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SUBJECT: Forwards response to NRC 980626 RAI re analysis to evaluate effects of one svc water pump available - post-LOCA.

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Vice President
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November 4, 1998

U.S. Nuclear Regulatory Commission
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Attn: Guy Vissing
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Washington, D.C. 20555

Subject: Response to Request for Additional Information (RAI) Related to the Effects of One Service Water Pump Available - Post-Loss-of-Coolant Accident (TAC No. M84947)
R. E. Ginna Nuclear Power Plant
Docket No. 50-244

Ref. (1): Letter from Guy S. Vissing (NRC) to Robert C. Mecredy (RG&E), SUBJECT: REQUEST FOR ADDITIONAL INFORMATION (RAI) RELATED TO THE ANALYSIS TO EVALUATE THE EFFECTS OF ONE SERVICE WATER PUMP AVAILABLE - POST-LOSS-OF-COOLANT ACCIDENT (TAC NO. M84947), dated June 26, 1998

Dear Mr. Vissing:

By Reference 1, the NRC staff requested additional information to evaluate the effects of One Service Water Pump Available - Post-Loss-of-Coolant Accident. The attachment to this letter provides the requested information.

Very truly yours,

Robert C. Mecredy

A001

Attachment

Subscribed and sworn to before me
on this 4th day of November, 1998

Christina K Sardou
Notary Public

CHRISTINA K. SARDOU
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U.S. NRC Ginna Senior Resident Inspector

RG&E RESPONSE TO NRC 6-26-98 RAI

Summary of Past Correspondence:

As a result of the Ginna Service Water System Operational Performance Inspection (SWSOPI) conducted by the NRC from December 2 through 20, 1991, the Inspection Team identified a concern with the existing Ginna Technical Specifications that would allow continuous plant operation with only two of four Service Water (SW) Pumps operable. This was identified as Deficiency No. 91-201-08 in the Inspection Report issued to RG&E by Reference 1. Since the design basis for Ginna described in the UFSAR following a LOCA was based upon the availability of one SW Pump during the injection phase of a LOCA and the availability of two SW Pumps during the recirculation phase of a LOCA, the Inspection Team expressed a concern that the failure of one of the two operable SW Pumps following a LOCA would prevent the plant from establishing the necessary SW flow required during the recirculation phase of a LOCA if only one SW Pump was available.

To address this issue, RG&E in Reference 2 submitted preliminary results related to the impact of one SW Pump availability during the recirculation phase of a LOCA. Since the major loads cooled by the SW System in the LOCA recirculation mode are the Containment Recirculating Fan Coolers (CRFCs) and the Component Cooling Water (CCW) Heat Exchangers, the preliminary results investigated the impact of the reduced SW flow during the recirculation phase on the containment transient response. Since peak containment pressures and temperatures for a LOCA occur prior to entering the recirculation phase of a LOCA, the reduced SW flow available to SW components following re-establishment of SW flow to the CCW Heat Exchangers during the recirculation phase primarily affects the long term cooling and de-pressurization of containment and hence the equipment qualification profile. The preliminary results for one SW Pump reported in Reference 2 stated that the changes in the containment pressure and temperature response due to reduced SW flows were still bounded by the containment pressure and temperature profiles used for the Ginna Environmental Qualification (EQ) Program.

The preliminary results provide in Reference 2 related to the operation of one SW Pump during the recirculation phase of a LOCA were finalized by RG&E in its 9-1-92 submittal (Reference 3) to the NRC. The Reference 3 submittal included the containment pressure and temperature transient response obtained as a result of the availability of only one SW pump during the LOCA recirculation phase. Additionally, it compared the resulting containment pressure and temperature transient with the EQ pressure/temperature profiles used for equipment qualification purposes. Consequently, with the Reference 3 submittal RG&E addressed the original concern expressed in Reference 1 related to the ability to maintain long term cooling of containment with one operable SW Pump during the recirculation phase of LOCA.

Subsequent to the Reference 3 submittal, a request for additional information was transmitted to RG&E by Reference 4 related to various Ginna SWSOPI issues. As part of this

transmittal RG&E was requested to provide component specific information related to one SW pump operation and a schematic listing SW flow distribution during the recirculation phase of a LOCA. RG&E was also requested to provide information related to the adequacy of one SW pump operation following other accident scenarios (e.g. steam line break, SGTR and Appendix R). RG&E submitted the required information in its response of 7-27-93 (Reference 5) to address these other accident scenarios and identify the bounding cases.

