U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-266/88018(DRS); 50-301/88016(DRS)

Docket Nos. 50-266; 50-301 Licenses No. DPR-24; DPR-27

Licensee: Wisconsin Electric Power Company
231 West Michigan
Milwaukee, WI 53202

Facility Name: Point Beach Nuclear Plant, Units 1 and 2

Inspection At: Point Beach Site, Two Creeks, Wisconsin

Inspection Conducted: August 15-19, 1988

Inspectors: for M. P. Huber — 9/8/88 Date

for J. F. Smith — 9/8/88 Date

Approved By: D. H. Danielson, Chief
Materials and Processes Section — 9/8/88 Date

Inspection Summary

Inspection on August 15-19, 1988 (Reports No. 50-266/88018(DRS); 50-301/88016(DRS))
Areas Inspected: Special unannounced safety inspection of the licensee's activities with respect to NRC Bulletin No. 85-03 and Supplement 1, both titled "Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings." (25573)
Results: Of the areas inspected, no violations or deviations were identified.

- Training had been provided to maintenance personnel with regard to electrical and mechanical refurbishment of Limitorque operators.
- Detailed maintenance procedures concerning the refurbishment/repair of Limitorque operators were available to ensure that all switches were properly set and maintained.
- The licensee invented and developed diagnostic equipment to verify operability of the valves.

DETAILS

1. Persons Contacted

Wisconsin Electric Power Company (WEPCo)

*J. J. Zach, Plant Manager
*J. E. Knorr, Regulatory Engineer
*T. R. Branum, Electrical Engineer, Maintenance
F. A. Flentje, Administration Specialist
J. Roberts, Nuclear Engineer, Maintenance

Resident USNRC Personnel

*R. Hague, SRI
R. J. Leemon, RI

*Denotes those who attended exit meeting held on August 19, 1988.

2. Licensee Action on IE Bulletin

(Open) TI 2515/73 and IE Bulletin 85-03 (266/85003-BB; 301/85003-BB): Motor-Operated Valve (MOV) Common Mode Failure During Plant Transients Due to Improper Switch Settings

a. Limitorque-Operated, Rising Stem, Gate and Globe Valve Switch Setting Evaluation

IE Bulletin 85-03 concerns the proper setting of switches controlling the operation of motor-operated valves. Action Item b of the bulletin requires that correct switch settings be established; Item c requires differential pressure testing preferably, or other justification to demonstrate operability with the settings from Item b.

Because of prevalent industry practice, most valves covered by the bulletin are Limitorque-operated, rising stem, gate or globe valves, as was the case at Point Beach.

Below is a list of the switches involved and concerns for their proper setting, typical setting approaches that have been taken in the industry, and either the resolution adopted at the Point Beach plant or an identification of the need for additional information or other action. The switches discussed are named:

- Thermal overload relay
- Torque switch
  - Open torque switch
  - Close torque switch

- Geared limit switch
  Open limit
  Open indication
  Open torque switch bypass

  Close limit
  Close indication
  Close torque switch bypass

(1) Discussion: Thermal overloads are sometimes used to protect motor winding insulation from breakdown. Devices used appear to uniformly consist of heaters at the motor control center which trip a heat sensitive relay, the contacts of which either interrupt current to the contractor closure coil (which stops the motor) or initiate an overload alarm, or both. Where thermal overload relays stop operator motor rotation on tripping, the heaters must either be sized to prevent inadvertently stopping the motor or bypassed when motor operation is important to safety, and they should be sized to protect the motor windings from thermal damage.

Designs that are being used at this time to eliminate the threat of inadvertent motor trips include: (1) removing the heaters or relay contacts from use; (2) using the relay contacts for alarm only; (3) bypassing the relay contacts during all operating modes except when a valve is being exercised for testing; (4) bypassing the relay contacts only during the presence of an automatic safety actuation signal; and (5) oversizing the thermal overloads. Problems noted with the above designs (with respect to preventing inadvertent trip) include inadequate surveillance of the bypass function (Nos. 3 and 4), failure to protect the remote manual operation function (No. 4), error in determining proper heater size and failure to install the heater specified (Nos. 4 and 5), and failure to consider actual running loads which often exceed rated values during valve closure at high system pressures (Nos. 4 and 5) or when valve packing is too tight. No problems have been noted with Designs 1 and 2.

