New Hampshire
Yankee

Ted C. Feigenbaum
President and
Chief Executive Officer

NYN- 92058

April 30, 1992

United States Nuclear Regulatory Commission
Washington, DC 20555

Attention: Document Control Desk

References: a) Facility Operating License NFP-86, Docket No. 50-443

b) USNRC Generic Letter No. 89-10, dated June 28, 1989, "Safety-Related Motor-operated Valve Testing and Surveillance"

c) USNRC letter dated February 2, 1992, "Motor-Operated Valve Inspection at Seabrook Station Inspection Report 50-443/91-81," M. W. Hodges to T. C. Feigenbaum

Subject: Response to a Request for Additional Information

Gentlemen:

Inspection Report 50-443/91-81 [Reference (c)] requested additional information regarding New Hampshire Yankee's (NHY) motor operated valve program controls related to switch setpoint error analysis and stem friction coefficients. The requested information is provided in the Enclosures.

Should you have any questions regarding this matter, please contact Mr. James M. Peschel, Regulatory Compliance Manager, at (603) 474-9521, extension 3772.

Very truly yours,

Ted C. Feigenbaum

TCF:TGP/act

Enclosure

IE01
1/1

Add:		Ltr	Encl
	AEOD/DSP/TPAB	1	1
	Boer, B RES	1	1
	DRR Cody, A. Jr.	1	1
	NRR/DET/EMEB	1	1
	NRR/LPEB/BC	1	1
	RES/DSIR/EIB	1	1

080013

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New Hampshire Yankee
April 30, 1992

ENCLOSURE 1 TO NYN-92058

SWITCH SETPOINT ERROR ANALYSIS

NRC Request

Motor Operated Valve Testing - New Hampshire Yankee (NHY) needs to:

"Establish design control measures for error analysis by April 30, 1992 and describe the method for determining the overall accuracy of the control switch setpoints."

NHY Response

Technical Support Group calculation 92-CALC-0003 addresses the measurement accuracy of the various diagnostic techniques used by NHY. This calculation has been independently reviewed and approved and is available for review at the station.

The NHY MOV diagnostic testing program includes two major valve groupings, rising stem MOVs and butterfly MOVs. The diagnostic test method differs for these two groups as the former involves a valve stem thrust measurement whereas the second involves a valve stem torque measurement.

There are four distinct techniques each with a separate accuracy capability. These techniques are:

- Strain Gauge Method (Tensile) - Rising Stem Valves
- Load Cell Method - Rising Stem Valves
- Load Cell Comparison Method - Rising Stem Valves
- Strain Gauge Method (Torsion) - Butterfly Valves

The accuracy for each case is determined by the Square-Root Sum-of-Squares Method in accordance with ANSI/ISA S67.04 - 1988. Attachment 1 provides additional information on the methods used to determine the overall accuracy of the control switch setpoints.

ATTACHMENT 1 TO ENCLOSURE 1

NHY Method for Determining the Overall Accuracy of Control Switch Setpoints

Described in the NHY NRC Generic Letter 89-10 Program, an ongoing design basis review ...g performed for Seabrook Station safety related MOV's. The design basis review for ...ch MOV includes a calculation that determines the minimum and maximum thrust or torque value for that valve. The thrust/torque values represent the design range and are documented in a controlled NHY design document, 1-NHY-250000.

...ign range does not take into account torque switch repeatability and diagnostic test ...ccuracy. These factors vary with the test method and are considered on a valve ...is by NHY Technical Support Group engineers when an MOV enters into the ...ic Letter 89-10 test program.

...Support Group Calculation, 92-CALC-0003, was developed to determine the ... accuracy associated with torque switch repeatability, data acquisition, and data ...accuracies. The combined accuracy value is then used to reduce the design range ...in 1-NHY-250000 to a more restrictive set of values called the "target range." In this way, if the target range is maintained for a given measurement, the design range will not be exceeded.

The accuracy factor for the MOV actuator's torque switch repeatability is based on actuator vendor recommendations. The data acquisition and data processing accuracies take into account the accuracies associated with:

- measuring and test equipment, (M&TE),
- physical constants for conversion of strain measurements to thrust or torque, and
- comparison techniques that associate load cell measurements on the valve open stroke to spring pack displacement on the valve's closing stroke.

