6.3 Generic Letter 95-07

August 17, 1995

To: All Holders of Operating Licenses (Except Those Licenses that have been Amended to Possession-Only Status) or Construction Permits for Nuclear Power Reactors

Subject: NRC GENERIC LETTER 95-07: PRESSURE LOCKING AND THERMAL BINDING OF SAFETY-RELATED POWER-OPERATED GATE VALVES

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this generic letter to request that addressees perform, or confirm that they previously performed, (1) evaluations of operational configurations of safety-related, power-operated (including motor-, air-, and hydraulically operated) gate valves for susceptibility to pressure locking and thermal binding and (2) further analyses, and any needed corrective actions, to ensure that safety-related power-operated gate valves that are susceptible to pressure locking or thermal binding are capable of performing the safety functions within the current licensing bases of the facility.

NRC previously provided guidance on an acceptable approach for addressing pressure locking and thermal binding of motor-operated valves (MOVs) in Supplement 6 to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," but did not request specific actions by licensees to address these problems at that time. This letter confirms (as was indicated earlier in Supplement 6) that licensees are expected, under existing regulations, to take actions as necessary to ensure that safety-related power-operated gate valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions. The guidance in Attachment 1 to this letter is derived directly from (and is intended to be the same as) the guidance in Enclosure 1 to GL 89-10, Supplement 6, except in this generic letter (1) the guidance is being issued as an approved generic NRC staff position for implementation by licensees who have not already satisfactorily addressed pressure locking and thermal binding of MOVs by implementing the guidance in Supplement 6 (or equivalent industry methods); and (2) the guidance also includes pressure locking and thermal binding phenomena in other types of power-operated (i.e., air- and hydraulically operated) gate valves, as well as MOVs. Additional information provided in Attachment 1 does not alter the basic approach to addressing pressure locking and thermal binding given in Supplement 6 to GL 89-10. Finally, for MOVs and other power-operated valves, this letter requires that licensees submit for staff review summary information regarding any actions taken to ensure that valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions, including (1) actions taken by licensees on their own volition to implement the guidance provided in Supplement 6 (or equivalent industry methods), as well as (2) actions taken in response to this letter. (In Supplement 6 to GL 89-10, the staff did not require any licensee response regarding pressure locking and thermal binding.)

In this generic letter, the NRC staff is requesting a preliminary evaluation of pressure locking and thermal binding of safety-related power-operated gate valves and, subsequently, a more detailed evaluation and resolution of the issue.

Background

The NRC staff and the nuclear industry have been aware of disk binding problems of gate valves for many years. The industry has issued several event reports describing failure of safety-related gate valves to operate due to pressure locking or thermal binding of the valve disks. Several of the industry's generic communications have given guidance for identifying susceptible valves and for performing appropriate preventive and corrective measures. Despite industry awareness of the problem, pressure-locking and thermal-binding events continue to occur. In addition to events at U.S. nuclear power plants, French experience with pressure-locking events was recently documented in NUREG/CP-0137 (July 1994), "Proceedings of the Third NRC/ASME Symposium on Valve and Pump Testing."

In GL 89-10 (June 28, 1989), the staff asked holders of operating licenses and construction permits to provide additional assurance of the capability of safety-related MOVs and certain other MOVs in safety-related systems to perform their safety-related functions. In GL 89-10 licensees were asked to review MOV design bases, verify MOV switch settings both initially and periodically, test MOVs under design-basis conditions where practicable, improve evaluations of MOV failures and necessary corrective action, and trend MOV problems. In Enclosure 1 to Supplement 6 to GL 89-10 (March 8, 1994), the NRC staff described one acceptable approach for licensees to address pressure locking and thermal binding of motor-operated gate valves.

In March 1993, the NRC issued NUREG-1275, Volume 9, "Pressure Locking and Thermal Binding of Gate Valves." This NUREG gives the history of pressure-locking and thermal-binding events, describes the phenomena, discusses the consequences of locking or binding on valve functionality, summarizes preventive measures, and assesses the safety significance of the phenomena. Pressure locking or thermal binding can cause a power-operated valve to fail to open, resulting in an inability of the associated safety train or system to perform its safety function. Pressure locking and thermal binding represent potential common-cause failure modes that can render redundant trains of certain safety-related systems or multiple safety systems incapable of performing their safety functions. Existing surveillance tests or normal operating cycles might not reveal such failures.

