Appendix B

Braidwood Station Operability Assessment for GL 95-07 Valves

ATTACHMENT C
OPERABILITY ASSESSMENT PROCESS

F.20.

a. PIF #: 456-201-95-022600 Assessment Expected Due Date/Time: 02/13/96/ -

454-200-95-0003

Operability Determination (check one): X Operable ☐ Inoperable ☐ Operable, but degraded

Approved **Compensatory Actions** - List those approved (also see attached page 7):

YES ☐

NO X

Approved **Corrective Actions** - List those approved (also see attached pages 8 & 9):

YES X

NO ☐

OPERABILITY ASSESSMENT RECOMMENDATION:

6.13.2 Preparer/Evaluator: R.C. Bedford 2/12/96

6.13.3.b Regulatory Assur. Supv: [signature] 2/13/96

System Manager Supv: [signature] 2/13/96

Site Eng. Support Supv: [signature] 2/13/96

Operating Engineer: [signature]

OPERABILITY ASSESSMENT APPROVAL:

6.13.5.d Shift Engineer: [signature]

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F.20. General Information:

b. Affected Station(s): Braidwood & Byron

c. Unit(s): 1 & 2

d. Description of problem, failure, defect, degraded or nonconforming condition:

Pressure locking and thermal binding of power operated gate valves (Se Attached)

e. Component(s) Affected:

Power Operated Valves

f. Identification Number(s)(EPN, part/serial number, etc): 1(2)CS007A/B, 1(2)CV8804A, 1(2)RH8716A/B, 1(2)RY8000A/B, 1(2)SI8801A/B, 1(2)SI8802A/B, 1(2)SI8811A/B 1(2)SI8812A/B, 1(2)SI8840

Evaluation:

g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

1. Does the affected SSC receive/initiate an RPS or ESF actuation signal?

2. Is the affected SSC in the main flow path of an ECCS or support system?

3. Is the affected SSC used to:

(a) Maintain containment integrity?

(b) Shutdown the reactor?

(c) Maintain it in a shutdown condition?

(d) Prevent or mitigate the consequences of an accident that could result in off-site exposures comparat to 10CFR100 guidelines.

4. Does the SSC provide required support (i.e. cooling, lubrication, etc.) to a TS required SSC?

5. Is the SSC used to provide isolation between safety trains, or between safety and non- safety ties?

6. Is the SSC required to be operated manually to mitigate a design basis event?

7. Technical specifications,

8. UFSAR or pending revisions

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F.20. (Cont'd)

Ensure the safety function(s) of the SSC are included in the description:

See Attached

h. Describe the effect the concern has on the SSC safety function(s):

See Attached

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F.20. (Cont'd)

i. Tech Spec SSC affected:

X Yes ☐ No

Tech Spec Section(s): 3/4.4, Reactor Coolant System

3/4.5, Emergency Core Cooling System

3/4.6, Containment Systems

j. Equipment Degraded:

☐ Yes - Enter Degraded Equipment Log or Equivalent X No

k. UFSAR System affected:

X Yes ☐ No

UFSAR Sections: 5.4.7, Residual Heat Removal System

6.3, Emergency Core Cooling System

Chapter 15, Accident Analysis

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l. Does the SSC meet its required design function?

X Yes ☐ No

m. Justification:

See Attached

Disposition:

1. IF the failed, DEGRADED or NONCONFORMING SSC prevents the accomplishment of the safe function(s) of a Tech Spec SSC specifically described by that TS, THEN the SSC does NOT meet required design function(s). Check **NO** and recommend to the shift engineer to declare the equipme inoperable;

2. IF the failed, DEGRADED or NONCONFORMING SSC alters a SSC from its description in the UFSAR AI the evaluation concludes that it does NOT affect the ability to meet the required design function(s) in t TS AND the intention is to continue operating the plant in that condition, THEN check **YES** and a 50. evaluation is required and should be attached to this attachment. A review shall be performed to determi if a UFSAR update is required;

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3. IF the failed, DEGRADED or NONCONFORMING SSC does NOT affect the ability to meet the require design function(s) and does NOT alter a SSC from its description in the UFSAR, THEN check YES an document the recommended corrective actions to restore full qualification on this attachment.

