not using the Limitorque "stall torque" equation to define design basis capability as stated in the inspection report. CECo's stall capability approach is distinct from the Limitorque "stall torque" equation and is justified for the limited application for which it is used at CECo, i.e., for establishing MOV testing thrust windows or for limited cases to determine interim operability until modifications are installed and/or test data outside of CECo's standard calculational assumptions is reconciled. CECo believes that sufficient technical information exists that demonstrate that AC motors produce greater than start torque at the stall condition. CECo feels that is appropriate to utilize this available "margin" to demonstrate MOV operability. This approach is consistent with the operability guidance provided by the NRC in GL 91-18.

References

1. Selection Procedures for Nuclear Actuators, Limitorque Corporation, June 6, 1979.

2. Limitorque Maintenance Update 89-1, Limitorque Corporation.

3. Limitorque Maintenance Update 92-1, Limitorque Corporation.

4. EPRI Report NP-6660-D, Research Project 2814-6, "Application Guide for Motor-Operated Valves in Nuclear Power Plants," March 1990.

5. EPRI Report, "Technical Repair Guidelines for the Limitorque Model SMB-000 Valve Actuator."

6. GDS Associations Calculation MSC-GN-001, "Study for Degraded Voltage Impact on DC Motor Starting Capability," Rev. 1, August 13, 1992.

Attachment B

RESPONSE TO NOTICE OF VIOLATION
NRC INSPECTION REPORT
50-373/92023; 50-374/92023

VIOLATION 2: (373/92023-02; 374/92023-02)

10 CFR 50.9 requires, in part, that information provided to the Commission by a licensee shall be complete and accurate in all material aspects.

Contrary to the above, the licensee provided incomplete and inaccurate information to the Commission during a meeting on November 18, 1992, by presenting a copy of a telephone conversation record dated February 6, 1991, between Bechtel and the vendor (Limitorque). The record was represented by the licensee as Limitorque's position and as justification for the licensee's use of the stall torque equation. This information was incomplete and inaccurate in that the licensee has prior knowledge that use of the stall torque equation for the purpose intended by the licensee was not Limitorque's position. In addition, the record directly conflicted with information previously issued by Limitorque and discussed with CECo technical representative.

This is a Severity Level IV violation (Supplement I).

CECo's RESPONSE TO VIOLATION

CECo's Understanding of the NRC's Description of the 11/18/92 Meeting:

CECo's understanding of the NRC's description of the 11/18/92 meeting is that CECo personnel presented to the NRC a 2/6/91 telecon record between Bechtel and Limitorque that represented Limitorque's position, as well as justification for the licensee's use of the stall torque equation. In addition, the NRC stated that CECo personnel had prior knowledge that use of the stall torque equation for the purpose intended by the licensee was not Limitorque's position because the 2/6/91 telecon directly conflicted with documented guidance issued by Limitorque in Maintenance updates 89-1 and 92-1. In addition, the NRC determined that Limitorque had advised licensee technical representatives that it should not use the "stall torque" equation for determining operability and that the Limitorque sales representative that signed the 2/6/91 telecon record was not authorized to sign technical concurrence documents.

CECo's Understanding of the 50.9 Violation

Based on conversations between CECo and the NRC after the inspection, CECo further understands that the 50.9 violation was issued because of inaccurate information documented in the Bechtel telecon record with Limitorque. This violation was issued based on a verbal discussion between the NRC inspectors and Limitorque. A written confirmation of this telephone conference was not provided to the NRC by Limitorque. However, based on the verbal information, CECo was cited for providing inaccurate information.

CECo's Response

Based on the CECo personnel's recollection of the 11/18/92 meeting with the NRC, CECo's understanding of the event is as follows:

Specifically, CECo did not represent the 2/6/91 telecon record as Limitorque's corporate position on the use of motor stall in MOV sizing calculations. CECo personnel discussed the conflicting Limitorque documentation on the use of the stall torque equation on several occasions with the NRC before and during the inspection. The telecon record was presented to the NRC at the 11/18/92 meeting as one piece of CECo's technical justification for the stall capability application. CECo personnel advised the NRC that CECo's use of the stall capability calculation was distinct from the Limitorque equation and was limited in scope and duration. The NRC was also told that CECo's specific application of the stall capability calculation was appropriate. CECo's justification for the use of motor stall is discussed in detail in CECo's response to Violation 1 (Attachment A).

CECo's personnel involved in the Lasalle MOV inspection understood that the NRC Inspectors were concerned with the fact that there appeared to be no formal documentation supporting the licensee's use of the stall capability calculations, even on an interim basis. CECo agrees that appropriate written documentation justifying CECo's application of motor stall was not readily available for review by the NRC inspectors. Because of the NRC's concerns, the 2/6/91 telecon record was presented to the Inspectors as one piece of contemporaneous documentation justifying CECo's initial bases for the use of the motor stall capability calculations. It was not presented as Limitorque's current or prior corporate position on the issue.

Prior to the issuance of the citation, in early December, the six licensee personnel present at the meeting individually wrote down their recollection of what happened at the meeting. After the citation was issued, the six CECo personnel completed a questionnaire concerning the facts alleged in the inspection report. No CECo individual present at the meeting recalls the facts as described in the violation. CECo knew the Limitorque employee who signed the 2/6/91 telecon record as an

applications engineer with a technical background associated with MOVs, not as a sales representative as characterized in the inspection report. CECo had dealt with this Limitorque employee previously on other technical issues and, thus, did not challenge the authenticity of his concurrence with our technical position. The cover letter that accompanied the fax transmittal of the 2/6/91 telecon record from the Limitorque representative to Bechtel makes reference to another engineer at Limitorque in the Nuclear Support Group. This led to CECo's perception that the content of the 2/6/91 telecon record was given some level of technical review at Limitorque.

Conclusion

In summary, CECo did not represent the 2/6/91 telecon record as Limitorque's corporate position on the use of motor stall in MOV sizing calculations. CECo disagrees with the apparent violation of 10 CFR 50.9 as stated in the inspection report. CECo requests that the NRC reconsider the issuance of the violation.