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Southern Nuclear Operating Company
the southern electric system

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Docket Nos.: 50-348
50-364

U.S. Nuclear Regulatory Commission
ATTN.: Document Control Desk
Washington, D.C. 20555

Joseph M. Farley Nuclear Plant
Response to Generic Letter 95-07

Ladies and Gentlemen:

The NRC Generic Letter 95-07, requests addressees (1) evaluate all operational configurations of safety-related, power-operated (including air-operated, motor-operated, or hydraulically-operated) gate valves for susceptibility to pressure locking and thermal binding (PLTB) and (2) perform further analyses, and any corrective actions, to ensure that safety-related power-operated gate valves that are susceptible to these phenomena are capable of performing safety functions within the current licensing bases. This is applicable primarily to valves that have an active safety function to open.

The NRC requested the following actions be completed within 90 days of the issuance of the generic letter:

- (1) Perform screening evaluations to identify those valves that are potentially susceptible to pressure locking or thermal binding;

- (2) Document a basis for the operability or, if operability cannot be supported, take action in accordance with individual plant technical specifications.

These 90-day actions have been completed by Southern Nuclear Operating Company as requested.

In addition, within 180 days each addressee was requested to implement and complete the guidance provided in Attachment 1 of the generic letter by performing the following:

- (1) Evaluate the different operating configurations to identify all valves that are susceptible to pressure locking or thermal binding.

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- (2) Perform further analyses as appropriate and take corrective actions to ensure susceptible valves identified in 1 above are capable of performing their intended safety function(s) under all modes of operation.

The above actions have been completed for Farley Nuclear Plant (FNP). Provided in the Attachment is Southern Nuclear Operating Company's 180 Day response concerning the results of our evaluation. As is detailed in the attachment, a screening/evaluation process was used on all applicable valves. Based on this screening and analytical analysis using two different models (one of which is a WOG methodology commonly known as the Com Ed methodology) all valves at FNP have sufficient actuator capability to perform their safety function. No physical modifications to FNP actuators are required.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Dave Morey

Sworn to and subscribed before me this 12th *day of* February 1996

Martha Gayle Dow
Notary Public *Seal*

My Commission Expires: November 1, 1997

REM/clt:gl9507r_.doc

Attachment

cc: Mr. S. D. Ebneter, Region II Administrator
Mr. B. L. Siegel, NRR Senior Project Manager
Mr. T. M. Ross, FNP Sr. Resident Inspector

Attachment

GL 95-07 180 Day Actions

FNP Response

SNC-Farley has identified all safety-related power operated gate valves at FNP. The identification process identified 198 power-operated gate valves. A listing of the 198 valves screened for potential susceptibility is provided in Section I of this attachment. In addition, SNC developed screening criteria to assist in the identifying and evaluating valves that may be potentially susceptible to pressure locking and/or thermal binding (PLTB) under potential operational configurations. A screening flow path was developed along with a basis for each of the associated criterion. This information is contained in Section II of this attachment. Subsequently, the Westinghouse Owner Group (WOG) issued generic guidance related to temperature and pressure screening criteria for PLTB evaluations. The Westinghouse Owners Group (WOG) PLTB criteria envelop the SNC values for quantitative generic screening criteria.

The screening/evaluation process consists of three levels. These levels are described below:

* Level (1) - Screened all power-operated gate valves within the generic letter scope using the screening flowchart and design-related parameters,

* Level (2) - Screened the valves which remained after the level 1 screening using the flowchart and plant-specific conditions more representative of normal and/or accident conditions, and

* Level (3) - Evaluated the valves which remain after the level 2 screening using plant specific parameters and the Entergy and Commonwealth Edison (ComEd) prediction models for "pressure locking" unseating thrust requirements.

The screening results were documented using formal evaluations. The format of the evaluations was developed to address a specific valve group (in lieu of individual valves) because of the similarities in the valves and in the associated system operation during normal and/or accident conditions. Copies of certain of these evaluations are provided in Section IV of this attachment. The evaluations selected for inclusion with this submittal represent a cross-section of the screening levels.

The Level 1 screening eliminated 118 of the 198 gate valves identified to be within the scope of the generic letter. Of the 80 valves remaining after the Level 1 screening, 23 valves were subsequently screened as part of Level 2 for potential susceptibility to both pressure locking and thermal binding. These 23 gate valves have flexible wedge disc designs. The remaining 57 solid wedge gate valves underwent Level 2 screening for the potential of thermal binding only. For these 80 valves requiring a Level 2 screening and/or evaluation, all valves were eliminated from susceptibility consideration for thermal binding while 65 were eliminated for pressure locking. The remaining 15 valves were screened and/or evaluated for pressure locking susceptibility as part of Level 3. For these valves the above referenced analytical models were utilized to predict the required unseating thrust values. The following valves are included in this group: 1(2)-8801A/B, 1(2)-8803A/B, 2-8811A, 1(2)-8884, 1(2)-8885, and 1(2)-8886. All of the preceding valves except 2-8811A are 3-inch, 1500 lb, Velan flexible wedge gate valves. Valve 2-8811A is a 14-inch, 300 lb, Westinghouse EMD flexible wedge gate valve.

As mentioned above, two different analytical models were initially utilized during the Level 3 evaluation phase for the remaining 15 valves. Section III of this report contains a summary spreadsheet reflecting the results of the Level 3 screening/evaluations for these 15 gate valves. In addition, included in Section III are representative copies of the input data forms for the ComEd and Entergy models. The results of a comparison between the more conservative prediction for unseating thrust (ComEd model) and the calculated design capability of these motor-operated valves indicates a minimum operating margin in excess of 50%. The design capability is determined using methods consistent with the FNP MOV Program approach. Given this large available margin, SNC-Farley concluded these valves are not susceptible to pressure locking.

SNC-Farley has reviewed the predictive models and the associated validation test data (the ComEd information was provided to SNC-Farley by the WOG) and has concluded the models are based on sound engineering principles reflecting the current level of knowledge regarding the determination of stem load resulting from the application of forces on the valve wedge and stem. Since these models are supported by test data and are based on analytically sound engineering principles , SNC-Farley, applying engineering judgment, concludes these methods/models are reasonably accurate. For the 15 valves requiring Level 3 screening at SNC-Farley, the mathematical model developed by Commonwealth Edison (ComEd) was determined to produce the more conservative results. Therefore, this model was used as the basis for evaluation of these valves.

As additional assurance for the acceptability of applying the above models to the valves at SNC-Farley, the following additional information is provided:

1- These valves have successfully operated at Farley Nuclear Plant for over 18 years (14 years for 2-8811A) without a single identified occurrence of pressure locking.
2- Eight of the 14 Velan valves were subjected to design basis differential pressure testing. During the conduct of this test all stem loads (assumed in the pressure locking Level 3 screening) except the "second disk drag" effect would have been present and, therefore, accounted for in establishing the minimum thrust requirements for setting the associated open torque switches.
3- Surveillance testing of the above 15 valves has established the same operating conditions, with respected to stem loads, as would be present during the assumed pressure locking scenarios. If, in fact, the analytical predictions were non-conservative by an amount in excess of the available margins, prior "pressure locking" problem should have been identified.
4- The assumed scenario conditions associated with the Level 3 screening included the use of pump shut-off heads and did not credit any bonnet pressure decay due to minor seat or packing leakage.
5- The practice of sizing thermal overloads at Farley Nuclear Plant ensures the overloads will not trip for at least 10% of the valve stroke time with a minimum of 2 seconds and a maximum of 4 seconds at rated lock rotor current.

SECTION I

Listing of 198 Power-Operated
Gate Valves
GL 95-07

The attached listing identifies the 198 power-operated gate valves identified for screening and/or evaluation as part of the actions associated with Generic Letter 95-07. The valves are identified by the Farley Nuclear plant Total Numbering System (TPNS) in additions to a corresponding noun description. The other columns associated with the listing:

1- Denotes whether or not a particular valves has an "Active" opening safety function,
2- Identifies the wedge design [solid (SWG) or flexible (FWG)] for each valve,
3- Identifies the screening criteria [pressure locking (PL) and/or thermal binding (TB)] applied to each individual valve,
4- Identifies the valve grouping associated with each valve (this number can be cross referenced to the formal evaluations), and
5- Identifies a code (reference screening evaluation flow chart) for the associated PL or TB screening criteria by which the particular valves was eliminated from susceptibility consideration.

All valves identified with a code of PL-7 or TB-6 required at least a Level 2 screening evaluation. Those identified by a PL-7 screening code required an analytical evaluation using the Entergy and/or the ComEd models.