F.20. (Cont'd)

n. **REFERENCE DOCUMENT LIST**

NFS Letter from D. Redden dated 01/18/96, PSS-96-011

UFSAR Sections 5.4.7, 6.3 and Ch. 15

Byron/Braidwoood Technical Specifications

Improved Technical Specifications

Byron/Braidwood Safety Evaluation Reports

NES Letter from B. Bunte dated 1/16/96, DG96-000078

Test Procedure for 4 inch Westinghouse Valve dated 09/12/95 Rev. 0

Test Procedure for 10 inch Borg Warner Valve dated 11/28/95 Rev. 0

Braidwood Calculations 95-111, 96-015, 96-021

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F.20. (Cont'd)

o.

COMPENSATORY ACTION ITEM LIST

Compensatory action(s) or mitigating condition(s) required to ensure operability:

☐ Yes X No (refer to Corrective Action Item List)

Listed below are compensation or mitigating conditions that are required to support operability of:

Compensatory Action #1:

Responsible Dept./Supv.:

Action Due:

NTS:

Compensatory Action #2:

Responsible Dept./Supv.:

Action Due:

NTS:

Compensatory Action #3:

Responsible Dept./Supv.:

Action Due:

NTS:

Compensatory Action #4:

Responsible Dept./Supv.:

Action Due:

NTS:

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OPERABILITY ASSESSMENT PROCESS

F.20. (Cont'd)

q.

CORRECTIVE ACTION ITEM LIST

Corrective Action(s) required?

X Yes ☐ No (refer to the Compensatory Action Item List)

If any of these items cannot be accomplished in the specified time notify the Operations Manager.

Corrective Action #1:

Revise operating procedures to ensure one train of RHR remains aligned to the RWST in mode 4.

Responsible Dept./Supv.: L. Weber / M. Rasmussen

Action Due: Prior to the next planned entry into mode 4.

NTS: 456-201-95-022602/454-200-95-0003S1-01

Corrective Action #2:

Revise appropriate procedures to stroke 1(2)CS007A/B valve following operation of the Containment Spray pump on recirculation in modes 1-4.

Responsible Dept./Supv.: L. Weber / M. Rasmussen

Action Due: Prior to the next operation of the CS pump.

NTS: 456-201-95-022603/454-200-95-0003S1-02

Corrective Action #3:

The Byron Station Technical Specification interpretation requiring that the closed crosstie valve (1(2)RH8716A/B) be capable of being opened from the MCB will be reviewed and revised as appropriate to address mode 4 requirements. Based on this review , operating procedural changes may be required at Braidwood and Byron.

Responsible Dept./Supv.: N. Stremmel

Action Due: 05/01/96

NTS: 454-200-95-0003S1-03

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F.20. (Cont'd)

q.

CORRECTIVE ACTION ITEM LIST

Corrective Action(s) required?

X Yes ☐ No (refer to the Compensatory Action Item List)

If any of these items cannot be accomplished in the specified time notify the Operations Manager.

Corrective Action #4:

Perform a calculation to quantify the bonnet pressure for 1(2)RH8716A and the ability to open under this pressure. Parameters such as, RHR system temperature and pressure (which is contained in the bonnet) at the time of closure, same conditions at the time of opening (8.5 hours after closure), and industry test data on bonnet pressure leak-off should be considered. Alternatively, a modification may be performed to ensure a leak off path exists for bonnet pressure.

Responsible Dept./Supv.: C. Bedford / N. Stremmel

Action Due: 06/01/96

NTS: 456-201-95-022604/454-200-95-0003S1-04

Corrective Action #5:

Evaluate the necessity of performing a modification to the 1(2)SI8812A/B valves to resolve the pressure locking concern.

Responsible Dept./Supv.: C. Bedford / N. Stremmel

Action Due: 5/01/96

NTS: 456-201-95-022605/454-200-95-0003S1-05

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F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

Pressure locking of gate valves can occur when the valve is closed. This phenomenon occurs when water contained in the valve bonnet becomes pressurized such that there is a differential pressure between the bonnet and the upstream/downstream side of the disc. Two types of situations can cause this phenomenon. The first occurs when water in the valve bonnet is heated from surrounding ambient air conditions or when the water is heated via heat transfer from hot water within the piping system. The second occurs when high pressure water becomes trapped within the bonnet either from leaking check valves connected to high pressure systems or from high pressure pumps. Sudden depressurization of the high pressure system or shutdown of the pump can cause this high pressure fluid to become trapped in the valve bonnet. Both of these phenomena can cause a pressure increase within the valve bonnet which potentially creates forces between the disc and seating surfaces which would not allow the valve disc to be pulled out of the seat. Thermal binding occurs when a valve is closed while the system is hot and then allowed to cool before attempting to open the valve. Mechanical interference occurs between the disk and seats not allowing the disk to move.

