LIBERTY TECHNOLOGY CENTER, INC.

Lee Park 1100 E. Hector Street Conshohocken, PA 19428 (215) 834-0330 FAX: (215) 834-0346

June 7, 1989

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
Nuclear Regulatory Commission
Washington, D.C. 20555

Dr. Murley:

The enclosed Customer Service Bulletin/VOTES® Technical Advisory has been issued to comply with the requirements set forth in the Code of Federal Regulations, Title 10 (CFR-10) and has been sent to all users of the Valve Operation Test & Evaluation System (VOTES®) manufactured by Liberty Technology Center, Inc.

Liberty, founded in 1984, provides engineered products, services and turnkey systems, focused on innovative measurement technology and diagnostic signal processing. Liberty has designed and developed specialized data acquisition, control, and monitoring systems for use in industrial, electric utility, transportation, and government applications. VOTES® is one such system.

VOTES® is a diagnostic tool primarily serving the nuclear utility industry for valve testing and incipient failure detection of valves and valve operators through trending analysis. With the VOTES® system, valve stem forces are measured by means of a strain sensor (VOTES® Force Sensor) permanently bonded to the yoke. The VOTES® Force Sensor is calibrated against stem force by seating the valve while a traceable calibration device (C-clamp or U-clamp) is temporarily affixed to the stem. The C-clamp or U-clamp measures the diametral expansion of the stem as it pushes the disc into the seat. The system software takes into account the stem geometry beneath the calibrator and the material properties of the stem to convert the stem expansion to actual force. Calibration is accomplished by combining this force trace with the simultaneous trace from the VOTES® Force Sensor.

Liberty has concluded that an incorrect calibration can result when a C-clamp or U-clamp calibrator is placed on the unthreaded portion of a valve stem, hereafter referred to as the "transition region", within 1-1/2 stem diameters of the threaded portion. This will result in a higher-than-actual force being indicated by the installed VOTES® Force Sensor calibrated in this manner.

Where the effective diameter of the valve stem suddenly increases (for example going from the threaded portion to the unthreaded portion of the stem) the uniformly distributed force within the threaded portion of the stem will spread out until it is once again uniformly distributed throughout the larger unthreaded portion of the stem. If the traceable calibration device is placed on the stem within the transition region, the VOTES® system will calculate a higher-than-actual force value for the measured diametral expansion. This will yield a lower-than-actual VOTES® Force Sensor sensitivity value resulting in a higher-than-actual force value in subsequent data.

In conjunction with Babcock & Wilcox Nuclear Power Division, Liberty's exclusive VOTES® field service partner responsible for training, Liberty will include warnings in its VOTES® technical manual and VOTES® system software while B&W will modify their training course and training manual to indicate the avoidance of placing the C-clamp or U-clamp on the unthreaded portion of the stem within 1-1/2 diameters of the thread transition point.

The scope of this potential calibration error extends only to those utilities using VOTES® and even then only to those MOV's where the C-clamp or U-clamp was placed on the unthreaded portion of the stem within 1-1/2 diameters of the thread transition. The following utilities, either owning or having used VOTES®, have been officially notified by the enclosed bulletin:

Philadelphia Electric Company
Commonwealth Edison
Northeast Utilities
Duke Power Company
Iowa Electric Power & Light

Any questions or comments regarding the technical advisory may be directed to:

Robert Leon - Chief Technical Officer, (215) 834-0330
Keith Trainor - Manager of Engineering, (215) 834-0330
Randy VanLear - B&W, (804) 385-2789

Yours truly,

Joseph Stephan

Joseph Stephan
Manager, Customer Service

LIBERTY TECHNOLOGY CENTER, INC.

Lee Park 1100 E. Hector Street Conshohocken, PA 19428 (215) 834-0330 FAX: (215) 834-0346

May 19, 1989

Dear VOTES® User:

The enclosed Customer Service Bulletin/VOTES® Technical Advisory is being issued to comply with the requirements set forth in the Code of Federal Regulations, Title 10 (CFR-10) and is being sent to all users of the Valve Operation Test & Evaluation System (VOTES®) manufactured by Liberty Technology Center, Inc. To further comply with CFR-10, a copy of the enclosed technical advisory will be forwarded to the Office of Nuclear Reactor Regulation at the Nuclear Regulatory Commission in Washington, D.C. in approximately two (2) weeks.