LISTING OF VALVES EVALUATED FOR SUSCEPTIBILITY TO PRESSURE LOCKING & THERMAL BINDING

TPNS NUMBER	ACTIVE	DISK	EVAL	GROUP	PL CODE	TB CODE	DESCRIPTION
Q2E11FCV0602A	Y	FWG	PL & TB	01	PL-7	TB-6	RHR A RECIRC VALVE
Q2E11FCV0602B	Y	FWG	PL & TB	01	PL-7	TB-6	RHR B RECIRC VALVE
Q1E21MOV8801A	Y	FWG	PL & TB	02	PL-7	TB-6	BIT OUTLET ISO
Q1E21MOV8801B	Y	FWG	PL & TB	02	PL-7	TB-6	BIT OUTLET ISO
Q2E21MOV8801A	Y	FWG	PL & TB	02	PL-7	TB-6	BIT OUTLET ISO
Q2E21MOV8801B	Y	FWG	PL & TB	02	PL-7	TB-6	BIT OUTLET ISO
Q1E21MOV8803A	Y	FWG	PL & TB	03	PL-7	TB-6	BIT INLET ISO
Q1E21MOV8803B	Y	FWG	PL & TB	03	PL-7	TB-6	BIT INLET ISO
Q2E21MOV8803A	Y	FWG	PL & TB	03	PL-7	TB-6	BIT INLET ISO
Q2E21MOV8803B	Y	FWG	PL & TB	03	PL-7	TB-6	BIT INLET ISO
Q1E21MOV8884	Y	FWG	PL & TB	04	PL-7	TB-6	CHG PMP TO RCS HOT LEG ISO
Q1E21MOV8886	Y	FWG	PL & TB	04	PL-7	TB-6	CHG PMP RCS COLD LEG ISO
Q2E21MOV8884	Y	FWG	PL & TB	04	PL-7	TB-6	CHG PMP TO RCS HOT LEG ISO
Q2E21MOV8886	Y	FWG	PL & TB	04	PL-7	TB-6	CHG PMP RCS COLD LEG ISO
Q2E11MOV8811A	Y	FWG	PL & TB	05	PL-7	TB-6	A RHR PUMP SUCT FROM CTMT SUMP
Q1E21MOV8885	Y	FWG	PL & TB	06	PL-7	TB-6	CHG PMP TO RCS COLD LEG ISO
Q2E21MOV8885	Y	FWG	PL & TB	06	PL-7	TB-6	CHG PMP TO RCS COLD LEG ISO
Q1E11MOV8888A	Y	FWG	PL & TB	07	PL-7	TB-6	A RHR/LHSI TO RCS COLD LEG
Q1E11MOV8888B	Y	FWG	PL & TB	07	PL-7	TB-6	B RHR/LHSI TO RCS COLD LEG
Q2E11MOV8888A	Y	FWG	PL & TB	07	PL-7	TB-6	A RHR/LHSI TO RCS COLD LEG
Q2E11MOV8888B	Y	FWG	PL & TB	07	PL-7	TB-6	B RHR/LHSI TO RCS COLD LEG
Q1E11MOV8889	Y	FWG	PL & TB	08	PL-7	TB-6	RHR TO HOT LEG
Q2E11MOV8889	Y	FWG	PL & TB	08	PL-7	TB-6	RHR TO HOT LEG
Q1E21LCV0115B	Y	SWG	TB	09	PL-1	TB-6	RWST TO CHG PMP SUCTION ISO
Q1E21LCV0115D	Y	SWG	TB	09	PL-1	TB-6	RWST TO CHG PMP SUCTION ISO
Q2E21LCV0115B	Y	SWG	TB	09	PL-1	TB-6	RWST TO CHG PMP SUCTION ISO
Q2E21LCV0115D	Y	SWG	TB	09	PL-1	TB-6	RWST TO CHG PUMP SUCTION ISO
Q1E11MOV8706A	Y	SWG	TB	10	PL-1	TB-6	A RHR TO CHG SUCTION
Q1E11MOV8706B	Y	SWG	TB	10	PL-1	TB-6	B RHR TO CHG SUCTION
Q2E11MOV8706A	Y	SWG	TB	10	PL-1	TB-6	A RHR TO CHG SUCTION
Q2E11MOV8706B	Y	SWG	TB	10	PL-1	TB-6	B RHR TO CHG SUCTION
Q1E11MOV8887A	Y	SWG	TB	11	PL-1	TB-6	A RHR/LHSI TO RCS HOT LEG
Q1E11MOV8887B	Y	SWG	TB	11	PL-1	TB-6	B RHR/LHSI TO RCS HOT LEG
Q2E11MOV8887A	Y	SWG	TB	11	PL-1	TB-6	A RHR/LHSI TO RCS HOT LEG
Q2E11MOV8887B	Y	SWG	TB	11	PL-1	TB-6	B RHR/LHSI TO RCS HOT LEG
Q1E11MOV8811A	Y	SWG	TB	12	PL-1	TB-6	A RHR PMP SUCTION FROM CTMT SUMP
Q1E11MOV8811B	Y	SWG	TB	12	PL-1	TB-6	B RHR PMP SUCTION FROM CTMT SUMP
Q1E11MOV8812A	Y	SWG	TB	12	PL-1	TB-6	A RHR PMP SUCTION FROM CTMT SUMP
Q1E11MOV8812B	Y	SWG	TB	12	PL-1	TB-6	B RHR PMP SUCTION FROM CTMT SUMP
Q2E11MOV8811B	Y	SWG	TB	12	PL-1	TB-6	B RHR PUMP SUCT FROM CTMT SUMP
Q2E11MOV8812A	Y	SWG	TB	12	PL-1	TB-6	A RHR PUMP SUCT FROM CTMT SUMP
Q2E11MOV8812B	Y	SWG	TB	12	PL-1	TB-6	B RHR PUMP SUCT FROM CTMT SUMP
Q1E13MOV8826A	Y	SWG	TB	13	PL-1	TB-6	A CTMT SPRAY PMP SUCTION
Q1E13MOV8826B	Y	SWG	TB	13	PL-1	TB-6	B CTMT SPRAY PMP SUCTION
Q1E13MOV8827A	Y	SWG	TB	13	PL-1	TB-6	A CTMT SPRAY PUMP SUCTION
Q1E13MOV8827B	Y	SWG	TB	13	PL-1	TB-6	B CTMT SPRAY PUMP SUCTION
Q2E13MOV8826A	Y	SWG	TB	13	PL-1	TB-6	A CTMT SPRAY PUMP SUCTION
Q2E13MOV8826B	Y	SWG	TB	13	PL-1	TB-6	B CTMT SPRAY PUMP SUCTION
Q2E13MOV8827A	Y	SWG	TB	13	PL-1	TB-6	A CTMT SPRAY PUMP SUCTION
Q2E13MOV8827B	Y	SWG	TB	13	PL-1	TB-6	B CTMT SPRAY PUMP SUCTION
Q1E13MOV8836A	Y	SWG	TB	14	PL-1	TB-6	SPRAY ADD TO EDUCTOR
Q1E13MOV8836B	Y	SWG	TB	14	PL-1	TB-6	SPRAY ADD TO EDUCTOR
Q2E13MOV8836A	Y	SWG	TB	14	PL-1	TB-6	SPRAY ADD TO EDUCTOR
Q2E13MOV8836B	Y	SWG	TB	14	PL-1	TB-6	SPRAY ADD TO EDUCTOR
Q1E13MOV8820A	Y	SWG	TB	15	PL-1	TB-6	A CTMT SPRAY PMP DISCHARGE ISO.
Q1E13MOV8820B	Y	SWG	TB	15	PL-1	TB-6	B CTMT SPRAY PMP DISCHARGE ISO.