With respect to protecting the motor windings from thermal damage, the remote location of the thermal overload relay (at the motor control center) prevents it from sensing actual winding temperature. Also, the motor has a long thermal decay time in comparison to the relay. These two factors prevent thermal overload protection of the windings during valve setup and testing when frequent stroking at unknown motor current levels can result in exceeding the motor duty cycle. One solution to this problem is to be knowledgeable of valve running currents and stroke times, and to limit the frequency of valve stroke cycles accordingly. Another solution is to determine the actual temperature of the motor and to limit operation when temperature approaches a predetermined level.

Site Specifics: Thermal overloads are a permanent feature at Point Beach, stopping valve motion on relay trip. No bypass features are used. The sizes of the licensee's thermal overload devices are empirically selected. The licensee evaluated the recommendations of Limitorque and concluded that they were conservative with respect to protecting the motor, but were too low to prevent premature tripping of the operator under extreme conditions. Empirically derived sizes are normally several heater sizes over those recommended by Limitorque.

The control of motor temperature during testing is not a problem. Instead of depending on the thermal overload devices to protect the motors from overheating, Point Beach relies on an electrician stationed at the motor to monitor motor temperature by placing his hand on the motor frame. No testing is done without the maintenance electrician. Although this may appear to be a simplistic approach to a complex problem, an objective analysis discloses it to be highly effective in preventing overheating of the reactor. The motor frame will be too hot to touch for some finite period before the internal temperature is high enough to destroy the insulation. When the motor becomes too hot to touch, testing is discontinued until the motor cools down. Testing and valve diagnostics represent the times when motor-operated valves are most likely to be overheated because of repeated cycling. Point Beach, by manually monitoring motor temperature, materially reduced the likelihood of overheating MOV's at these times.

(2) Open Torque Switch

Discussion: This switch is normally used as a mecnanical fuse to limit the mechanical thrust applied to a valve or operator when stroking the valve in the open direction. It generally provides no normal control function and is a backup for some other failure that may cause its need.

This switch is usually bypassed during the initial valve unseating, which is the most challenging portion of the op stroke. Failure to set it (or its bypass) properly can cause valve failures.

If the switch is used, it must be set properly to enable the valve operator to apply adequate thrust on the valve stem to operate the valve against the limiting differential pressure (DP).

A process pump can be used to test the valves against DP to determine the torque switch setting adequacy. Diagnostic testing can determine the valve thrust available for a given torque switch setting without DP, however, it is necessary to show the adequacy of the calculated requirement against which it is compared.

Site Specifics: The open torque switch at Point Beach is wired into the circuit for valves, but is bypassed for no less than 15% of valve stroke beginning at valve unseating (this could not be verified for all valves and is discussed in Paragraph 2.a.6). This setting accounts for the unseating of the valve and highest demand portion with respect to thrust requirements, and is sufficient to prevent the torque switch from actuating.

Following the bypassed portion of the stroke, the torque switch is part of the circuit. The open torque switch settings for the valves were established using the recommended settings provided by Limitorque. Differential pressure (DP) testing was performed on all valves to verify the adequacy of the torque switch settings.

Since the issuance of the bulletin, the licensee also developed their own diagnostic equipment to evaluate and measure packing load, thrust at torque switch trip, over thrust, and open torque switch bypass timing.

In addition to the DP testing conducted on all of the valves, a sample of valves were tested using the licensee's diagnostic equipment to verify operability of the valves.

This is a conservative approach and provides a high confidence that the valves will open. This is an acceptable configuration.

(3) Close Torque Switch

Discussion: The close torque switch is normally used to stop motor rotation on the completion of valve travel in the close direction. The limiting requirement for closure is at the end of travel when the thrust requirements are highest. The thrust at torque switch trip should equal the most limiting closure thrust requirement including the thrust needed to overcome the DP across the valve.