Subsequent to the Reference 5 submittal, during a phone conversation with the NRC on 11-16-93, the NRC asked three additional questions related to the one SW pump operation scenario. The additional questions related to one SW Pump flow following a loss of off-site power without Safety Injection (non-LOCA) and also following a seismic event with a complete severance of a 10" SW header line. RG&E responded to these additional scenarios in its 3-30-94 submittal (Reference 6). This submittal provided SW flow distributions assuming no isolation of safety related loads following a LOOP. It also provided a discussion of the range in SW Pump flows that could be expected following a seismic event for both a design basis critical crack in the moderate energy SW piping and a beyond design basis severance of the 10" SW header requested by the NRC.

Finally, additional NRC questions related to this issue were identified during an NRC Site Inspection on the spent fuel pool cooling system in the summer of 1995 and a subsequent follow-up phone conversation. RG&E in Reference 7 responded to the two specific areas identified by the NRC.

Based upon the various requests for additional information received from the NRC between the original SWSOPI inspection in December of 1991 and the 11-16-93 phone conversation, RG&E has performed multiple evaluations of one SW Pump operation for a wide variety of plant conditions as documented in References 2, 3, 5-7. From a review of this information, the two limiting conditions associated with one SW Pump operations are:

- 1 SW Pump operation in the Recirculation Phase of a LOCA
- 1 SW Pump operation following a LOOP w/o SI initiation

Although the 3-30-94 submittal identified that a complete severance of the 10" SW header could result in SW Pump run-out flows beyond 8000 gpm, this condition is outside the existing design basis for the Ginna plant and the regulatory guidance specified in Standard Review Plan Sections 3.6.1 and 3.6.2. Consequently, the limiting design basis condition for SW Pump run-out occurs for the LOOP w/o SI initiation since it requires the operating SW pump to supply both safety related and non-safety related SW loads. However, since the initiating event does not involve an actuation of ECCS equipment, the only safety related component of interest for this scenario besides the SW Pump is the Emergency Diesel Generators (EDGs). Additionally, since the EDG load for a LOOP w/o SI scenario is significantly lower than the EDG design loading, the amount of SW flow required to cool the EDGs is significantly lower than the design EDG SW flow as discussed in Reference 6.

Although the 1 SW Pump flow during the recirculation phase of a LOCA is not a bounding case for pump run-out, it does represent a bounding case for reduced flow to various safety-related components that require SW flow during the recirculation phase of a LOCA. Consequently, it has been evaluated for the impact of reduced flows upon safety related component performance and long term cooling capability of the containment post-LOCA. Results for this scenario have been submitted to the NRC in Reference 2, 3, 5-7.

Since the initial NRC request in December 1991 for information related to SW System flows with one operating SW Pump, a number of modifications have been made to the Ginna SW System to improved its overall reliability. These modification have included replacement of the original CRFCs, re-tubing of the EDG coolers, replacement of the SW Pump motors, replacement of the CRFC fan motor coolers, replacement/refurbishment of the SW System motor operated isolation valves and replacement of various sections of piping. Additionally, periodic inspections and back flushing of various sections of the SW System piping have been performed to prevent plugging and silting of piping that would affect the SW System hydraulic resistance. Finally, other modifications to the SW System are either in-progress (up-grading the SW Pump impeller materials) or are planned (re-tubing the CCW Heat Exchangers). In support of the SW pump impeller replacement activity, testing of the original and the replacement SW pump impellers was conducted in August and October of this year to confirm the performance of the SW pump during and after runout conditions.

All of these activities have or will affect the hydraulic resistance and functional capability of SW system components. Consequently, RG&E has revised its hydraulic model of the SW System to incorporate these changes to the SW System as well as to include the latest SW System operational testing information. Using the revised hydraulic model, RG&E has re-analyzed the SW System flow capability for the two bounding one SW Pump operation cases identified during all of the past evaluations. The SW flow distribution results of these re-analyses are summarized in the attached responses for Question 1-8 as requested by Reference 8.