1(2)CS007A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

These valves were evaluated as being susceptible to pressure locking. These valves are normally closed and open automatically on a containment spray actuation. During a containment spray actuation the 1(2)CS007A/B valves receive an open signal prior to the pumps starting. The possibility exists that these valves could experience pressure locking subsequent to containment spray pump testing. During this scenario the pump would be tested on recirculation back to the Refueling Water Storage Tank (RWST) with the 1(2)CS007A or B valve closed. When the containment spray pump is shut down the potential exists for high pressure fluid to become trapped in the valve's bonnet. The LCOAR for the tested train is normally exited shortly after system restoration which could be prior to bonnet pressure decay.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are normally closed and automatically open on a containment spray actuation signal. These valves are located in the flowpath between the containment spray pump and the containment spray ring header. These valves provide a containment isolation function and open to provide a flowpath for the containment spray system such that pressure in the containment is maintained below the containment design pressure in the event of a steam line break or LOCA.

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to this phenomenon the 1(2)CS007A/B valve may not open automatically on a containment spray actuation signal. This would only be a concern immediately following operation of the containment spray pump in the test mode (recirculation back to the RWST).

F.20.m Justification:

Procedure changes have been initiated to ensure the 1(2)CS007A&B valves are stroked following operation of the Containment Spray pumps in the test mode (See Corrective Action #2). This requirement to stroke the valve following operation of the Containment Spray pump is only applicable in modes 1-4. These procedure changes will be completed prior to the next operation of the Containment Spray pump in the test mode.

1(2)CV8804A

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

The phenomenon which can cause pressure locking of these valves postulates that hot water from the RH pump discharge piping system migrates to the closed valve causing the disc and the water trapped in the bonnet to heatup. This heating of the water in the bonnet causes the pressure to increase to a point which would not allow the valve to open. This scenario could occur while the 1(2)CV8804A valves are closed during shutdown cooling operations (the source of the heated water) and a Loss of Coolant Accident (LOCA) occurs requiring the valves to be opened to provide recirculation water to the Centrifugal Charging Pumps.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are required to be manually opened from the Control Room in accordance with the emergency operating procedures during the recirculation phase of Emergency Core Cooling following a LOCA. These valves are opened such that the Residual Heat Removal (RHR) system can supply the Charging pumps with a long term supply of recirculated water following a LOCA. These valves are interlocked with the RHR suction isolation valves one of which must be closed, the containment sump suction valve which must be open and the Safety Injection pump miniflow valves which must both be closed (or the common miniflow closed).

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F.20.h Describe the effect the concern has on the SSC safety function(s):

These valves are not affected by this concern during a LOCA in modes 1-3 (since RHR is not operating in the shutdown cooling mode), however, they are affected during a LOCA in mode 4. Due to thermally induced pressure locking these valves may not open on a signal from the control room. If these valves failed to open electrically attempts to locally operate the valve via the handwheel would be possible.

F.20.m Justification:

Susceptibility during a mode 4 LOCA was determined to be outside the design basis and, therefore, outside the scope of GL 95-07. This valve is located in piping connected to the RHR discharge piping (source of the heated water) and approximately 30 pipe diameters away from the point of connection. Very little heating of this valve would be expected to occur due to heat transfer through the water with no flow. In accordance with NFS letter PSS-96-011, a large break LOCA in mode 4 is not credible and has been eliminated from concern through probabilistic analysis performed by Westinghouse. Under a small break scenario, this valve would not have to be opened until the RWST reached the low low setpoint and transfer to the recirculation phase took place in accordance with procedures 1(2)BwOA (BOA) S/D-2, Shutdown LOCA Unit 1(2), and 1(2)BwEP (BEP) ES-1.3, Transfer to Cold Leg Recirculation Unit 1(2). Under this scenario, it is judged, there would be sufficient time prior to opening the 1(2)CV8804A valve such that cooling and depressurization of the bonnet would be allowed to occur. Additionally, there would be sufficient time to locally open the 1(2)CV8804A valve for the recirculation phase of the Emergency Core Cooling System (ECCS), if required prior to depletion of the RWST. Finally, an additional flowpath through the 1(2)SI8804B (which was determined not to be susceptible to pressure locking) will remain available. Based on the above, no further actions are required for this valve.