Differential pressure testing, using system process pumps with appropriate data gathering and diagnostic evaluation, is a positive means of assuring the adequacy of the close torque switch setting. Other approaches based on similarity and analysis may also be acceptable with sufficient basis.

Site Specifics The bulletin valves at Point Beach close with the close torque switch limiting torque for essentially the entire valve stroke. Close torque switch settings were provided to Point Beach by the valve vendors and Limitorque calculation techniques were used. Again, for a sample of the valves, the licensee used their diagnostic equipment to set the close torque switch to ensure adequate margin existed for

the required closure thrust. For all valves, the licensee used DP testing to ensure the adequacy of the close torque switch settings.

No problems were noted with this approach.

(4) Open Limit Switch

Discussion: This switch provides the control function of determining the upper limit of valve stem travel in the open direction and stops motor rotation by opening the circuit to the associated motor contactor coil. The setting of this switch must assure an adequate valve stroke but, normally, must prevent backseating. Deliberate backseating using the power of the motor-operated, or motor inertia, can and has caused valve stem shearing, stem thread twisting, and valve bonnet metal working until stem scoring and packing blowout occur. Hence, it is important to set the open limit switch away from the backseat and with enough margin to allow for motor contactor dropout time and inertia.

Site Specifics: The valves at Point Beach "open on limit" with the use of the open limit switch stopping the motor before the valve backseats.

During review of the licensee's program, the NRC inspectors determined that verification of the correct setting of the open limit switch was not completed by the licensee for those valves that were not tested using diagnostic equipment. Discussions with the licensee supported the NRC inspectors conclusions. However, there was no concern for operability because all these valves were DP tested. The licensee informed the NRC inspectors that all open limit switches will be verified by December 31, 1988. Verification of the correct open limit switch settings for those valves not previously tested using diagnostic equipment is considered an Open Item (50-266/88018-01(DRS)); (50-301/88016-01(DRS)).

(5) Open Indication

Discussion: Open indication is usually identified by the presence of a red light that goes out only when the valve is fully closed. Often the same rotor is used for the open torque switch bypass, and the setting of the point where the rotor turns has conflicting requirements for the two functions.

In setting for ideal position indication, there is not adequate bypass of the torque switch to assure valve operability; conversely, changes to satisfy the bypass requirements have resulted in false valve position indication.

Site Specifics: Point Beach uses both the open indication and open torque switch bypass, which are derived from the same rotor. This results in the concern for setting the open torque switch bypass correctly, but to allow for correct valve position indication and interlock settings.

For the open indication setting, the NRC inspectors reviewed the valve electrical wiring, and switch setting logic diagrams to determine the possible problems resulting from the conflicting requirements. The NRC inspectors determined that all valves have a motor contactor seal-in feature that allows the valve to cycle completely upon control switch actuation. In addition, operators at Point Beach have been trained on the function of MOV's and this configuration.

The licensee is reviewing the possibility of modifying the actuator to replace the two rotor limit switches with four rotor limit switches. This would eliminate the conflicting requirements for the same switch by allowing them to be set using separate rotors.

(6) Open Torque Switch Bypass

Discussion: When an open torque switch is used, the bypass switch is required to bypass it during the initial portion of the open stroke so that the torque switch will not prematurely stop valve travel due to the high torque conditions required for initial valve movement. There is no clear answer on where to set the bypass; but, if the valve disk (not the stem) has moved between 10% and 20% of its total travel distance away from the seat when the bypass opens, this has been accepted as adequate.

Site Specifics: The valves at Point Beach have the torque switch bypass set to prevent the actuation of the open torque switch in the initial high demand at valve unseating. All valves set with the diagnostic equipment have been verified to have the open torque switch bypass set at 15% of valve stroke. The remaining valves have been verified as adequate using the DP testing.

In cases where the open torque switch bypass setting conflicted with any interlocks, the interlocks took precedence and the opening thrust was verified to be great enough to overcome the initial high demand portion of the valve stroke.

(7) Close Limit

Discussion: The close limit switch is not often used on rising stem valves. When it is, it is usually related to a special application and takes the place of the close torque switch by opening the motor circuit at the end of valve closure. It may be used with or without a close torque switch in series.