Description of Circumstances

After issuing Volume 9 of NUREG-1275, the NRC staff performed a number of site visits to discuss pressure locking and thermal binding with licensees (1) to gather information on the technical issues related to generic and plant-specific valve and system characteristics and (2) to determine the implementation status of previous industry guidance for identification of susceptible valves and application of preventive and corrective measures. NRC surveys indicated that in response to the number of generic industry communications on the subject, some licensees have performed multiple reviews of pressure locking and thermal binding. However, the staff found only limited instances of valves being modified to alleviate the effects of pressure locking and thermal binding.

In Enclosure 1 to Supplement 6 of GL 89-10, the NRC staff reminded licensees that they are expected under existing regulations to take actions to ensure that safety-related motor-operated gate valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions, and described an acceptable approach for licensees and permit holders to address pressure locking and thermal binding of motor-operated gate valves as part of their GL 89-10 programs. The information on pressure locking and thermal binding of motor-operated gate valves provided in Enclosure 1 to Supplement 6 of GL 89-10 was intended as timely notification of operating experience feedback. During inspections of GL 89-10 programs, the staff found the actions taken by licensees to address pressure locking and thermal binding of motor-operated gate valves to be varied. Although many licensees had conducted some level of review of the potential for pressure locking and thermal binding of their motor-operated gate valves, few licensees had either (1) thoroughly evaluated the capability of the motor actuators to overcome the phenomena in light of recent information regarding MOV and system performance, or (2) taken corrective action to prevent the phenomena as discussed in Supplement 6. In view of these inspection results, the NRC staff has determined that issuing this generic letter is now warranted to ensure that safety-related power-operated gate valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions.

Most licensees are nearing completion of their GL 89-10 programs. In meetings with industry representatives and licensees, the staff stated that, during its GL 89-10 closure review, it will assess the progress being made by licensees in addressing pressure locking and thermal binding of motor-operated gate valves. The staff also stated that licensees need not complete their response to the pressure-locking and thermal-binding issue at the time that the verification of the design-basis capability of MOVs within the scope of GL 89-10 is completed because the staff would evaluate the acceptability of addressee resolution to pressure locking and thermal binding of all safety-related power-operated gate valves, including MOVs, in a consolidated effort (through evaluation of actions taken in response to this generic letter). Finally, the staff stated that this generic letter would address the schedule for completing the licensees' response to the pressure locking and thermal binding issue.

The NRC staff held a public workshop on February 4, 1994, to discuss pressure locking and thermal binding of gate valves, including prioritization of susceptible valves for corrective action. A summary of the

public workshop is available in the NRC Public Document Room (Accession Number 9403020090) and contains information on evaluation of pressure locking and thermal binding, and actions taken in response to the identification of susceptible valves.

On February 28, 1995, NRC issued Information Notice (IN) 95-14, "Susceptibility of Containment Sump Recirculation Gate Valves to Pressure Locking." This information notice alerted licensees to a report by Northeast Nuclear Energy Company, the licensee for Millstone Nuclear Power Station, Unit 2, that both containment sump recirculation motor-operated gate valves might experience pressure locking during a design-basis loss-of-coolant accident and fail in the closed position. On March 15, 1995, NRC issued IN 95-18, "Potential Pressure-Locking of Safety-Related Power-Operated Gate Valves," alerting licensees to a report by Connecticut Yankee Atomic Power Company, the licensee for Haddam Neck Nuclear Power Plant, that seven motor-operated gate valves in the safety injection systems were susceptible to pressure locking to the extent that the operability of the valves may have been jeopardized.