NHY employs four general techniques to test MOVs depending on the valve's configuration and physical arrangement in the plant as follows:

- Strain Gauge Method (Tensile) - Rising Stem Valves
- Load Cell Method - Rising Stem Valves
- Load Cell Comparison Method - Rising Stem Valves
- Strain Gauge Method (Torsion) - Butterfly Valves

Calculation 92-CALC-0003 determines accuracy factors for the various data acquisition/data processing configurations used in these techniques for each individual valve.

92-CALC-0003 combines the torque switch repeatability factor with the data acquisition/data processing accuracy factors using the "square-root sum-of-the-squares" method described in ANSI/ISA S67.04 - 1988.

As mentioned above, the resulting combined accuracy is then applied to the design thrust or torque range to provide the target range values. The target range values are tabulated in approved station procedure, ES1850.003. Diagnostic testing is performed to confirm that MOV control switch setpoints result in control switch actuation within the specified target range for thrust/torque. As the design basis review verification is completed, this process will be carried out and continued for each MOV included in the NHY NRC Generic Letter 89-10 Program.

In December 1990, the NHY MOV diagnostic system was tested at the Idaho National Engineering Laboratory, (INEL). This testing confirmed the accuracies expected for the NHY diagnostic system. NHY and INEL presently have an on-going program to standardize the diagnostic test system accuracy results to the MOV Users Group TEMV format.

ENCLOSURE 2 TO NYN-92058

STEM FRICTION COEFFICIENTS

NRC REQUEST

New Hampshire Yankee (NHY) needs to:

> "Validate the assumed valve factors or friction coefficients using the design basis test results and justify the use of 0.15 as a stem friction coefficient."

NHY RESPONSE

The New Hampshire Yankee response to the first part of the NRC request to "validate the assumed valve factors or friction coefficients using the design basis test results" is provided as follows:

> The NHY NRC Generic Letter 89-10 program is being revised to include a methodology which will use the MOV diagnostic field test results to confirm the design basis calculations. This methodology will feed back actual test measurements to recalculate valve factors/friction coefficients and will verify that the values assumed in the design calculations are conservative. This methodology will be implemented by December 31, 1992.

The New Hampshire Yankee response to the second part of the NRC request concerning the use of a 0.15 stem to stem nut coefficient of friction for selected valves, is provided as follow:

> Discussion
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> The required torque output of a valve operator is calculated by multiplyirg the required thrust for valve operation by the stem factor. The stem factor is based on the physical parameters of the stem (stem diameter, pitch, lead) and the assumed coefficient of friction between the stem and stem nut. Valve manufacturers have provided the recommended stem/stem nut coefficient of friction to be used for determining the thrust output for valve actuators. The valve manufacturers usually provide a coefficient of friction of either 0.15 or 0.20. A 0.20 coefficient of friction is generally used to take into account the possibility of poor maintenance on the stem threads. In Inspection Report 91-81 the NRC has requested New Hampshire Yankee to justify the use of a 0.15 coefficient of friction.
>
> Presently motor-operated valves at Seabrook supplied by Westinghouse and Velan and valves having Rotork actuators use a coefficient of friction less than 0.20. A basis for the use of the lower friction factors is described below.
>
> Westinghouse Valves
>
> Westinghouse recommends a 0.15 coefficient of friction. Following the EPRI Marshall Electric Motor-Operated Valve (PORV Block Valve) Testing, in which the Westinghouse valves experienced higher than expected stem thrusts, Westinghouse initiated a valve testing program to determine the causes of the higher than expected stem thrusts. The Westinghouse testing consisted of three subprograms: 1) water flow

testing, 2) valve internal friction testing and 3) valve seat friction factor testing. Following these tests separate effects testing was performed on the motor operators and on the valve design. During thrust/torque testing the coefficient of friction was verified less than the 0.15 design value of coefficient of friction.

Reference Westinghouse proprietary test report WEMD 5672 "Motor operated Gate Valve Closure Problem Flow Testing Program" dated September 23, 1982. This report has a typical graph of the friction coefficient which shows a friction coefficient less than 0.12 for multiple tests (60) under flow and differential pressure conditions.