Site Specifics None of the bulletin valves at Point Beach are wired to "close on limit." The circuit is opened for the valves, stopping the motor, in all cases by actuation of the close torque switch.

(8) Close Indication

Discussion: Close indication is usually identified by the presence of a light that goes out only when the valve is fully open. This function is usually derived off the same rotor as the open limit switch, and while concern exists for the setting of the open limit, no problem has been identified with the corresponding closed indication light switch.

Site Specifics: There was no concern for this switch setting based on a review of valve schematic diagrams and discussions with the licensee. Point Beach has set the switch based on the open limit switch requirements.

(9) Close Torque Switch Bypass

Discussion: The close torque switch bypass acts in the same manner as the open torque switch bypass; however, contrary to its counterpart function, it normally bypasses the torque switch during the lightest duty portion of the stroke. If utilized, it should be set to operate during the initial part of the stroke.

Site Specifics: The close torque switch bypass is on the same rotor as the open limit which opened early in travel. The licensee used the close torque switch bypass, and since the valves were properly guarded against backseating, there was no concern identified with respect to this switch setting.

(10) Undervoltage Considerations

The NRC inspectors reviewed the valve torque switch settings to determine to what extent the licensee took into account the possibility that Motor Control Center bus voltage degradation would affect the valve operability.

The licensee calculated the maximum thrusts that would be available to the valves if undervoltage did in fact exist.

For AC valves motors the bus voltage could degrade, as allowed by Technical Specifications, to 77.4% of nominal, reducing the available motor output torque by 43% for 460 V valves and 37.3% for 440 V valves.

For DC valve motors, the minimum allowable battery voltage of 105 volts leads to a voltage drop of 15 volts.

The NRC inspectors performed sample calculations to determine if the valves at reduced voltages could deliver the needed thrusts to operate at design basis conditions. Calculated thrusts corresponded to the maximum thrusts allowable for the valves. That is, operator output was limited by the licensee to the maximum thrusts available at degraded voltage conditions.

During diagnostic testing of the valves, the licensee gathered data on the valves and after compiling the data, determined that the Limitorque recommended settings may not be as conservative as expected. The licensee has determined from the data that newer more conservative thrust data is appropriate for valves. When diagnostic testing was performed, the licensee calculated valves were set to maximum thrust values.

All valves were verified by the NRC inspectors to have their maximum torque switch settings at or below the point where the operator would be capable of delivering the desired thrusts.

b. Valve Testing Program

In response to the bulletin, the licensee developed new procedures and revised existing procedures to reflect the switch setting philosophies. Once procedures were incorporated, a program of testing, maintenance, resetting of any switches was conducted.

During the course of the inspection, the NRC inspectors reviewed the licensee's program and test records to ensure all testing was performed for all valves identified in accordance with the licensee's approved program.

(1) MOV Maintenance and Test Procedures

During the course of the inspection the NRC inspectors reviewed the procedures listed below:

- MI 5.1.1, Revision 7, "Limitorque MOV Torque and Limit Switch Adjustment for Gate and Globe Valves."
- MI 5.1.4, Revision 2, "Limitorque Model SMB-000 Disassembly, Inspection, Repair and Reassembly."
- MI 5.1.5, Revision 3, "Limitorque Motor Operated Valves Models SMB-0 Through SMB-00 Disassembly, Inspection, Repair and Reassembly."

Procedures were detailed and provided instruction for maintenance to be performed to maintain switch settings and test MOV when required as a part of corrective and preventive maintenance.

MI 5.1.1 defined the methodologies for switch settings of the geared limit switches and specified the calculated thrusts, both maximum and minimum, for the bulletin valves.

(2) Personnel Performance

During the course of the inspection, the NRC inspectors observed the performance of work by maintenance personnel on a valve.

Work was being performed on the valve to correct a packing leak. In response to the maintenance work request the licensee performed diagnostic testing on the valve to ensure that once the packing was tightened, adequate margin for operability would still exist.