On June 13, 1995, the Millstone Unit 2 licensee performed an evaluation which determined that the power-operated relief valve (PORV) block valves were potentially susceptible to thermal binding. Specifically, it was found that, if the PORV block valves were closed and a subsequent plant cooldown was performed, the block valves could experience thermal binding. In GL 90-06, "Resolution of Generic Issue 70, 'Power-Operated Relief Valve and Block Valve Reliability,' and Generic Issue 94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,' Pursuant to 10 CFR 50.54(f)," the staff asked licensees to include PORV block valves in their GL 89-10 program. Therefore, although PORV block valves may not be classified as safety related at particular plants, licensees will be expected to have evaluated these valves for potential pressure locking or thermal binding. Similarly, licensees may need to evaluate for potential pressure locking or thermal binding other valves outside the scope of this generic letter based on previous licensing commitments.

Discussion

The pressure-locking and thermal-binding phenomena are based on well-known concepts. The identification of susceptible valves and the determination of when the phenomena might occur require a thorough knowledge of components, systems, and plant operations. Pressure locking occurs in flexible-wedge and double-disk gate valves when fluid becomes pressurized within the valve bonnet and the actuator is not capable of overcoming the additional thrust requirements resulting from the differential pressure created across both valve disks by the pressurized fluid in the valve bonnet. For example, the fluid may enter the valve bonnet (1) during normal open and close valve cycling, (2) when a fluid differential pressure across a disk causes the disk to move slightly away from the seat, creating a path to either increase the fluid pressure or fill the bonnet with fluid, or (3) for a steamline valve, when differential pressure exists across the disk and the valve orientation permits condensate to collect and enter the bonnet. Surveillance testing can cause a valve to experience pressure locking or thermal binding. For example, an inboard isolation MOV in the reactor core isolation cooling (RCIC) system steamline at a boiling-water reactor (BWR) plant failed in the closed position following routine surveillance testing. Pressure locking and thermal binding can occur to varying degrees, but does not necessarily render a valve incapable of operating, although valve damage may occur.

Various plant operating conditions can introduce pressure locking. Pressure in the valve bonnet might be higher than anticipated, causing pressure locking under certain conditions. For example, when (1) the gate valve is in a line connected to a high-pressure system and isolated only by check valves (which may transmit pressure even when passing leak-tightness criteria) and (2) bonnet volume temperature increases, pressurization results from thermal expansion of the confined fluid. Temperature in the valve bonnet might increase in response to heatup during plant operation, ambient air temperature rise due to leaking components or pipe breaks, or thermal conduction or convection through connected piping. Over time, bonnet pressure could decrease by leakage past the seating surfaces or stem packing. However, the depressurization time may be longer than the system response time to initiate valve actuation to perform its safety function. Also, valve actuator operation at locked rotor conditions for a few seconds could degrade the motor torque capability of a motor-operated gate valve.

Thermal binding is generally associated with a wedge gate valve that is closed while the system is hot and then is allowed to cool before attempting to open the valve. Mechanical interference occurs because of different expansion and contraction characteristics of the valve body and disk materials. Thus, reopening the valve might be prevented until the valve and disk are reheated. Solid-wedge gate valves are most susceptible to thermal binding. However, flexible-wedge gate valves experiencing significant temperature changes or operating with significant upstream and downstream temperature differences may thermally bind.

Pressure locking or thermal binding occurs as a result of the valve design characteristics (wedge and valve body configuration, flexibility, and material thermal coefficients) when the valve is subjected to specific pressures and temperatures during various modes of plant operation. Operating experience indicates these situations were not always considered as part of the design basis for valves in many plants.

Requested Actions

Within 90 days of the date of this generic letter, each addressee of this generic letter is requested to perform and complete the following actions:

- Perform a screening evaluation of the operational configurations of all safety-related power-operated (i.e., motor-operated, air-operated, and hydraulically operated) gate valves to identify those valves that are potentially susceptible to pressure locking or thermal binding; and

- Document a basis for the operability of the potentially susceptible valves or, where operability cannot be supported, take action in accordance with individual plant Technical Specifications.

Within 180 days of the date of this generic letter, each addressee of this generic letter is requested to implement and complete the guidance provided in Attachment 1 to perform the following actions:

- Evaluate the operational configurations of safety-related power-operated (i.e., motor-operated, air-operated, and hydraulically operated) gate valves in its plant to identify valves that are susceptible to pressure locking or thermal binding;

Perform further analyses as appropriate, and take needed corrective actions (or justify longer schedules), to ensure that the susceptible valves identified in 1 are capable of performing their intended safety function(s) under all modes of plant operation, including test configuration.