1(2)RH8716A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

The scenario which can cause pressure locking of the 1(2)RH8716A/B valve postulates that hot water from the RH pump discharge piping migrates to the closed valve causing the disc and the water trapped in the bonnet to heatup. This heating of the water in the bonnet causes the pressure to increase to a point which would not allow the valves to open. This scenario could occur prior to opening the 1(2)RH8716A/B valves for hot leg recirculation after being closed during cold leg recirculation (the source of the heated water) and during shutdown cooling if the RHR system is required to realign for a mode 4 LOCA and provide injection to all four cold legs.

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F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are normally open in modes 1-3 such that injection into all four Reactor Coolant System (RCS) cold legs can be accomplished assuming a single RHR pump failure. During the cold leg recirculation phase of ECCS, these valves are closed. During the switchover to hot leg recirculation the 1(2)RH8716A valve is opened. In mode 4 during shutdown cooling operations, the RH8716A or B must be closed to prevent lifting of the opposite RHR train suction relief valve.

F.20.h Describe the effect the concern has on the SSC safety function(s):

The concern does not effect the closing of these valves. Due to the phenomenon of thermally induced pressure locking, these valves may not open on a signal from the control room. This could occur during the transfer from cold to hot leg recirculation following a LOCA or during mode 4 if injection into all four cold legs were required following a LOCA.

F.20.m Justification:

The 1(2)RH8716B valve was determined not to be susceptible to this phenomenon due to the proximity of the valve to the RH pump discharge piping. The valve is approximately 50 pipe diameters from the discharge piping and heating of the valve would not be expected through this length of piping with no flow.

During initiation of the cold leg recirculation phase of ECCS following a LOCA in modes 1-3 the 1(2)RH8716A valve would be closed with hot recirculated water in the bonnet thus eliminating the potential for heating of the bonnet water and a pressure locking concern. Emergency Operating Procedure BwEP (BEP) ES-1.3, Transfer to Cold Leg Recirculation was reviewed and the estimated time between closing the 1(2)SI8812A (follows opening of the containment sump suction valve) and closing the 1(2)RH8716A valve is greater than 30 seconds. At an RHR flowrate of 3000 gallons/minute it would take approximately 30 seconds before recirculated water reached the 1(2)RH8716A valve (estimated 1500 gallons of water between the sump and the valve). Based on the proximity of the 1(2)RH8716A valve to the RHR pump discharge piping (approximately 1') mixing would occur such that the 1(2)RH8716A valve would be closed with recirculated water in the bonnet. With system temperatures cooling from this point on, the already heated water in the bonnet is not expected to pressurize. Therefore, pressure locking during this mode of operation is not expected to occur (this evaluation will be further documented in Corrective Action #4 to verify design margin).

Valve 1(2)RH8716A is susceptible under mode 4 LOCA conditions. However, susceptibility during a mode 4 LOCA was determined to be outside the design basis and, therefore, outside

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the scope of GL 95-07. Technical Specification 3.5.3 requires that one ECCS subsystem comprised of the following be operable during mode 4: (1) One operable charging pump, (2) One operable RHR heat exchanger, (3) One operable RHR pump and (4) An operable flow path capable of taking a suction from the RWST upon being manually realigned and transferring suction to the containment sump during the recirculation phase of operation. Current station procedures for operation of the RHR system in mode 4 require that, with RHR being used for decay heat removal, one of the 1(2)RH8716A/B valves must be closed but capable of being opened from the main control board. This requirement is based on a Byron Station Technical Specification 3.5.3 interpretation which applied mode 1-3 requirements for RHR four loop injection to mode 4 conditions.