The personnel performed the work in a proficient manner, and were very knowledgeable. The interface between the cognizant system engineer and the maintenance personnel was good. This was due to the fact that engineering personnel were also present to perform the diagnostic portion of the valve work and therefore always present to assist in maintaining a good valve condition and quality of work.

The NRC inspectors also inspected the physical condition of the valve. Limit switch contacts were in good condition. The torque switch operated freely and no degradation was noted. The overall physical condition of the valve was good, both internally and externally.

(3) Review of Completed Packages

The NRC inspectors reviewed selected completed work packages for testing and setting switches on motor operated valves. The operations were identified in sufficient detail to assure proper comprehension and performance by qualified personnel. Completion of operations was properly documented. Operation of the Point Beach diagnostic equipment was performed by maintenance engineering personnel. Primary documentation was provided by hard copies of the data generated by the diagnostic equipment. The NRC inspectors detected no deficiencies in the documents.

c. Maintenance of Valve Operability

Action Item d of the bulletin requires plant procedures that will assure the maintenance of correct switch settings throughout plant life. To some extent, this involves all programmatic activities that assure long term valve operability because wear and degradation of either the valve or operator affect the adequacy of the switch settings.

Some factors in assuring adequate switch settings are valve and valve operator mechanical conditions. Gate valve seat friction factors appear to be anywhere from half to twice that assumed in the past using previously accepted formulas; field measurements of stem thrust show that valve stem thread lubrication may impact thrust values by a factor of two; stem packing tightening has been shown to be a significant factor, actually causing motor burnout in more severe cases of overtightening. These concerns have to be addressed by maintenance, surveillance, and post maintenance test programs to assure that operability factors are maintained.

Since the bulletin was issued, the licensee has developed a diagnostic testing system to measure the stem thrust and corresponding torque switch setting for the desired conditions. The geared limit switch settings can also be set and verified as desired by use of the diagnostic system.

(1) Preventive Maintenance

Valve condition is maintained by implementation of a callup program. The callup program is a program which defines the schedule and type of maintenance to be performed on MOV's.

Based on licensee experience, a Limitorque operator did not require a full rebuild, consisting of new grease, gaskets and seals every five years. From this conclusion and other data, the MOV callup program established five, ten, and 15 year scheduled rotation for valve operators that fell into certain categories. Every five years however, a "checkout" is to be performed on all safety-related MOV's, which includes all bulletin valves. The "checkout" includes: Stem thrust setting, stem lubrication, and checking spring pack for grease to name a few.

No problems were noted with this maintenance schedule, coupled with the use of the diagnostic equipment.

d. Training and MOV Maintenance Personnel

The need for training of personnel to perform maintenance on motor-operated valves at Point Beach was somewhat less critical than it would be for most other facilities because the actual testing and valve diagnostics are always performed by the cognizant engineers. These engineers are intimately familiar with the testing equipment and process because they invented and developed it and are now in the process of patenting it. There are no plans for ever transferring the testing and diagnostic functions to shop personnel. Training of shop personnel is administered by a separate training department. Training courses reviewed by the NRC inspectors were found to be adequate. Records of training and capabilities of individuals were complete and extensive. These records are computerized and readily available to anyone requiring this information. Personnel have been trained so extensively that to save time, a short, unofficial list

can be generated to identify courses or activities in which an individual has NOT been trained. This information is used for rapid reference only, and is confirmed on the official records before being used to assign any work or training. Training for MOV maintenance covers all phases of the work, including installation and adjustment of the load cells for diagnostic work and interface with the control room for valve operation during testing.

The computer which stores training information also provides training programs for new personnel and can be programmed to identify personnel who require additional training when new technologies develop and prior training becomes obsolete. The training program appears to be capable of providing competent support personnel for the MOV maintenance program.

3. Open Items

Open items are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which require some action on the part of the NRC or licensee or both. An open item disclosed during the inspection is discussed in Paragraph 2.a.(4).

4. Exit Interview

The NRC inspectors met with licensee representatives (denoted in Paragraph 1) on August 19, 1988, to discuss the scope and findings of the inspection. The licensee acknowledged the statements made by the inspectors with respect to items discussed in the report. The inspectors discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection and the licensee did not identify any such documents or processes as proprietary.