Attachment 2 discusses potential resolution options for gate valves found susceptible to pressure locking or thermal binding.

[Note: If a licensee has previously performed an evaluation of operational configurations to identify motor-operated gate valves susceptible to pressure locking or thermal binding, and has performed additional analyses and taken needed corrective actions for identified valves, in a manner that satisfactorily implements the guidance in Supplement 6 to GL 89-10 (or equivalent industry methods) so that the identified valves are capable of performing their required safety functions, the licensee need not perform any additional action under paragraphs 1 and 2 above for MOVs.]

Requested Information

All addressees, including those who have already satisfactorily addressed pressure locking and thermal binding for MOVs by implementing the guidance in Supplement 6 to GL 89-10 (or equivalent industry methods), are requested to provide a summary description of the following:

- The susceptibility evaluation of operational configurations performed in response to (or consistent with) 180-day Requested Action 1, and the further analyses performed in response to (or consistent with) 180-day Requested Action 2, including the bases or criteria for determining that valves are or are not susceptible to pressure locking or thermal binding;

- The results of the susceptibility evaluation and the further analyses referred to in 1 above, including a listing of the susceptible valves identified;

- The corrective actions, or other dispositioning, for the valves identified as susceptible to pressure locking or thermal binding, including: (a) equipment or procedural modifications completed and planned (including the completion schedule for such actions); and (b) justification for any determination that particular safety-related power-operated gate valves susceptible to pressure locking or thermal binding are acceptable as is.

- The staff believes that a corrective action schedule (if corrective actions are needed) may be based on risk significance, including consideration of common cause failure of multiple valves. Plant operation and outage schedules may also be considered in developing corrective action schedules. However, the time schedules for completing corrective action in response to pressure locking or thermal binding concerns do not supersede the requirements of the NRC regulations and individual plant Technical Specifications in the event that a safety-related valve is determined to be incapable of performing its safety function. In GL 91-18 (November 7, 1991), "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability," the staff provides guidance on the review of operability determinations and resolution of degraded and nonconforming conditions by licensees. An addressee's schedule for completing corrective action in response to this generic letter will be considered independent from GL 89-10.

Required Response

All addressees are required to submit the following written response to this generic letter:

- Within 60 days from the date of this generic letter, a written response indicating whether or not the addressee will implement the action(s) requested above. If the addressee intends to implement the requested action(s), provide a schedule for completing implementation. If an addressee chooses not to take the requested action(s), provide a description of any proposed alternative course of action, the schedule for completing the alternative course of action (if

applicable), and the safety basis for determining the acceptability of the planned alternative course of action;

- Within 180 days from the date of this generic letter, a written response to the information request specified above.

- All addressees shall submit the required written reports to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, under oath or affirmation under the provisions of Section 182a, Atomic Energy Act of 1954, as amended, and 10 CFR 50.54(f). In addition, a copy shall be submitted to the appropriate regional administrator.

Backfit Discussion

10 CFR Part 50 (Appendix A, Criteria 1 and 4) and plant licensing safety analyses require and/or commit that the addressees design and test safety-related components and systems to provide adequate assurance that those systems can perform their safety functions. Other individual criteria in Appendix A to 10 CFR Part 50 apply to specific systems. In accordance with those regulations and licensing commitments, and under the additional provisions of 10 CFR Part 50 (Appendix B, Criterion XVI), licensees are expected to take actions to ensure that safety-related power-operated gate valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions. Supplement 6 to GL 89-10 alerted licensees to the problems with pressure locking and thermal binding in MOVs, and described an acceptable approach for addressing these phenomena for MOVs, but did not request any specific actions or response from licensees.

The actions requested in this generic letter are considered compliance backfits, under the provisions of 10 CFR 50.109 and existing NRC procedures, to ensure that safety-related, power-operated gate valves that are susceptible to pressure locking or thermal binding are capable of performing their intended safety functions. In accordance with the provisions of 10 CFR 50.109 regarding compliance backfits, a full backfit analysis was not performed for this proposed action; but the staff performed a documented evaluation which stated the objectives of and reasons for the requested actions and the basis for invoking the compliance exception. A copy of this evaluation will be made available in the NRC Public Document Room.