In accordance with NFS letter PSS-96-011 which considered a Westinghouse mode 4 LOCA evaluation (WCAP-12476), the RHR crosstie valves (1(2)RH8716A/B) are not required to be opened to mitigate a LOCA in mode 4 in the generic analysis. In fact opening of the crosstie valves in mode 4 may lead to an undesirable water hammer. This letter specifies that large break LOCAs in mode 4 have been eliminated through probabilistic analysis and ECCS equipment normally available in mode 4 would successfully mitigate a small break LOCA. If the 1(2)RH8716A valve did not open, the charging pump would inject into all four cold legs and the RHR pump would be capable of injecting into two cold legs.

During shutdown cooling operations, the RHR crosstie valves are subjected to temperatures which could be expected to cause thermally induced pressure locking. However, there have been no failures indicative of this phenomenon to date. This indicates that mitigating effects such as seat and packing leakage do occur which prevent this phenomenon from occurring. If these valves do experience pressure locking, the motor would stall and the thermal overloads would trip with no valve or operator damage expected. Attempts to manually operate the valve via the handwheel could then be made locally.

The Byron Station Technical Specification interpretation requiring that the closed crosstie valve be capable of being opened from the control room will be reviewed and revised as appropriate to address mode 4 requirements (See Corrective Action #3). Based on the result: of this review, operating procedural changes may be required at Braidwood and Byron.

As discussed above, any one of the following conditions will provide for successful performance of 1(2)RH8716A, to accomplish switchover to hot leg recirculation, which provides reasonable assurance that the system is operable: (1) The temperature of the wate: in the bonnet at the time of isolation is considered hot, (2) there is 8.5 hours available for the bonnet to depressurize by cooling as well as by decay (during cold leg recirculation), (3) manual action could be taken to open 1(2)RH8716A via the handwheel (thi: delay would not be significant compared to the 8.5 hour switchover time frame). However, these are qualitative assessments which will be quantitatively addressed, or the valves modified to establish full design qualification (See Corrective Action #4).

1(2)RY8000A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

These valves are normally open, however, one or both may be closed to isolate a leaking Pressurizer Power Operated Relief Valve (PORV) during normal plant operation in accordance with the Technical Specifications. One of the two isolation valves may be required to reopen in the event of a Steam Generator Tube Rupture or to mitigate an inadvertent ECCS actuation at power in accordance with the Emergency Operating Procedures (EOPs). These valves would potentially be required to open at a lower RCS pressure and temperature then at which they are closed and, as such, are potentially susceptible to pressure locking and thermal binding.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

The normal position of the Pressurizer PORV block valves is open. One or both may be closec to isolate a leaking PORV in accordance with Technical Specification 3/4.4.4. These valves may be required to reopen in accordance with the Emergency Operating Procedures (EOPs). These valves are also required to open for Low Temperature Overpressure Protection (LTOP).

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to the pressure locking and thermal binding phenomenon these valves may not open when required. This could occur if the RY8000 valves are required to open after being closed to isolate a leaking PORV.

F.20.m Justification:

If the 1(2)RY8000A/B valves are closed during normal operation to isolate a leaking PORV the piping configuration is such that very little cooling of the valve body would be expected. The valves are located less than 5 feet from a vertical section of pressurizer piping containing steam. During several transient conditions the PORV isolation valve would be required to be opened within approximately 1 hour from the initiating event. Within this time period, the 1(2)RY8000A/B valve is not expected to cool such that thermal binding woulc be a concern. Under a feed and bleed scenario, the block valves would not be subject to these phenomena due to high RCS pressures and temperatures.

These valves are normally opened after plant cooldown. In mode 4 and below, however, this is not a safety function so thermal binding is not a safety concern in this mode. Braidwood calculation 95-111 demonstrates that these valves have adequate margin to overcome pressure locking effects during the scenarios above.

1(2)SI8801A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

These valves are normally closed and automatically open on a safety injection signal. These valves remain open during the injection, cold leg recirculation and hot leg recirculation phases of ECCS. The valves would be subject to elevated system temperatures prior to being closed for system realignment. The potential for thermal binding would occur during reopening of these valves. The valves are subject to charging pump pressure during normal plant operation and a pump shutdown as could occur in a Loss of Off-site Power would create the possibility for pressure locking.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are normally closed and their safety function is to open to provide an injection flowpath upon receipt of a safety injection signal. The opening of these valves allows the charging pumps to provide RWST water to the RCS cold legs during the injection phase of ECCS and recirculated water during the recirculation phase of ECCS.