Any questions or comments regarding the technical advisory may be directed to:

Robert Leon - Chief Technical Officer, (215) 834-0330
Keith Trainor - Manager of Engineering, (215) 834-0330
Randy VanLear - B&W, (804) 385-2789

Yours truly,

Joseph Stephan

Joseph Stephan
Manager, Customer Service

LIBERTY TECHNOLOGY CENTER, INC.

Lee Park 1100 E. Hector Street Conshohocken, PA 19428 (215) 834-0330 FAX: (215) 834-0346

No: CSB-005
Date: May 19, 1989

CUSTOMER SERVICE BULLETIN

SUBJECT: VOTES TECHNICAL ADVISORY - "EFFECT OF PLACING C-CLAMP OR U-CLAMP IN STEM TRANSITION REGION."

Gentlemen:

Be advised that Liberty Technology Center has concluded that an incorrect calibration can result when a C-clamp or U-clamp calibrator is placed on the unthreaded portion of a valve stem within 1-1/2 stem diameters of the threaded portion. This will result in a higher-than-actual force being indicated by the installed VOTES® Force Sensor calibrated in this manner.

Background

With the VOTES® system, valve stem forces are measured by means of a strain sensor (VOTES® Force Sensor) permanently bonded to the yoke. The VOTES® Force Sensor is calibrated against stem force by seating the valve while a traceable calibration device (C-clamp or U-clamp) is temporarily affixed to the stem. The C-clamp or U-clamp measures the diametral expansion of the stem as it pushes the disc into the seat. The system software takes into account the stem geometry beneath the calibrator and the material properties of the stem to convert the stem expansion to actual force. Calibration is accomplished by combining this force trace with the simultaneous trace from the VOTES® Force Sensor.

Discussion of the Problem

Where the effective diameter of the valve stem suddenly increases (for example going from the threaded portion to the unthreaded portion of the stem) the uniformly distributed force within the threaded portion of the stem will spread out until it is once again uniformly distributed throughout the larger unthreaded

portion of the stem (See Figure 1). This spreading out of force occurs within approximately 1-1/2 stem diameters of the unthreaded portion of the stem, hereafter referred to as the "transition region." If the traceable calibration device is placed on the stem within the transition region, the VOTES® system will calculate a higher-than-actual force value for the measured diametral expansion. This will yield a lower-than-actual VOTES® Force Sensor sensitivity value resulting in a higher-than-actual force value in subsequent data.

Testing was conducted to define the length of the transition region and quantify the error resulting from locating a calibrator within this region. The test consisted of an MOV - with a permanently mounted VOTES® Force Sensor - being calibrated six (6) separate times with a C-clamp calibrator. The calibrator was moved to a different, predetermined location on both sides of the threaded to unthreaded transition point for each calibration run. The stem used was a 1-3/8 inch diameter stem having four (4) threads per inch. The test results are as follows:

- Indicated VOTES® Force Sensor sensitivities match within 1% with the C-clamp placed both on the threaded side of the stem - at the transition - and two (2) inches above the transition - on the threads.

- Indicated VOTES® Force Sensor sensitivities are about 6% low for the two cases where the C-clamp was placed on the unthreaded side, one (1) inch below the transition point.

- The indicated VOTES® Force Sensor sensitivity is about 16% low with the C-clamp being placed on the unthreaded side of the stem at the transition point.

From this we can draw the following conclusions:

- No effective error results when the calibration device is placed on the threaded side of the transition.

- When placing the calibration device within the transition region, lower-than-actual VOTES® Force Sensor sensitivities can result. This will yield correspondingly higher-than-actual force indications in subsequent data.

- The largest error is with the calibrator on the unthreaded side at the transition. The resulting approximate percentage error can be computed from the formula:

$$E = \frac{100}{[1.333 \times d_o \times TPI - 1]}$$

where: E = Calibration Error
d_o = Outside Diameter
TPI = Threads Per Inch

For example:

With an outside diameter equal to 2-1/2 inches and with 4 threads per inch, the indicated error using the above formula is 8.1%.

- Locating the calibrator more than 1-1/2 stem diameters away from the transition point of the stem significantly reduces the error to less than one-tenth the value calculated from the above formula.

Affected Equipment

Only those MOV's where the C-clamp or U-clamp was placed on the unthreaded portion of the stem **within** 1-1/2 diameters of the thread transition.