Federal Register Notification

A notice of opportunity for public comment was published in the Federal Register (60 FR 15799) on March 27, 1995. Comments were received from 14 licensees, 1 industry organization, and 1 private company. Copies of the staff evaluation of these comments will be made available in the NRC Public Document Room.

Paperwork Reduction Act Statement

The information collections contained in this request are covered by the Office of Management and Budget clearance number 3150-0011, which expires July 31, 1997. The public reporting burden for this collection of information is estimated to average 75 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Information and Records Management Branch (T-6F33), U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0011), Office of Management and Budget, Washington, D.C. 20503.

Licensee response to the following request for information is purely voluntary. This information would assist NRC in evaluating the cost of complying with this generic letter:

The licensee staff time and costs to perform requested inspections, corrective actions, and associated testing;

The licensee staff time and costs to prepare the requested reports and documentation;

The additional short-term costs incurred as a result of the inspection findings such as the costs of the corrective actions or the costs of down time;

An estimate of the additional long-term costs which will be incurred in the future as a result of implementing commitments such as the estimated costs of conducting future inspections or increased maintenance.

If you have any questions about this matter, please contact the technical contact or lead project manager listed below, or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Attachments:
1. Guidance for Addressing Pressure Locking and Thermal Binding of Power-Operated Gate Valves

2. Description of Potential Resolution Options for Gate Valves Found Susceptible to Pressure Locking or Thermal Binding

ATTACHMENT 1

GUIDANCE FOR ADDRESSING PRESSURE LOCKING ANDTHERMAL BINDING OF POWER-OPERATED GATE VALVES

The material that follows summarizes one acceptable approach to addressing pressure locking and thermal binding of gate valves within the scope of the accompanying generic letter:

- Perform an evaluation of the safety-related power-operated gate valves having operational configurations that may be susceptible to pressure locking or thermal binding. Document the basis for determining whether valves (a) are susceptible to pressure locking or thermal binding or (b) can be removed from further consideration. For example, solid wedge disk gate valves might not be susceptible to pressure locking. Double disk gate valves are not likely to be susceptible to thermal binding. The absence of a heat source could be a basis for eliminating valves from consideration of susceptibility to thermally induced pressure locking.

The evaluation should include consideration of the potential for gate valves to undergo pressure locking or thermal binding during surveillance testing.

The evaluation also should include review of generic studies for site-specific applicability, such as in the areas of thermal effects and design-basis depressurization. For example, the potential for thermally induced pressure locking of containment sump recirculation valves was recently recognized. Licensees should also be aware that efforts to improve the leak-tightness of primary system valve pressure boundaries could increase susceptibility to pressure locking.

Examples of unacceptable reasons as the sole basis for eliminating valves from consideration of pressure locking or thermal binding are (a) leakage rate, (b) engineering judgement without justification, and (c) lack of event occurrence at the specific plant.

Several plants have experienced either pressure locking or thermal binding in safety-related and non-safety-related systems. These cases are discussed in NUREG-1275, Volume 9. Examples of gate valves involved in pressure locking events are:

- Low-pressure coolant injection (LPCI) and low-pressure core spray (LPCS) system injection valves;
- Residual heat removal (RHR) system hot-leg crossover isolation valves;
- RHR containment sump and suppression pool suction valves;
- High-pressure coolant injection (HPCI) steam admission valves;
- RHR heat exchanger outlet valves;
- Emergency feedwater isolation valves; and
- RCIC steamline isolation valve.

Examples of gate valves involved in thermal binding events are:

- Reactor depressurization system isolation valves;
- RHR inboard suction isolation valves;

- HPCI steam admission valves;
- Power-operated relief valve (PORV) block valves;
- Reactor coolant system letdown isolation valves;
- RHR suppression pool suction valves;
- Containment isolation valves (sample line, letdown heat exchanger inlet header);
- Condensate discharge valves; and
- Reactor feedwater pump discharge valves.