LISTING OF VALVES EVALUATED FOR SUSCEPTIBILITY TO PRESSURE LOCKING & THERMAL BINDING

TPNS NUMBER	ACTIVE	DISK	EVAL	GROUP	PL CODE	TB CODE	DESCRIPTION
Q2E13MOV8820A	Y	SWG	TB	15	PL-1	TB-6	A CTMT. SPRAY PMP DISCHARGE ISO
Q2E13MOV8820B	Y	SWG	TB	15	PL-1	TB-6	B CTMT. SPRAY PMP DISCHARGE ISO
Q1P16MOV3024A	Y	SWG	TB	16	PL-1	TB-6	SW FROM CTMT COOLER
Q1P16MOV3024B	Y	SWG	TB	16	PL-1	TB-6	SW FROM CTMT COOLER
Q1P16MOV3024C	Y	SWG	TB	16	PL-1	TB-6	SW FROM CTMT COOLER
Q1P16MOV3024D	Y	SWG	TB	16	PL-1	TB-6	SW FROM CTMT COOLER
Q2P16MOV3024A	Y	SWG	TB	16	PL-1	TB-6	SW FROM 2A CTMT COOLER
Q2P16MOV3024B	Y	SWG	TB	16	PL-1	TB-6	SW FROM 2B CTMT COOLER
Q2P16MOV3024C	Y	SWG	TB	16	PL-1	TB-6	SW FROM 2C CTMT COOLER
Q2P16MOV3024D	Y	SWG	TB	16	PL-1	TB-6	SW FROM 2D CTMT COOLER
Q1N23MOV3209A	Y	SWG	TB	17	PL-1	TB-6	SW TO AFW ISO
Q1N23MOV3209B	Y	SWG	TB	17	PL-1	TB-6	SW TO AFW ISO
Q1N23MOV3210A	Y	SWG	TB	17	PL-1	TB-6	SW TO MDAFW PUMP SUCTION
Q1N23MOV3210B	Y	SWG	TB	17	PL-1	TB-6	MDAFW PUMP SUCTION
Q2N23MOV3209A	Y	SWG	TB	17	PL-1	TB-6	SW TO AFW ISO
Q2N23MOV3209B	Y	SWG	TB	17	PL-1	TB-6	SW TO AFW ISO
Q2N23MOV3210A	Y	SWG	TB	17	PL-1	TB-6	SW TO MDAFW PUMP SUCTION
Q2N23MOV3210B	Y	SWG	TB	17	PL-1	TB-6	MDAFW PUMP SUCTION
Q1N23MOV3216	Y	SWG	TB	18	PL-1	TB-6	SW TO AFW ISO
Q2N23MOV3216	Y	SWG	TB	18	PL-1	TB-6	SW TO AFW ISO
Q1E22MOV3872A	Y	SWG	TB	19	PL-1	TB-6	RX CAVITY H2 DILLUTION FAN AIR DAMPER
Q1E22MOV3872B	Y	SWG	TB	19	PL-1	TB-6	RX CAVITY H2 DILLUTION FAN AIR DAMPER
Q2E22MOV3872A	Y	SWG	TB	19	PL-1	TB-6	RX CAVITY H2 DILLUTION FAN AIR DAMPER
Q2E22MOV3872B	Y	SWG	TB	19	PL-1	TB-6	RX CAVITY H2 DILLUTION FAN AIR DAMPER
Q1B13MOV8000A	N	FWG	PL & TB	20	B-2	B-2	PRZR PORV BLOCK VALVE
Q1B13MOV8000B	N	FWG	PL & TB	20	B-2	B-2	PRZR PORV BLOCK VALVE
Q2B13MOV8000A	N	FWG	PL & TB	20	B-2	B-2	PRZR PORV BLOCK VALVE
Q2B13MOV8000B	N	FWG	PL & TB	20	B-2	B-2	PRZR PORV BLOCK VALVE
Q1E11MOV8701A	N	FWG	PL & TB	21	B-2	B-2	RCS LOOP C TO A RHR PUMP
Q1E11MOV8701B	N	FWG	PL & TB	21	B-2	B-2	A RHR PUMP SUCT ISO
Q1E11MOV8702A	N	FWG	PL & TB	21	B-2	B-2	RCS LOOP A TO B RHR PUMP
Q1E11MOV8702B	N	FWG	PL & TB	21	B-2	B-2	B RHR PUMP SUCT ISO
Q2E11MOV8701A	N	FWG	PL & TB	21	B-2	B-2	RCS LOOP C TO A RHR PUMP
Q2E11MOV8701B	N	FWG	PL & TB	21	B-2	B-2	A RHR PUMP SUCT ISO
Q2E11MOV8702A	N	FWG	PL & TB	21	B-2	B-2	RCS LOOP A TO B RHR PUMP
Q2E11MOV8702B	N	FWG	PL & TB	21	B-2	B-2	B RHR PUMP SUCT ISO
Q1E11MOV8809A	N	SWG	TB	22	B-2	B-2	RWST TO A RHR PUMP SUCTION
Q1E11MOV8809B	N	SWG	TB	22	B-2	B-2	RWST TO B RHR PUMP SUCTION
Q2E11MOV8809A	N	SWG	TB	22	B-2	B-2	RWST TO A RHR PUMP SUCTION
Q2E11MOV8809B	N	SWG	TB	22	B-2	B-2	RWST TO B RHR PUMP SUCTION
Q1E13MOV8817A	N	SWG	TB	23	B-2	B-2	RWST TO A CTMT SPRAY PUMP
Q1E13MOV8817B	N	SWG	TB	23	B-2	B-2	RWST TO B CTMT SPRAY PUMP
Q2E13MOV8817A	N	SWG	TB	23	B-2	B-2	RWST TO A CTMT SPRAY PUMP
Q2E13MOV8817B	N	SWG	TB	23	B-2	B-2	RWST TO B CTMT SPRAY PUMP
Q1E21MOV8100	N	SWG	TB	24	B-2	B-2	RCP SEAL LEAKOFF ISOLATION VLV
Q1E21MOV8112	N	SWG	TB	24	B-2	B-2	RCP SEAL LEAKOFF ISO VALVE
Q2E21MOV8100	N	SWG	TB	24	B-2	B-2	RCP SEAL LEAKOFF ISO VLV
Q2E21MOV8112	N	SWG	TB	24	B-2	B-2	RCP SEAL LEAKOFF ISO VALVE
Q1E21MOV8107	N	FWG	PL & TB	25	B-2	B-2	NORMAL CHG ISO
Q1E21MOV8108	N	FWG	PL & TB	25	B-2	B-2	NORMAL CHG ISO
Q2E21MOV8107	N	FWG	PL & TB	25	B-2	B-2	NORMAL CHG ISO
Q2E21MOV8108	N	FWG	PL & TB	25	B-2	B-2	NORMAL CHG ISO
Q1E21MOV8106	N	FWG	PL & TB	26	B-2	B-2	CHG PUMP MINIFLOW ISO
Q2E21MOV8106	N	FWG	PL & TB	26	B-2	B-2	CHG PUMP MINIFLOW ISO
Q1E21MOV8130A	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q1E21MOV8130B	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION

TPNS NUMBER	ACTIVE	DISK	EVAL	GROUP	PL CODE	TB CODE	DESCRIPTION
Q1E21MOV8131A	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q1E21MOV8131B	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q2E21MOV8130A	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q2E21MOV8130B	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q2E21MOV8131A	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q2E21MOV8131B	N	SWG	TB	27	B-2	B-2	CHG PMP SUCTION HEADER X-CONNECTION
Q1E21MOV8132A	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q1E21MOV8132B	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q1E21MOV8133A	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q1E21MOV8133B	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q2E21MOV8132A	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q2E21MOV8132B	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q2E21MOV8133A	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q2E21MOV8133B	N	FWG	PL & TB	28	B-2	B-2	CHG PMP DISCHARGE HEADER X-CONN.
Q1E21MOV8808A	N	FWG	PL & TB	29	B-2	B-2	ACCUM 1A DISCHARGE
Q1E21MOV8808B	N	FWG	PL & TB	29	B-2	B-2	ACCUM 1B DISCHARGE
Q1E21MOV8808C	N	FWG	PL & TB	29	B-2	B-2	ACCUM 1C DISCHARGE
Q2E21MOV8808A	N	FWG	PL & TB	29	B-2	B-2	ACCUM 2A DISCHARGE
Q2E21MOV8808B	N	FWG	PL & TB	29	B-2	B-2	ACCUM 2B DISCHARGE
Q2E21MOV8808C	N	FWG	PL & TB	29	B-2	B-2	ACCUM 2C DISCHARGE
Q1N11HV3368A	N	FWG	PL & TB	30	B-2	B-2	A LOOP UPSTREAM MSIV BYPASS
Q1N11HV3368B	N	FWG	PL & TB	30	B-2	B-2	B LOOP UPSTREAM MSIV BYPASS
Q1N11HV3368C	N	FWG	PL & TB	30	B-2	B-2	C LOOP UPSTREAM MSIV BYPASS
Q1N11HV3976A	N	FWG	PL & TB	30	B-2	B-2	A LOOP DOWN STREAM MSIV BYPASS
Q1N11HV3976B	N	FWG	PL & TB	30	B-2	B-2	B LOOP DOWN STREAM MSIV BYPASS
Q1N11HV3976C	N	FWG	PL & TB	30	B-2	B-2	C LOOP DOWN STREAM MSIV BYPASS
Q2N11HV3368A	N	FWG	PL & TB	30	B-2	B-2	A LOOP UPSTREAM MSIV BYPASS
Q2N11HV3368B	N	FWG	PL & TB	30	B-2	B-2	B LOOP UPSTREAM MSIV BYPASS
Q2N11HV3368C	N	FWG	PL & TB	30	B-2	B-2	C LOOP UPSTREAM MSIV BYPASS
Q2N11HV3976A	N	FWG	PL & TB	30	B-2	B-2	A LOOP DOWN STREAM MSIV BYPASS
Q2N11HV3976B	N	FWG	PL & TB	30	B-2	B-2	B LOOP DOWN STREAM MSIV BYPASS
Q2N11HV3976C	N	FWG	PL & TB	30	B-2	B-2	C LOOP DOWN STREAM MSIV BYPASS
Q1N23MOV3764A	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1A S/G
Q1N23MOV3764B	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1B S/G
Q1N23MOV3764C	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1C S/G
Q1N23MOV3764D	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1B S/G
Q1N23MOV3764E	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1A S/G
Q1N23MOV3764F	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 1C S/G
Q2N23MOV3764A	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2A S/G
Q2N23MOV3764B	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2B S/G
Q2N23MOV3764C	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2C S/G
Q2N23MOV3764D	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2B S/G
Q2N23MOV3764E	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2A S/G
Q2N23MOV3764F	N	FWG	PL & TB	31	B-2	B-2	MDAFW ISO TO 2C S/G
Q1P16M0V3441A	N	SWG	TB	32	B-2	B-2	SW FROM 1A CTMT COOLER
Q1P16M0V3441B	N	SWG	TB	32	B-2	B-2	SW FROM 1B CTMT COOLER
Q1P16M0V3441C	N	SWG	TB	32	B-2	B-2	SW FROM 1C CTMT COOLER
Q1P16M0V3441D	N	SWG	TB	32	B-2	B-2	SW FROM 1D CTMT COOLER
Q1P16MOV3019A	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q1P16MOV3019B	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q1P16MOV3019C	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q1P16MOV3019D	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q2P16M0V3441A	N	SWG	TB	32	B-2	B-2	SW FROM 2B CTMT COOLER
Q2P16M0V3441B	N	SWG	TB	32	B-2	B-2	SW FROM 2B CTMT COOLER
Q2P16M0V3441C	N	SWG	TB	32	B-2	B-2	SW FROM 2C CTMT COOLER
Q2P16M0V3441D	N	SWG	TB	32	B-2	B-2	SW FROM 2D CTMT COOLER