Velan

Velan recommends a 0.15 coefficient of friction for their valves. Velan recommendation is based on testing performed at Velan, their experience and other sources (Rotork coefficient of friction testing). Velan Test Report No. RD-406 analyzed Velan proprietary test report to determine the coefficient of friction between the stem and the stem nut. The proprietary testing had been performed by Velan to qualify gear actuators. Stem torque and thrust readings were obtained from stem mounted strain gages at 0, 500, 1000, 2000 and 2500 stem open/close cycles. Stem diameters of 1-5/8", 1-7/8", 2-1/8" and 2-1/2" were tested. The stems were lubricated prior to testing. Velan Report RD-406 concluded that the coefficient of friction experienced during testing was less than 0.13.

Valves with Rotork Motor-Operators

Rotork provided a Stem Factor Test Summary of Rotork Technical Reports TR-219 and TR-209. The objective of these Technical Reports was to determine actual stem factors of two typical threaded stems with appropriately tapped aluminum bronze stem nuts. Torque and thrust were simultaneously measured under varying conditions of lubrication. Rotork concluded that the Rotork published stem factors (based on a coefficient of friction of 0.14) are conservative for lubricated stems. Rotork found that lack of lubrication had a much greater effect on stem factor than load did on thread efficiency. Rotork performed an additional stem factor test (reference Rotork Technical Report TR-3027 which concluded that the Rotork assumed coefficient of friction of 0.14 is conservative. These test results and field experience have shown that there is margin between the recommended theoretical coefficient of friction and the actual coefficient of friction.

Rotork stated that during the recently completed thrust uprate for the Rotork actuators the observed coefficient of friction was 0.12 - 0.13.

Limitorque

Limitorque Corporation's sizing procedures include tables of stem factors for two coefficients of friction, 0.15 and 0.20 in SEL-10. The Limitorque gate and globe valve selection procedure (SEL-1) states " Conservatively, 0.20 is generally used to take into account the possibility of poor maintenance on the stem threads The actuator

manufacturer has no control of the coefficient of friction. Lower coefficient of friction may be used if the stem and stem nut material as well as the surface finish and lubrication warrant, however, the valve manufacturer shall make this judgement."

EPRI MOV Application Guide

The EPRI Application Guide states " A thread friction coefficient of 0.15 is suggested as a nominal value for in-service applications in the absence of specific test data for a particular application."

Industry Testing

During the recently completed Thrust Rating Increase Testing of Limitorque SMB-000, SMB-00, SMB-0 and SMB-1 performed by Kalsi Engineering, coefficient of friction was found in the range of 0.08 and 0.14 with typical values equal to 0.12. Proper lubrication was maintained during the testing of four different sizes of actuator stem/stem nut combinations tested to 4,000 cycles each.

Seabrook Testing

In general, the measured thrust output during valve diagnostic testing was greater than the calculated thrust output based on the torque switch setting curves. New Hampshire Yankee practices a formal stem maintenance and stem lubrication program in accordance with Station Procedures. NHY plans to measure thrust and torque during future diagnostic testing where practical to facilitate calculating as tested stem factors. Additionally, NHY performs as found testing, where practical, which provides information on the adequacy of the lubrication program.

Conclusion

The use of higher coefficient of friction to attempt to bound all eventualities such as stem damage, unlubricated stems etc could result in valve or actuator damage due to thrusts much higher than calculated being produced. New Hampshire Yankee follows good valve stem maintenance and valve stem lubrication practices in accordance with Station Procedures. NHY is testing motor operated valves to verify that the required thrust output is achieved. Future testing will include torque and thrust measurements where practical to verify that appropriate stem factors are being used. For the reasons stated above, NHY will continue to use coefficient of friction values recommended by valve manufacturers unless these friction factors are proven unacceptable by valve testing or industry experience proves that a 0.15 coefficient of friction is unacceptable.

REFERENCES

1) EPRI Report NP-6660-D: "Application Guide for Motor-Operated Valves in Nuclear Power Plants

2) EPRI Topical Report TR-100449: "EPRI MOV Performance Prediction Program Motor-Operated Valve Margin Improvement Guide"

3) Westinghouse proprietary test report WEMD 5672 "Motor-Operated Gate Valve Closure Problem Flow Testing Program" dated September 23, 1982.

4) Velan Test Report No. RD-406: "Analysis of Stem/Nut Coefficient of Friction"

5) Rotork "Stem Factor Test Summary" from Rotork Technical Reports TR-219 and TR-209 of April 1975

6) Rotork Technical Report TR-3027: "Stem Factor Investigation"

7) Limitorque Corporation "Gate and Globe Valve Selection Procedures"