Perform a further analysis of the safety-related, power-operated gate valves identified (in 1 above) as susceptible to either pressure locking or thermal binding to ensure all such valves can be opened to perform their safety function under all modes of plant operation, including test configuration.

If a safety-related, power-operated gate valve is found to be susceptible to pressure locking or thermal binding and the addressee relies on the capability of the actuator to overcome pressure locking or thermal binding, consideration of the uncertainties surrounding the prediction of the required thrust to overcome these phenomena should be included in the evaluation. Credit for bonnet pressure decay within the valve response time may not be acceptable unless operation of the actuator under those conditions will not degrade actuator capability.

In calculating thrust required to overcome these phenomena, sliding friction coefficients are more appropriate than valve factors determined in the flow stream. Prediction of actuator output capability in response to pressure locking and thermal binding should be consistent with other evaluations of safety function capability (such as GL 89-10 programs for MOVs).

Attachment 2 to this generic letter describes potential resolution options that may be used by licensees for power-operated gate valves found susceptible to pressure locking or thermal binding. Several preventive and corrective measures for pressure locking and thermal binding are also discussed in NUREG-1275, Volume 9, though each method has limitations with respect to applicability, safety, effectiveness, and cost.

The NRC regulations require an analysis under 10 CFR 50.59 for any valve modifications and the establishment of adequate post-modification and inservice testing of any valves installed as part of the modification. For example, addressees may need to evaluate the effects of drilling the hole in the disk if this option is used to resolve a pressure-locking concern. One consideration is the fact that, with a hole in one disk and the other flexible disk allowing fluid to enter the valve bonnet, the valve will be leak-tight with respect to pipe flow in only one direction.

As required through Appendix B to 10 CFR Part 50, the addressee may need to establish training for plant personnel to perform any necessary actions and incorporate specific procedural precautions/revisions into the existing plant operating procedures. For example, plant personnel might periodically stroke certain valves to reduce the potential for thermal binding.

ATTACHMENT 2

DESCRIPTION OF POTENTIAL RESOLUTION OPTIONS FOR GATE VALVES FOUND SUSCEPTIBLE TO PRESSURE LOCKING OR THERMAL BINDING

Analysis Only to Justify Adequate Capability to Overcome the Thrust Requirements of Pressure Locking or Thermal Binding

The staff considers the prediction of the thrust required to overcome pressure locking or thermal binding to be very difficult. An addressee may be able to justify adequate actuator capability in response to pressure locking for certain (e.g., small) valves. Because of the uncertainties in valve geometries and material expansion and contraction characteristics, the staff believes considerable effort will be required by a licensee to justify this alternative in a manner adequate to resolve concerns regarding thermal binding.

Testing Only to Justify Adequate Capability to Overcome the Thrust Requirements of Pressure Locking or Thermal Binding

An addressee may be able to demonstrate through an in-situ or prototype test that the actuator has adequate capability to overcome pressure locking for a particular valve. The staff considers this alternative difficult to justify for thermal binding concerns because of the uncertainty in modeling actual plant and valve conditions.

A Combination of Testing and Analysis to Justify Adequate Capability to Overcome the Thrust Requirements of Pressure Locking or Thermal Binding

An addressee may be able to demonstrate adequate capability of the actuator to overcome pressure locking based on test information from the particular valve or similar valves from other sources, together with an analysis to demonstrate applicability. As with Alternative 2, the staff considers this alternative difficult to justify for thermal binding concerns.

Equipment Modifications to Prevent Pressure Locking or Thermal Binding

The staff considers this to be the least difficult alternative to justify in addressing pressure locking of susceptible gate valves. Examples of possible modifications to prevent pressure locking are provided in NUREG-1275, Volume 9. Modifications to prevent thermal binding are also possible, such as replacing a wedge gate valve with a parallel-disk gate valve.

Procedure Modifications to Prevent Pressure Locking or Thermal Binding

The staff considers procedure modification to be a strong alternative for preventing thermal binding of gate valves. As opposed to thermal binding, procedure modifications are less likely to be a justifiable alternative for preventing pressure locking of gate valves.