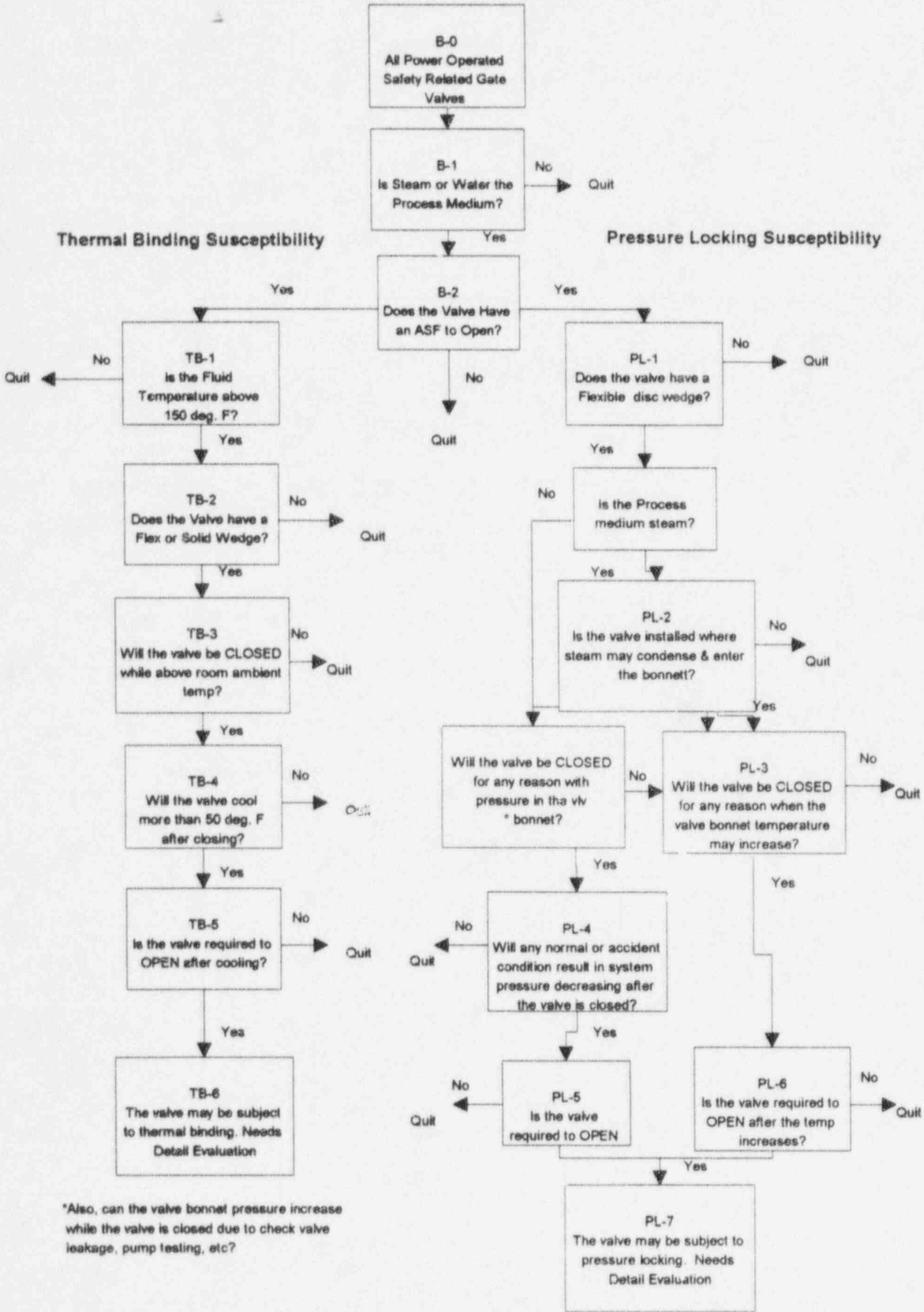
LISTING OF VALVES EVALUATED FOR SUSCEPTIBILITY TO PRESSURE LOCKING & THERMAL BINDING

TPNS NUMBER	ACTIVE	DISK	EVAL	GROUP	PL CODE	TB CODE	DESCRIPTION
Q2P16MOV3019A	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q2P16MOV3019B	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q2P16MOV3019C	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q2P16MOV3019D	N	SWG	TB	32	B-2	B-2	SW TO CTMT COOLER
Q1P16MOV3023A	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q1P16MOV3023B	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q1P16MOV3023C	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q1P16MOV3023D	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q2P16MOV3023A	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q2P16MOV3023B	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q2P16MOV3023C	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q2P16MOV3023D	N	SWG	TB	33	B-2	B-2	SW FROM CTMT COOLER
Q1P16MOV3131	N	SWG	TB	34	B-2	B-2	SW FROM RCP MOTOR COOLERS
Q1P16MOV3134	N	SWG	TB	34	B-2	B-2	SW FROM RCP MOTOR COOLERS
Q1P16MOV3135	N	SWG	TB	34	B-2	B-2	SW TO RCP MOTOR COOLERS
Q2P16MOV3131	N	SWG	TB	34	B-2	B-2	SW FROM RCP MOTOR COOLERS
Q2P16MOV3134	N	SWG	TB	34	B-2	B-2	SW FROM RCP MOTOR COOLERS
Q2P16MOV3135	N	SWG	TB	34	B-2	B-2	SW TO RCP MOTOR COOLERS
Q1P17MOV3046	N	SWG	TB	35	B-2	B-2	CCW FROM RCP ISO
Q1P17MOV3052	N	SWG	TB	35	B-2	B-2	CCW TO RCP ISO
Q1P17MOV3182	N	SWG	TB	35	B-2	B-2	CCW RETURN FROM RCP BEARINGS
Q2P17MOV3046	N	SWG	TB	35	B-2	B-2	CCW FROM RCP ISO
Q2P17MOV3052	N	SWG	TB	35	B-2	B-2	CCW TO RCP ISO
Q2P17MOV3182	N	SWG	TB	35	B-2	B-2	CCW RETURN FROM RCP BEARINGS
Q1E21LCV0115C	N	SWG	TB	36	B-2	B-2	VCT TO CHARGING PUMP SUCTION
Q1E21LCV0115E	N	SWG	TB	36	B-2	B-2	VCT TO CHARGING PUMP SUCTION
Q2E21LCV0115C	N	SWG	TB	36	B-2	B-2	VCT TO CHARGING PUMP SUCTION
Q2E21LCV0115E	N	SWG	TB	36	B-2	B-2	VCT TO CHARGING PUMP SUCTION
Q1E21MOV8105	N	FWG	PL & TB	37	B-2	B-2	SEAL WATER INJ. ISO VALVE
Q2E21MOV8105	N	FWG	PL & TB	37	B-2	B-2	SEAL WATER INJ. ISO VALVE

SECTION II

Screening Flow Chart with Criteria Descriptions

GL 95-07 SCREENING EVALUATION



*Also, can the valve bonnet pressure increase while the valve is closed due to check valve leakage, pump testing, etc?

GL 95-07 Screening Criteria Basis

B-0 All Power Operated Safety Related Gate Valves

This is the scope as defined by Generic Letter 95-07 for Pressure Locking and Thermal Binding (PLTB) evaluation. It includes motor-, air-, and hydraulically-operated gate valves. Because of plant specific licensing commitments, there may be non-safety valves that should be included in the scope of this review. The NRC cites the PORV block valve as an example because it is not safety related at some plants, but it is included in the GL 89-10 reviews.

B-1 Is Steam Or Water The Process Medium?

Pressure locking is not a concern in air or gas service valves because the heat capacities and heat transfer coefficients of the process are not significant when compared to water or steam, and the "boiler effect" is not possible without liquid in the bonnet.

Thermal binding is also of lesser concern because high temperature gasses are not used. Thus, there is no mechanism to heat a valve body to a significant degree.

B-2 Does The Valve Have An Active Safety Function (ASF) To Open?

The Generic Letter states in multiple places that licenses are to ensure that valves susceptible to pressure locking or thermal binding are capable of performing their required safety functions. Pressure locking and thermal binding only prevents closed valves from being opened. Thus to meet the requirements of the GL, only those valves that are required to open from a closed position to perform a safety related function are in the scope of this review.

Valves that are not in the GL scope of review because of this criteria, but may be susceptible to PLTB should still be evaluated for commercial considerations. There may be valves that could become pressure locked or thermally bound as part of a test, surveillance, or normal operational sequence. Even though these events would have no safety significance, (because the valve would not be performing a safety function) they could be on critical path, or result in equipment damage. An example of a valve that would fall into this category is the Vogtle RHR heat exchanger outlet valve, HV-8809B. This valve is normally open and has no safety function that requires the valve to open from a closed position. However it has been thermally bound as part of the RHR system cool down sequence performed during unit start-up.