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to the pressure locking and thermal binding phenomena these valves may not open when required.

F.20.m Justification:

The relatively low system temperature differentials (<112°F)which would be experienced by these valves is not expected to cause thermal binding based on ComEd testing and industry data. Reclosing and opening this valve subsequent to the recirculation phase of ECCS is not required. If a Loss of Off-site power were to occur coincident with a safety injection signal the valves and the charging pumps would lose power. Upon startup of the Diesel Generators and closing of the output breaker the charging pump and the SI8801 valves would be powered at essentially the same time. Therefore, as the valve starts to open the pump will come up to speed and the pump discharge pressure would eliminate the pressure locking

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concern for this valve.

1(2)SI8802A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

During the hot leg recirculation phase of ECCS the valves are subject to elevated system temperatures prior to being closed for transfer back to cold leg recirculation. The valves would be required to reopen during transfer back to hot leg recirculation and thus would be potentially susceptible to thermal binding. These valves are also subject to bonnet pressurization from RCS check valve leakage during normal operation. If followed by a sudden RCS depressurization (LOCA), the potential for pressure locking is created. They are also subject to bonnet pressurization due to Safety Injection pump discharge pressure during surveillance and accident operations.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are located on the discharge of the Safety Injection pumps and provide a flowpath to the RCS hot legs. These valves are normally closed and are manually opened from the control room during the transfer from the cold leg to hot leg recirculation phase of ECCS.

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to the pressure locking and thermal binding phenomena these valves may not open when required.

F.20.m Justification:

The relatively low system temperature differentials (<112°F) which would be experienced by these valves is not expected to cause thermal binding. Hot leg recirculation is not initiated until 8.5 hours after a LOCA. As specified in calculation BRW 96-015 this time period exceeds that required to depressurize the valve bonnet based on ComEd testing of a similar pressure class and size valve. Calculation BRW 96-015 also demonstrates that these valves have margin to overcome pressure locking effects for the scenarios in which Safety Injection pump discharge pressure causes a pressure locking concern. Based on this information, pressure locking is not a safety concern.

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1(2)SI8811A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

The scenario which can cause pressure locking of these valves postulates that, after a LOCA, the hot water from the ECCS containment sump heats up the closed valve causing the disc and the water trapped in the bonnet to heatup. This heating of the water in the bonnet causes the pressure to increase to a point which would not allow the valve to open. This scenario could occur while the 1(2)SI8811A/B valves are closed prior to the initiation of the recirculation phase of ECCS. Heating and pressurization of the valve bonnet could also occur in mode 4 during shutdown cooling operations. If a mode 4 LOCA were to occur, this valve may have to be opened for recirculation capability.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

The valves are normally closed and automatically open on a refueling water storage tank low low level coincident with a safety injection signal. These valves provide a long term supply of water from the containment recirculation sump to the ECCS pumps following a LOCA. These valves must also be capable of being opened in mode 4 following a LOCA to provide a long term supply of water to the ECCS equipment.

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to the phenomenon of thermally induced pressure locking, this valve may not open automatically during the transfer from injection to the recirculation phase of ECCS following a LOCA.

F.20.m Justification:

Calculation BRW 96-021 demonstrates that these valves have adequate margin to overcome pressure locking effects during each of the scenarios in which these valves are susceptible Based on this calculation, pressure locking is not expected to occur. To restore design margin a design change for Braidwood (E20-1/2-95-215) and Byron (DCP9500200/201) has been initiated. This design change is scheduled for installation at Braidwood during A2R05 and A1R06 and at Byron during B1R07 and B2R06.