Suggested Corrective Action

Review the past data to determine whether the concern about U-clamp and C-clamp location applies to any existing data. If so, apply the indicated formula as the "worst case condition" to determine whether the thrust at the control switch trip point falls outside the target range. In assessing the need for corrective action, it would be appropriate to determine whether the original calculated minimum thrust values contained a safety margin. Including a safety margin would have allowed for inaccuracies in switch repeatability, measurement equipment errors, and probably other undefined inaccuracies. In view of the possibility of additional measurement errors due to the U-clamp or C-clamp location, it is suggested that the minimum potential thrust

value be recalculated to assure valve operability. Following that reassessment, it may be necessary to reset the torque switch and retest the valve.

For MOV's yet to be tested, avoid placing the C-clamp or U-clamp on the unthreaded portion of the stem within 1 1/2 diameters of the thread transition. Avoid the large diameter side of any other effective diameter transitions as well. Modify in-plant procedures accordingly.

Liberty's Corrective Action

Liberty will include warnings in its VOTES® technical manual and VOTES® system software while B&W will modify their training course to indicate the avoidance of placing the C-clamp or U-clamp on the unthreaded portion of the stem within 1-1/2 diameters of the thread transition point.

Any questions or clarification issues regarding the above notification may be directed to:

Robert Leon - Chief Technical Officer, (215) 834-0330
Keith Trainor - Manager of Engineering, (215) 834-0330
Randy VanLear - B&W, (804) 385-2789

Yours truly,

Joseph Stephan

Joseph Stephan
Customer Service Manager

VOT:CFR-Not

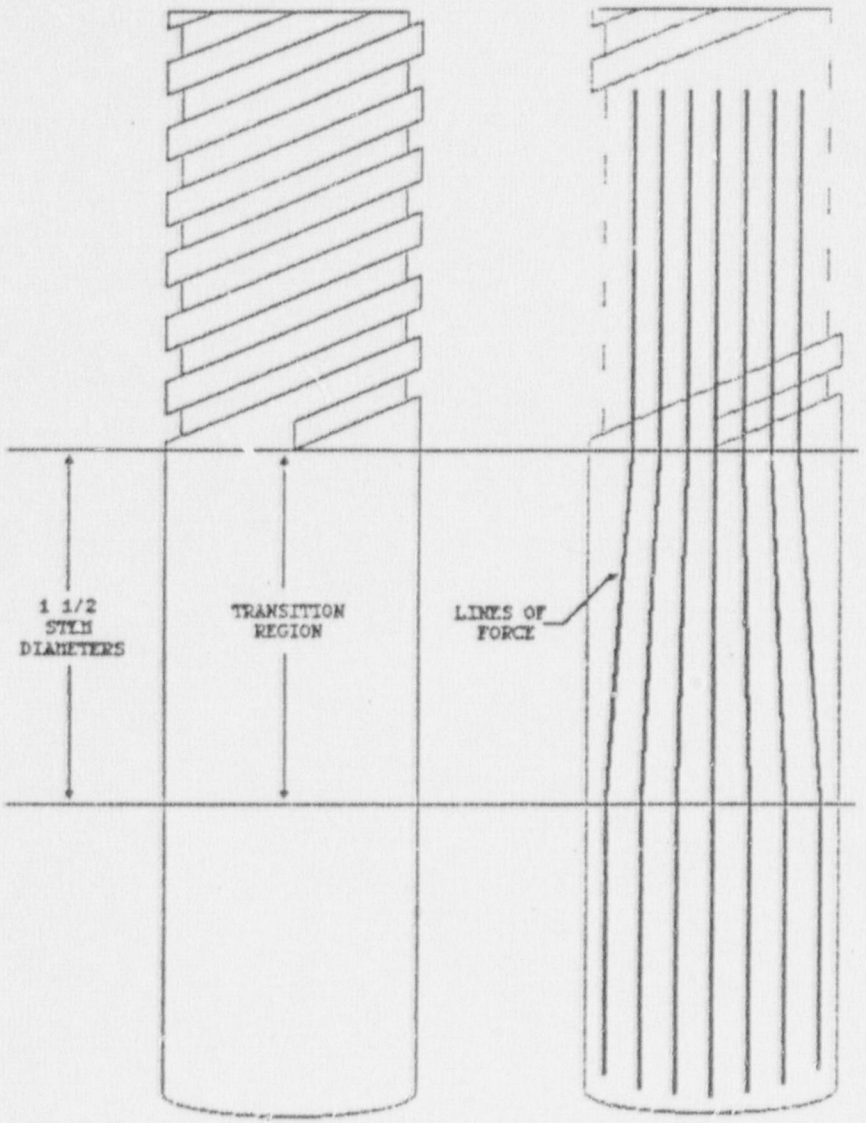

Figure 1