GL 95-07 Screening Criteria Basis

TB-1 Is The Fluid Temperature Above 150°F?

The 150°F cut off was chosen as a lower limit for the process temperature, below which thermal binding would not be expected. For thermal binding to occur, the valve body and disc must expand or contract at different rates, or by different amounts. The coefficient of thermal expansion for all steels is lower at lower temperatures, and the amount of valve heat-up and cool down that can occur for a process temperature at 150°F or below is limited to relatively insignificant amounts.

TB-2 Does The Valve Have A Flex Or Solid Wedge?

Only solid wedge and flex wedge gate valves are identified as being susceptible to thermal binding in GL 95-07. Solid wedge gate valves are most susceptible, but flexible wedge gate valves with significant temperature changes are also potentially susceptible.

TB-3 Will The Valve Be Closed While Above Room Ambient Temperature?

In order for thermal binding to occur, the valve and disc must change dimensions by different amounts. If the valve is not closed above room temperature, it would not be expected to cool as the room ambient temperature would tend to heat the valve. Even if the fluid in the valve is cooler than room temperature, the differential temperature would be less than that discussed in TB-4.

TB-4 Will The Valve Cool More Than 50°F After Closing, Or The Disc Warm More Than 50°F More Than the Valve After Closing?

A relatively small temperature decrease would not be expected to cause thermal binding or pressure locking. A 50°F differential change in temperature between the valve and the disc would result in much less than 1 thousandth of an inch in interference. Check for dissimilar wedge and body materials that have different coefficients of expansion as these would be more susceptible to thermal binding.

Some have postulated that the valve body would heat faster than the disc with the valve open since it would have flow through it and the disc would be out of the flow stream. Others have postulated that the stem expands (lengthens) when the valve is closed and creates a higher wedging force. Thermal binding events are possibly more severe when valves are only momentarily opened, the valve body is warmed but the disc and stem are still cool, rather than if the disc and body are uniformly hot, and then the valve is closed and allowed to uniformly cool. Closing a cool disc into a warm body allows the disc to be closed farther into the body, then when it warms to expand and bind the valve.

GL 95-07 Screening Criteria Basis

TB-5 Is The Valve Required To Open After Cooling?

If the valve is not required to open, then there is no concern even if thermal binding exists. For this screening, "required to open" means the valve must open for the system to perform its safety function(s).

TB-6 The Valve May Be Subject To Thermal Binding - Needs Detailed Evaluation

Since the valve did not screen out prior to this step, a detailed evaluation will be performed.

PL-1 Does The Valve Have A Flexible Disc Wedge?

Pressure locking is much more significant for valves that can be pressurized between the discs. These valves may see twice the friction force with a pressurized bonnet and no line pressure as they might see if only a differential pressure across the wedge is considered. Heating the water in a water solid bonnet can make the friction forces even more significant as the pressure could be many times the original line pressure.

PL-2 Is The Valve Installed Where Steam May Condense & Enter The Bonnet?

Steam valves are only affected when there is water in the bonnet. Otherwise, the pressure in the bonnet could be no higher than the steam pressure in the line. The water can collect when the valves is mounted in a vertical line, when the valve is in the system low point, or when the valve bonnet is not mounted vertically above the valve.

PL-3 Will The Valve Be Closed For Any Reason When The Valve Bonnet Temperature May Increase?

Different studies have shown that the pressure increase in a water solid bonnet may be as much as 100 psi per °F increase in bonnet temperature. Lower pressure increases per degree temperature increase occur at lower temperatures (on the order of 33 psi per °F. In fact, NUREG -1275 Vol. 9 states that the lowest pressure locking event occurred at slightly below 200°F. This effect has been referred to as the "Boiler Effect."

Bonnet temperature increase may be due to accident room temperatures (high energy line breaks, flow through piping in the same room, or loss of room cooling), cold water heated up to normal room temperature, conduction and convection through the connected piping, or leakage through check valves connected to a higher temperature system.

PL-4 Will Any Normal Or Accident Condition Result In System Pressure Decreasing After The Valve Is Closed?

With pressure in the bonnet, a decrease in the line pressure will cause the bonnet pressure to force the disc against both seats and increase the friction force resisting disc movement. The "Entergy" method or "Con Ed" method has been used to calculate this increased force in some cases.

GL 95-07 Screening Criteria Basis

PL-5 Is The Valve Required To Open After The Valve Is Closed?

If the valve is not required to open, then there is no concern even if pressure locking exists. Given enough time, it is expected that the high pressure in the bonnet would decrease to the highest line pressure at the disc. For this screening, "required to open" means the valve must open for the system to perform its safety function.

PL-6 Is The Valve Required To Open After The Temperature Increases?

If the valve is not required to open, then there is no concern even if pressure locking exists. Given enough time, it is expected that the high pressure in the bonnet would decrease to the highest line pressure at the disc. For this screening, "required to open" means the valve must open for the system to perform its safety function.

PL-7 The Valve May Be Subject To Pressure Locking- Needs Detailed Evaluation

Since the valve did not screen out prior to this step, a detailed evaluation will be performed.

SECTION III

Analytical Evaluation Results
Including Input Data

The information in this section relates to the 15 valves for which the Entergy and ComEd predictive models were utilized for the Level 3 screening/evaluation process. Included is a spreadsheet providing the results of the comparison of the predicted unseating thrust requirements to the design capability values for each of these 15 valves. The comparison is performed on a valve-specific basis under all operating conditions where a significant "pressure locking" component is possible. Therefore, certain valves are evaluated for operation under an safety injection (SI) actuation situations and for transferring from the injection phase of emergency core cooling to the hot (HL) and cold (CL) recirculation phases.

Below is a summary of the method used to establish the values in the various columns on the spreadsheet.

Column 1 - The values in this column were obtained by using the Entergy model at the expected bonnet and line pressures. The static unseating thrusts used in the model represents either the actual measure unseating thrust for the particular valve (when this data was available) or an average based on all other identical valves tested at Farley Nuclear Plant. The plate friction coefficient used in the model 0.5. This value is consistent with the data from the EPRI MOV Performance Prediction Program (PPP) and is conservative when compared to available dynamic test data.

Column 5 - This column reflects values obtained through the use of the ComEd predictive model using the same input parameters as identified above for Column 1.

Column 10 - The values in this column reflect the calculated design capability for the respective valves. The voltage input corresponds to the "worst case" voltage at the time of the required valve opening. The remaining inputs required to determine the design actuator output torque (AOT) capability are consistent with the methods employed to perform such calculations as part of the MOV program. The stem factor values required to convert the design AOT to thrust are based on test data obtained at Farley Nuclear Plant. For the 3-inch Velan valves, the stem factor used corresponds to a coefficient of friction (COF) greater than the measured value for any of the subject valves. The stem factor used for 2-8811A is based on the average (COF) for all stem-stem nuts at Farley utilizing Nebula EP-1 as a stem lubricant. This option was chosen for 2-8811A because the actual measured stem factor for this MOV was extremely low.

The margin column reflects the per cent margin between the more conservative ComEd unseating prediction and the calculated design capability for the particular valve.

Also included in this section are example data sheets for the application of the ComEd model to certain of these valves. The method employed by SNC-Farley for the determination of the mean seat radius differs slightly from the method contained in the User Guide for the ComEd model. However, the impact of the difference on the comparative conclusions has been assessed and determined to be less than 5%.

PRESSURE LOCKING SUMMARY TABLE

FARLEY NUCLEAR PLANT

RESULTS OF COMPARISONS BETWEEN UNSEATING THRUST PREDICTIONS USING THE COMED MODEL AND THE CALCULATED DESIGN CAPABILITY VALUES

MOV TPNS NO.	ENTERGY TOTAL REQ'D THRUST (ACTUAL OR AVG UNST)	COM ED TOTAL REQ'D THRUST (ACTUAL OR AVG UNST)	LOCA / POST LOCA (AVG + 2STD)	COM ED % MARGIN TOTAL (AVG + 2STD)
	(1)	(5)	(10)	(5)(10)
1-8801A - SI	5,657	10,780	19,971	85.26
1-8801B - SI	5,509	10,632	16,631	56.42
2-8801A - SI	6,580	11,703	19,639	67.81
2-8801B - SI	5,166	10,289	16,694	62.25
1-8803A - SI	5,315	10,504	19,934	89.78
1-8803B - SI	5,363	10,552	16,418	55.59
2-8803A - SI	4,101	9,290	19,597	110.95
2-8803B - SI	5,315	10,504	16,394	56.07
1-8803A - HL TO CL	12,891	14,503	26,502	82.73
1-8803B - HL TO CL	12,939	14,551	25,774	77.13
2-8803A - HL TO CL	11,677	13,289	26,319	98.05
2-8803B - HL TO CL	12,891	14,503	25,594	76.47
2-8811A - CL	20,634	20,280	40,376 (A)	99.09
1-8884 - CL TO HL	13,128	14,747	25,414	72.33
2-8884 - CL TO HL	11,145	12,764	24,820	94.45
1-8885 - HL TO CL	14,095	15,707	26,624	69.50
2-8885 -HL TO CL	12,057	13,669	25,414	85.92
1-8886 - CL TO HL	13,750	15,353	25,895	68.66
2-8886 - CL TO HL	12,126	13,728	25,235	83.82