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1(2)SI8812A&B

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

The scenario which can cause pressure locking of these valves postulates that hot water from the RH pump suction piping migrates to the closed valve causing the disc and the water trapped in the valve bonnet to heatup. There are check valves (1/2SI8958A/B) between the suction piping and the 1(2)SI8812A/B valves, however, these components are connected to one another and heat transfer occurs through conduction. This heating of the water in the bonnet causes the pressure to increase to a point which would not allow the valve to open. This could occur when 1(2)SI8812A/B are closed during the period RH is operating in shutdown cooling in mode 4 (the source of heated water) and a LOCA occurs requiring the 1(2)SI8812A/B valves to open to provide water to the RCS from the RWST.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

These valves are normally open to provide a suction source (RWST) for the RHR pumps in modes 1-3. During a LOCA, these valves are manually closed from the control room during the transfer from injection to cold leg recirculation. In mode 4, the 1(2)SI8812A/B valve in the train of RHR being utilized for shutdown cooling is closed and the other 1(2)SI8812A/B may be closed but must be capable of being manually opened from the control room to provide a suction supply of RWST water to the RHR pump.

F.20.h Describe the effect the concern has on the SSC safety function(s):

There is no effect during operation in modes 1-3 since the 1(2)SI8812A/B valves are required to be open. However, in mode 4 when RHR is being utilized for shutdown cooling the applicable 1(2)SI8812A/B valve may not open due to the thermally induced pressure locking phenomenon. Technical Specification 3.5.3 requires that there be one operable RHR train in mode 4 which is capable of taking a suction from the RWST and transferring suction to the containment sump. Current station procedures allow both RHR trains to be operated in the shutdown cooling mode. In this case, both 1(2)SI8812A/B valves would be susceptible to thermally induced pressure locking and potentially one would not be capable of being aligned to the RWST in accordance with the Technical Specifications.

F.20.m Justification:

Valves 1(2)SI8812A/B are susceptible under mode 4 LOCA conditions. However, susceptibility during a mode 4 LOCA was determined to be outside the design basis and, therefore, outside the scope of GL 95-07. Procedure changes have been initiated to ensure that one RHR train

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remains capable of being aligned to the RWST for the duration of mode 4 operation (See Corrective Action #1). If RHR train swaps are required in mode 4, then the operators will have a 30 minute time period to open the 1(2)SI8812A/B valve on the train being shut down. This will allow sufficient time to realign the RHR train which was just started to the RWST if the 1(2)SI8812A/B in the shutdown train does not open. Temperature monitoring was conducted in mode 4 and indicated that the bonnet temperature increase over a 30 minute time period was negligible and the valve could be reopened before pressure locking would be a concern. These procedure changes will ensure that the 1(2)SI8812A/B valves are capable of being opened on the operable RHR train. These procedure changes will be completed prior to the next planned entry into mode 4. Long term corrective actions will be reviewed including potential modification of these valves (See Corrective Action #5).

1(2)SI8840

F.20.d. Description of Problem, failure, defect, degraded or nonconforming condition:

These valves are normally closed and are manually opened from the control room during transfer from the cold leg to hot leg recirculation phase of ECCS. During the hot leg recirculation phase of ECCS, the valves are subject to elevated system temperatures prior to being closed for transfer back to cold leg recirculation. The valves would be required to reopen during transfer back to hot leg recirculation and thus would be potentially susceptible to thermal binding. These valves are also subject to bonnet pressurization from RCS check valve leakage during normal operation after which a sudden RCS depressurization (LOCA) would create the potential for pressure locking.

F.20.g. Describe the safety function(s) or safety support function(s), answering the following as part of the description:

The valves are located on the discharge of the RHR pumps and provide a flowpath to the RCS hot legs. The valves are normally closed and their safety function is to open during transfer from the cold leg to hot leg recirculation phase of ECCS.

F.20.h Describe the effect the concern has on the SSC safety function(s):

Due to the pressure locking and thermal binding phenomenon these valves may not open when required.

F.20.m Justification:

he relatively low system temperature differentials (<112°F) which would be experienced by

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these valves during the hot leg recirculation phase of ECCS is not expected to cause thermal binding in accordance with ComEd testing and industry data. The hot leg recirculation phase of ECCS is not initiated until 8.5 hours after a LOCA. Assuming that the bonnet of this valve was pressurized to RCS pressure prior to a LOCA a sufficient amount of time exists to depressurize the bonnet prior to the opening of this valve. Based on ComEd testing of a similar pressure class valve, depressurization rates were on the order of between 40-200 psig/minute under a depressurization scenario. Within 8.5 hours or 510 minutes the pressure in this bonnet would depressurize such that pressure locking would not be expected to occur. No further actions are required for this valve.