A. USED AVERAGE STEM FACTOR FOR ALL VALVES IN MOV PROGRAM AT FNP.

Input Data

ODseat(in)	C2	3.378	OD of valve seat
IDseat(in)	C3	2.278	ID of valve seat
a(in)	C4	1.414	mean seat radius
b(in)	C5	0.871	wedge hub radius
Pup(psig)	C6	2632.000	Pressure upstream
Pdn(psig)	C7	0.000	Pressure downstream
Pbonnet(psig)	C8	2581.000	Pressure in valve bonnet
V	C9	0.300	Poisson's ratio for C.S.
Theta	C10	5.000	Wedge Seat Angle
Mu	C11	0.500	Plate Friction coefficient for Stellite
SD	C12	1.125	Stem Diameter

E	27600000
t	0.8285

Calculated values for use in formula

a/b	C15	1.623		
b/a	C16	0.616		
@LN(A/B)	C17	0.485		
(B/A)^2	C18	0.379		
(1-V)	C19	0.700		
(1+V)	C20	1.300		
(B/A)^4	C21	0.144		
Hub Area(in2)	C22	2.383		
Hub Circ.(in)	C23	5.473	HUBlength	0.489
Dp(psi)(dn-up)	C24	-2632.000	A^4	3.997584
V^2		0.09	A^3	2.827146
A^2		1.999396	B^2	0.758641

Calculations

C2	0.063216		
C3	0.007364		
C8	0.782802		
C9	0.260898		
L11	0.000751	L3	0
L17	0.057939	L9	0

Qb(lb/in) 901.008

Measured unwedging Load (lbf)
9289

D	1437354.8
G	10615385
DPavg	1265
Mrba	3231.0023
Mrbb	0.0734805
Mrb	-237.4157
Ybqpr	-1.05E-05
Ksapr	-0.104552
Ysqpr	-3.01E-05
Pforce	4928.4029
Ystretch	-1.83E-05
Yprtotal	-5.89E-05
Ybw	-4.38E-08
Ksaul	-0.581443
Ysaul	-9.35E-08
Ycompr	-3.30E-08
Yultotal	-1.70E-07
seat load	3069.8791
stem force	1261.541
Fpiston	2564.2638
Fvert	1385.0493
Fpreslock	2523.0821
Ftotal	**10632.868**

Input Data

ODseat(in)	C2	3.378	OD of valve seat
IDseat(in)	C3	2.278	ID of valve seat
a(in)	C4	1.414	mean seat radius
b(in)	C5	0.871	wedge hub radius
Pup(psig)	C6	2641.000	Pressure upstream
Pdn(psig)	C7	0.000	Pressure downstream
Pbonnet(psig)	C8	2690.000	Pressure in valve bonnet
V	C9	0.300	Poisson's ratio for C.S.
Theta	C10	5.000	Wedge Seat Angle
Mu	C11	0.500	Plate Friction coefficient for Stellite
SD	C12	1.125	Stem Diameter

E	27600000
t	0.8285

Calculated values for use in formula

a/b	C15	1.623		
b/a	C16	0.616		
@LN(A/B)	C17	0.485		
(B/A)^2	C18	0.379		
(1-V)	C19	0.700		
(1+V)	C20	1.300		
(B/A)^4	C21	0.144		
Hub Area(in2)	C22	2.383		
Hub Circ.(in)	C23	5.473	HUBlength	0.489
Dp(psi)(dn-up)	C24	-2641.000	A^4	3.997584
V^2		0.09	A^3	2.827146
A^2		1.999396	B^2	0.758641

Calculations

C2	0.063216		
C3	0.007364		
C8	0.782802		
C9	0.260898		
L11	0.000751	L3	0
L17	0.057939	L9	0

Qb(lb/in) 975.439

Measured unwedging Load (lbf)

8946 avg group

D	1437354.8
G	10615385
DPavg	1369.5
Mrba	3497.9111
Mrbb	0.0734805
Mrb	-257.0283
Ybqpr	-1.13E-05
Ksapr	-0.104552
Ysqpr	-3.26E-05
Pforce	5335.5319
Ystretch	-1.98E-05
Yprtotal	-6.37E-05
Ybw	-4.38E-08
Ksaul	-0.581443
Ysaul	-9.35E-08
Ycompr	-3.30E-08
Yultotal	-1.70E-07
seat load	3323.4778
stem force	1365.7553
Fpiston	2672.557
Fvert	1499.4664
Fpreslock	2731.5106
Ftotal	**10504.42**

Input Data

ODseat(in)	C2	3.378	OD of valve seat		
IDseat(in)	C3	2.278	ID of valve seat		
a(in)	C4	1.414	mean seat radius		
b(in)	C5	0.871	wedge hub radius	E	27600000
Pup(psig)	C6	179.000	Pressure upstream	t	0.8285
Pdn(psig)	C7	0.000	Pressure downstream		
Pbonnet(psig)	C8	2786.000	Pressure in valve bonnet		
V	C9	0.300	Poisson's ratio for C.S.		
Theta	C10	5.000	Wedge Seat Angle		
Mu	C11	0.500	Plate Friction coefficient for Stellite		
SD	C12	1.125	Stem Diameter		

Calculated values for use in formula

a/b	C15	1.623			D	1437354.8
b/a	C16	0.616			G	10615385
@LN(A/B)	C17	0.485			DPavg	2696.5
(B/A)^2	C18	0.379			Mrba	6887.2708
(1-V)	C19	0.700			Mrbb	0.0734805
(1+V)	C20	1.300			Mrb	-506.0802
(B/A)^4	C21	0.144			Ybqpr	-2.23E-05
Hub Area(in2)	C22	2.383			Ksapr	-0.104552
Hub Circ.(in)	C23	5.473	HUBlength	0.489	Ysqpr	-6.41E-05
Dp(psi)(dn-up)	C24	-179.000	A^4	3.997584	Pforce	10505.485
V^2		0.09	A^3	2.827146	Ystretch	-3.91E-05
A^2		1.999396	B^2	0.758641	Yprtotal	-0.000125

Calculations

C2	0.063216			Ybw	-4.38E-08
C3	0.007364			Ksaul	-0.581443
C8	0.782802			Ysaul	-9.35E-08
C9	0.260898			Ycompr	-3.30E-08
				Yultotal	-1.70E-07
L11	0.000751	L3	0		
L17	0.057939	L9	0	seat load	6543.8174
				stem force	2689.1268
Qb(lb/in)	1920.606			Fpiston	2767.9345
				Fvert	2952.3995
Measured unwedging Load (lbf)				Fpreslock	5378.2537
	9790			**Ftotal**	**15352.719**

Input Data

ODseat(in)	C2	13.500	OD of valve seat
IDseat(in)	C3	11.620	ID of valve seat
a(in)	C4	6.290	mean seat radius
b(in)	C5	2.560	wedge hub radius
Pup(psig)	C6	39.000	Pressure upstream
Pdn(psig)	C7	49.000	Pressure downstream
Pbonnet(psig)	C8	50.000	Pressure in valve bonnet
V	C9	0.300	Poisson's ratio for C.S.
Theta	C10	7.000	Wedge Seat Angle
Mu	C11	0.500	Plate Friction coefficient for Stellite
SD	C12	2.000	Stem Diameter

E	27600000
t	2.59

Calculated values for use in formula

a/b	C15	2.457		
b/a	C16	0.407		
@LN(A/B)	C17	0.899		
(B/A)^2	C18	0.166		
(1-V)	C19	0.700		
(1+V)	C20	1.300		
(B/A)^4	C21	0.027		
Hub Area(in2)	C22	20.589		
Hub Circ.(in)	C23	16.085	HUBlength	0.85
Dp(psi)(dn-up)	C24	10.000	A^4	1565.318
V^2		0.09	A^3	248.8582
A^2		39.5641	B^2	6.5536

Calculations

C2	0.134135		
C3	0.021724		
C8	0.707976		
C9	0.297242		
L11	0.003679	L3 =	0
L17	0.117644	L9=	0

Qb(lb/in) 38.684

Measured unwedging Load (lbf)

20000

D	43912255
G	10615385
DPavg	6
Mrba	335.30045
Mrbb	0.1870338
Mrb	-62.71252
Ybqpr	-3.60E-06
Ksapr	-0.289066
Ysqpr	-2.50E-06
Pforce	621.91782
Ystretch	-4.65E-07
Yprtotal	-6.56E-06
Ybw	-4.82E-07
Ksaul	-1.078745
Ysaul	-2.47E-07
Ycompr	-2.96E-08
Yultotal	-7.58E-07
seat load	342.08171
stem force	128.07667
Fpiston	157
Fvert	181.77196
Fpreslock	256.15334
Ftotal	**20280.925**

SECTION IV

Sample Evaluations for Pressure Locking and Thermal Binding

This section includes sample evaluations for representative valves screened as part of the susceptibility determination process. A separate evaluation was completed for each identified valve grouping (see listing in Section I). The group evaluations utilized operational and physical data representative of the most susceptible valve within the group. Therefore, the use of a single group evaluations, in lieu of individual valve evaluations, is deemed appropriate.

GL 95-07 EVALUATION SHEET

GROUP 02

System: E21 (HHSI/CVCS) **Valves:** Q(1)2E21MOV8801A/B (V0004A/B) **Revision: 1**

Valve Function: BORON INJECTION TANK OUTLET VALVE

Valve Manufacturer: VELAN

Valve Type: 3" FLEX WEDGE GATE

Normal Position: CLOSED **Post Accident Position:** OPEN/CLOSE/OPEN

Does valve need to open to perform safety function? Yes ■ No ☐
If Yes, what mode(s): SI SIGNAL; SWITCH OVER FROM HOT LEG TO COLD LEG RECIRC.

Design Fluid Temp:	650	°F	**Press:**	N/A	**PSIG**
Service Fluid Temp:	280	°F	**Press:**	N/A	**PSIG**
Post Accident Fluid Temp:	200	°F	**Press:**	N/A	**PSIG**
Normal Atmosphere Temp:	110	°F	**Press:**	N/A	**PSIG**
Operating Atmosphere Temp:	N/A	°F	**Press:**	N/A	**PSIG**
Post Accident Atmosphere Temp:	104	°F	**Press:**	N/A	**PSIG**

Location: AB, EL. 121', ROOM 223 (2223)
Normal distance from heat source: SEE EXPANDED EVALUATION.
Post accident distance from heat sources: SEE EXPANDED EVALUATION.

Valve Inservice Testing: FNP-1(2)-M-046 (M071)
Frequency of IST: QUARTERLY

System Functional Testing: FNP-1(2)-M-046 (M071)
Frequency of Functional Test: QUARTERLY/REFUELING

References: P&ID D-175038-1 D-205038-1 **Physical/ISO:** D-175367/D-205367
Valve Drawing: U-169426/ U-217804 **Physical/ISO:**
Other Information: SEE EXPANDED EVALUATION AND SECTION VI FOR ADDITIONAL REFERENCES.

Valve susceptible to thermal binding: Yes ■ NO ☐ **Accept. Criteria** SEE EX. EVAL.
Valve susceptible to pressure lock: Yes ■ NO ☐ **Accept. Criteria** SEE EX. EVAL.

Condition under which valve is susceptible: SEE EXPANDED EVALUATION.

Proposed fixes: SEE EXPANDED EVALUATION.

D. L. Daniels — ORIGINATOR — 2/6/96 DATE

J. L. Bellew — REVIEWER — 2/6/96 DATE

GL 95-07

EXPANDED EVALUATION

FOR

PRESSURE LOCKING & THERMAL BINDING

Valve TPNS No. : **<u>Q1(2)E21MOV8801A/B</u>** **Revision: 1**

An initial review for these MOVs, using the design data obtained from the line list specification (SS-1109-2) and comparing the values to the established screening criteria, identifies a potential susceptibility to the thermal binding/pressure locking phenomena. A further evaluation is required using operational data more representative of those occurring during both normal and accident conditions. The results of this further evaluation are provided below.

Physical Information:

These valves are located in the BIT outlet high head safety injection line to the RCS cold leg. The valves are aligned in closed position during normal plant operations. The piping (3" CCB-21) is insulated from the charging pump discharge header to the valve. The valves are located approximately 50 feet from the charging pump discharge header. The downstream piping connects to the RCS cold leg piping approximately 92 feet from the valves. There are double isolation check valves (8997A, B, C & 8998A, B, C) located downstream of these valves prior to the RCS.

The valves are located in the 121' Piping Penetration room in the Aux. Bldg. The normal expected temperature ranges for this room is 93 ^{0}F to 124 ^{0}F (based on unit 2 room temperatures).

Normal Operating:

These valves are aligned in the closed position during normal operations. Since these valves are isolated by check valves from the reactor coolant system (RCS), it is assumed the valve bonnet can be pressurized by the back leakage from the RCS. Normal operations do not require manipulation of these valves. Surveillance stroke testing for these MOVs are conducted quarterly (FNP-1(2)-STP-10.3).

Valve TPNS No. : Q1(2)E21MOV8801A/B **Revision: 1**

Accident Conditions:

The subject valves are automatically stroked open upon receipt of a safety injection (SI) signal to align the discharge of the HHSI pump to the RCS cold leg. The valves remain open during cold leg recirculation phase (FNP-1(2)-ESP-1.3). During switch over to hot leg recirculation (FNP-1(2)-ESP-1.4) the operator will perform manual realignment to close these valves. The associated train charging pump is restarted after the valves are closed. During transfer back to cold leg recirculation (FNP-1(2)-ESP-1.5), these valves are re-opened. Procedurally, prior to re-opening the valves the residual heat removal pump is running and the associated train charging pump is stopped. Once the valves are re-opened, the charging pump is started.

Pressure Locking:

- Hydraulic Locking

Hydraulic locking of MOV8801A can potentially occur following a large break LOCA concurrent with LOSP. Under this scenario, the upstream and downstream piping can de-pressurize causing pressure to be trapped in the valve bonnet. Based on a review of SCS calculation (SM-95-981-001, Rev.0), the maximum expected pressure that may be trapped in the bonnet is 2,581 psig with zero upstream and downstream pressures. As a result of the above assessment, the MOV may be susceptible to a pressure locking event (double disk drag). An evaluation has been performed using both the Commonwealth Edison (Com Ed) and Entergy methods to predict the required opening thrust. Based on a review of the results using the two mathematical methods, the Com Ed equation predicted the higher thrust requirement of 11,703 lbf. A further assessment is provided to determine if sufficient actuator thrust capability is available to overcome this predicted value. Based on a review of SCS calculation (SM-95-981-001, Rev. 0), the actuator's thrust capability for LOCA voltage condition resulted in a calculated thrust of 16,631 lbf. This reduced voltage thrust value is calculated using the worst case voltages and statistical average stem factors for the group. Based on a comparison of the predicted thrust from the Com Ed equation and the reduced voltage capability, the MOV will open under the assumed worst case pressure locking condition.

- Boiler Effect

Bonnet pressure increases due to internal and/or external heating of the trapped fluids is not expected to occur. MOV8801A/B are cold trapped during normal operation due to the piping separation between the valves and the charging pump header upstream and the RCS piping downstream. Additionally, the normal room temperature variations are expected to occur slowly over a significant period of time and, therefore, is not considered an initiator for pressure locking. Therefore, the valves should not be subjected to pressure locking via the boiler effect.

Valve TPNS No. : Q1(2)E21MOV8801A/B **Revision: 1**

Thermal Binding:

Thermal binding is not considered credible for these MOVs. The valves are routinely cycled during normal operation with the process temperature below 150 °F. As a result of the cold trap during the cycling between the cold and hot leg recirculation any change in process fluid would be moderated.

Summary:

Based on the above evaluation, a condition may exist where a hydraulic locking event could occur. However, based on surveillance testing conducted during normal operation a pressure locking event is not expected to occur. No further action is required.

G. L. Daniels — ORIGINATOR — DATE: 2/6/96

R. L. Ballew — REVIEWER — DATE: 2/6/96

GL 95-07 EVALUATION SHEET

GROUP 05

System: RHR/LHSI **Valve(s):** Q2E11MOV8811A(V025A) REV.1

Valve Function: RHR PUMP SUCTION FROM CTMT SUMP

Valve Manufacturer: WESTINGHOUSE ELECTRIC

Valve Type: 14"- FLEXIBLE WEDGE GATE

Normal Position: CLOSED **Post Accident Position:** OPEN

Does valve need to open to perform safety function? Yes ■ No ☐
If Yes, what mode(s): TRANSFER FROM INJECTION TO COLD LEG RECIRC

Design Fluid Temp: HCB-46/ECB-7	300/400	°F	**Press:**	N/A	**PSIG**
Service Fluid Temp:	350	°F	**Press:**	N/A	**PSIG**
Post Accident Fluid Temp:	300≤	°F	**Press:**	N/A	**PSIG**
Normal Atmosphere Temp:	90-104	°F	**Press:**	N/A	**PSIG**
Operating Atmosphere Temp:	90-104	°F	**Press:**	N/A	**PSIG**
Post Accident Atmosphere Temp:	104	°F	**Press:**	N/A	**PSIG**

Location: AB 77'EL. , RM 2131
Normal distance from heat source: N/A
Post accident distance from heat sources: APPROXIMATELY 10 FT

Valve Inservice Testing: FNP-2-M-071
Frequency of IST: QUARTERLY

System Functional Testing: FNP-2-M-071
Frequency of Functional Test: QUARTERLY

References: P&ID D-205038,2/3 **Physical/ISO:** D-205366
Valve Drawing: U-278948 **Physical/ISO:**
Other Information: SEE EXPANDED EVALUATION AND SECTION VI FOR ADDITIONAL REFERENCES
FSAR APPENDIX 3K, FSAR TABLE T-15.4-3;

Valve susceptible to thermal binding: Yes ■ NO ☐ **Accept. Criteria** SEE EX. EVAL.

Valve susceptible to pressure lock: Yes ■ NO ☐ **Accept. Criteria** SEE EX. EVAL.

Condition under which valve is susceptible: SEE EXPANDED EVALUATION

Proposed fixes: SEE EXPANDED EVALUATION

[signature] 2/6/96
ORIGINATOR DATE

G. L. Daniels 2/6/96
REVIEWER DATE

GL 95-07

EXPANDED EVALUATION

FOR

PRESSURE LOCKING & THERMAL BINDING

Valve No: Q2E11MOV8811A **Revision:** 1

An initial evaluation for this power operated valve, using design data obtained from the FNP line list (Specification SS-1109-02) and comparing these values to the established screening criteria, identifies a potential susceptibility to the thermal binding and pressure locking (PLTB) phenomena. Further evaluation has been performed using operational data more representative of those conditions occurring during normal and accident conditions. The results of this evaluation are provided below.

Physical Information:

This is a motor operated gate valve (MOV) with a flexible wedge disc. This valve is located in the RHR pump suction from the containment sump piping. It is the first isolation valve from the containment sump to the RHRS. There is a 2 ft. dead leg of fluid in the vertical pipe leaving the sump to this valve. The valve is encapsulated. The valve is normally closed during plant operation.

The valve is located in room 2131, elevation 77' of the auxiliary building. The normal expected room temperature ranges between 90-104°F. The post accident temperature is expected to be approximately 104°F. Following an accident, the maximum containment sump fluid temperature is approximately 300°F.

Normal Operation:

This MOV is normally closed. Normal plant operations do not require manipulation of this valve. The valve is cycled during quarterly surveillance testing of the RHR system valves. The valve remains closed during RHR pump quarterly testing. Therefore, the fluid in the pipe and valve bonnet are assumed to be approximately equal to the room ambient air temperature.

Accident Conditions:

This valve does not receive a signal to open or close upon initial "SI" initiation. During the safety injection phase, the RHR suction fluid temperature ranges between 35-104°F. Since there is a large dead leg of fluid between the connection for the supply from the containment sump and the supply from the RWST, the valve temperature will remain relatively stable.

During an accident, this valve is opened by operator action following a low RWST level alarm or is opened automatically on a low-low RWST level signal.

Pressure Locking:

*** Hydraulic Locking**

During initial system alignments following refueling or cold shutdown the RHR pump suction piping is pressurized by the RCS through the hot leg connection. The 8811A valve is isolated from this pressure by a solid wedge gate valve. Upon isolation of the RHR system, the pressure decays in the RHR pump suction piping due to alignment to the RWST. The resulting pressure will correspond to the RWST head resulting from the system alignment to the RWST. Administrative procedures require relieving the potential high pressure downstream of isolation valve 8812A prior to stroking the 8811A valve for surveillance tests. The pressure assumed to be trapped in the bonnet during establishment of the 2 ft dead leg to the containment sump and after quarterly testing is the RWST head considering a full tank.

After an "SI" initiation with the containment at atmospheric pressure, the total required thrust at valve opening for transfer from injection to cold leg recirculation using the Commonwealth Edison (ComEd) model is 20,280 lbf. This thrust requirement is well within the valve actuator capabilities of 40,376 lbf. This actuator thrust capability is calculated using the worst case voltages and an average stem factor.

*** Boiler Effect**

Bonnet pressure increases due to internal and external heating of the trapped fluid in the bonnet is not expected to occur. The temperature of the fluid in the bonnet will remain relatively constant during quarterly testing. During an accident, the valve will not be exposed to nominal room temperatures appreciably above normal operating conditions. Temperatures of the fluid at valve MOV8811A will remain steady during the injection phase due to the insulating qualities of the upstream and downstream fluid. The fluid and subsequent valve temperature will elevate after the valve has been opened for cold leg recirculation.

Thermal Binding:

Thermal binding is not considered credible since during surveillance testing the room ambient temperature and the fluid temperature are below 150°F. This value is the threshold below which thermal considerations of pipe and piping system components are considered insignificant. Also, after the valve is opened for cold leg recirculation the valve will not be closed and reopened during an accident.

Valve No: Q2E11MOV8811A Revision: 1

Summary:

Based on the above evaluation, a condition does exist where the pressure locking phenomena could potentially exist. However, the required thrust to overcome the additional bonnet pressure is well within the capability of the operator. No further action is required.

T. L. Ballew	2/6/96
ORIGINATOR	DATE
D. L. Dominick	2/6/96
REVIEWER	DATE

GL 95-07 EVALUATION SHEET

GROUP 20

System: B13 (RCS) **Valves:** Q1(2)B13MOV8000A/B(V027A/B) REV.0

Valve Function: PRZR PORV BLOCK VALVE

Valve Manufacturer: VELAN

Valve Type: 3" FLEXIBLE WEDGE GATE

Normal Position: OPEN **Post Accident Position:** OPEN

Does valve need to open to perform safety function? Yes ☐ No ■

If Yes, what mode(s):

Design Fluid Temp: CCA-20	680	oF	**Press:**	N/A	**PSIG**
Service Fluid Temp:	650	oF	**Press:**	N/A	**PSIG**
Post Accident Fluid Temp:	N/A	oF	**Press:**	N/A	**PSIG**
Normal Atmosphere Temp:	N/A	oF	**Press:**	N/A	**PSIG**
Operating Atmosphere Temp:	N/A	oF	**Press:**	N/A	**PSIG**
Post Accident Atmosphere Temp:	N/A	oF	**Press:**	N/A	**PSIG**

Location:

Normal distance from heat source:

Post accident distance from heat sources:

Valve Inservice Testing: FNP-1(2)-M-046 (M071)

Frequency of IST: QUARTERLY

System Functional Testing:

Frequency of Functional Test:

References: P&ID D-175037-2, D205037-2 **Physical/ISO:**

Valve Drawing: U-266490, U-280770 **Physical/ISO:**

Other Information: THE BLOCK VALVE WILL ONLY BE CLOSED TO PROTECT AGAINST RCS DEPRESSURIZATION OR OVER FILLING THE PRT (OR SURVEILLANCE TESTING). SINCE THE UPSTREAM PRESSURE WILL BE GREATER THAN OR EQUAL TO THE BONNET PRESSURE, THE ACTUATOR WILL PROVIDE THE REQUIRED FORCE TO OPEN THE VALVE. PRESSURE LOCKING IS NOT CREDIBLE.

Valve susceptible to thermal binding: Yes ☐ NO ■ **Accept. Criteria** B-2

Valve susceptible to pressure lock: Yes ☐ NO ■ **Accept. Criteria** B-2

Condition under which valve is susceptible: THERMAL BINDING MAY OCCUR IF THE VALVE IS CLOSED AFTER SYSTEM IS AT OPERATING TEMPERATURE AND THE PRESSURIZER IS COOLED DOWN AT ITS MAXIMUM RATE OF 200°F/HR.

Proposed fixes: THERE IS NO OPERATIONAL REQUIREMENT TO REOPEN THIS VALVE AFTER CLOSING OTHER THAN FOR SURVEILLANCE TESTING. THEREFORE, NO ADMINISTRATIVE ACTION OR MODIFICATION IS REQUIRED.

A.R. Ballew
ORIGINATOR

2/6/96
DATE

H.L. Daniel
REVIEWER

2/6/96
DATE

GL 95-07 EVALUATION SHEET

GROUP 21

System: E11 (RHR/LHSI) **Valves:** Q1(2)E11MOV8701A/B,8702A/B REV:0 (V001A,016A,001B,016B)

Valve Function: RCS LOOP TO RHR PUMP SUCTION ISO & RHR PUMP SUCTION ISO

Valve Manufacturer: COPES-VULCAN INC.

Valve Type: 12" FLEXIBLE WEDGE GATE

Normal Position: CLOSED **Post Accident Position:** CLOSED

Does valve need to open to perform safety function? Yes ☐ No ■

If Yes, what mode(s):

Design Fluid Temp: ECB-13,14	400	°F	**Press:**	N/A	**PSIG**
Service Fluid Temp:	350	°F	**Press:**	N/A	**PSIG**
Post Accident Fluid Temp:	N/A	°F	**Press:**	N/A	**PSIG**
Normal Atmosphere Temp:	N/A	°F	**Press:**	N/A	**PSIG**
Operating Atmosphere Temp:	N/A	°F	**Press:**	N/A	**PSIG**
Post Accident Atmosphere Temp:	N/A	°F	**Press:**	N/A	**PSIG**

Location:

Normal distance from heat source:

Post accident distance from heat sources:

Valve Inservice Testing: FNP-1(2)-M-046 (M071)

Frequency of IST: COLD SHUTDOWN / REFUELING

System Functional Testing:

Frequency of Functional Test:

References: P&ID D-175041-1, D-205041-1 **Physical/ISO:**

Valve Drawing: U-167460, U-214167 **Physical/ISO:**

Comments: THESE VALVES HAVE NO ACTIVE SAFETY FUNCTION. THEY REMAIN CLOSED DURING NORMAL OPERATION AND REMAIN CLOSED DURING LICENSING BASES EVENTS.

Valve susceptible to thermal binding: Yes ☐ NO ■ Accept. Criteria B-2

Valve susceptible to pressure lock: Yes ☐ NO ■ Accept. Criteria B-2

Condition under which valve is susceptible:

Proposed fixes:

[signature] 2/6/96

ORIGINATOR DATE

[signature] 2/6/96

REVIEWER DATE