References:

1) NRC Letter, S. A. Varga (NRC) to Dr. R. C. Mecredy (RG&E), "Service Water System Operational Performance Inspection (50-244/91-201)", 1-30-92
2) RG&E Letter, R. C. Mecredy (RG&E) to S. A. Varga (NRC), "Response to NRC Service Water System Operational Performance Inspection (SWSOPI) of the R. E. Ginna Nuclear Power Plant (50-244/91-201)", 4-6-92
3) RG&E Letter, R. C. Mecredy (RG&E) to S. A. Varga (NRC), "Response to Additional Questions on Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 9-21-92
4) NRC Letter, A. R. Johnson (NRC) to Dr. R. C. Mecredy (RG&E), "Request for Additional Information Re: R. E. Ginna Nuclear Power Plant - Service Water System - Rochester Gas & Electric Corporations's Responses to Deficiencies Identified in NRC Report 50-244/91-201), January 30, 1992 (TAC No. M84947)", 5-24-93

5) RG&E Letter, R. C. Mecredy (RG&E) to A. R. Johnson (NRC), "Additional Information - Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 7-27-93
6) RG&E Letter, R. C. Mecredy (RG&E) to A. R. Johnson (NRC), "Additional Information - Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 3-30-94
7) RG&E Letter, R. C. Mecredy (RG&E) to A. R. Johnson (NRC), "Response to Additional Questions on Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 9-21-95
8) NRC Letter, G. S. Vissing (NRC) to Dr. R. C. Mecredy (RG&E), "Request for Additional Information RAI) Related to the Analysis to Evaluate the Effects of One Service Water Pump Available - Post-Loss-of-Coolant Accident (TAC No. M84947)", 6-26-98

QUESTION 1:

The bounding maximum flow case for single service water (SW) pump operation has not been clearly defined. What is the maximum flow case for one SW pump?

a. *Describe the maximum flow case. This case is not limited to Chapter 15 events.*

The two bounding one Service Water (SW) Pump flow scenarios identified by RG&E are:

Case A - One SW Pump operation during the LOCA Recirculation Phase
Case B - One SW Pump operation following a reactor trip w/LOOP (non-LOCA)

Case A evaluates the design basis LOCA condition assuming that only one SW Pump instead of the two assumed by the UFSAR is available during the Recirculation Phase of a LOCA. Since the non-safety related SW loads have been isolated by the SI actuation, this case does not represent a bounding condition for maximum SW Pump flow. However, this case results in less long term cooling of containment due to the reduction in SW flow to the Containment Recirculating Fan Coolers (CRFCs) and the Component Cooling Water (CCW) Heat Exchangers in the Recirculation Phase. The flows to these components are below their nominal design flows which results in reduced heat rejection to the Ginna ultimate heat sink during the Recirculation Phase of the LOCA. Additionally, reduced SW flow to the Emergency Diesel Generators (EDGs) also occurs for this scenario. Consequently, the major concerns related to this scenario are long term containment cooling capability and EDG cooling.

The Case B scenario results in the maximum SW Pump flow which needs to be evaluated for its effect on pump operability. The purpose of this limiting case is to ensure that the SW Pump is not damaged prior to manual actions to isolate non-essential SW loads. Also, since this is a non-LOCA scenario with LOOP, the adequacy of SW cooling to the EDGs is also evaluated. Due to Case B being a non-LOCA scenario, the corresponding EDG loading for assessing SW cooling adequacy is appreciably lower than the EDG LOCA design basis loading.

b. *State all assumptions and conditions used. Include in your discussion (but do not limit your discussion to) the consideration of pump degradation and ultimate heat sink temperature and level. State whether each condition or assumption used is conservative and why.*

Case A

Consistent with past submittals, the SW flow distribution for this accident has been analyzed by use of the KYPIPE code. The hydraulic model used incorporates the present hydraulic resistance of the SW system based upon the present SW System configuration and the latest plant test data on the actual hydraulic resistance of the major SW System components.

Additionally, for conservatism the SW piping hydraulic resistance was based upon pipe roughness for piping exposed to water conditions for forty years. The minimum expected lake level along with the minimum SW Pump performance allowed by the ISI program for pump operability have been used to minimize flow to the functioning safety related components. A maximum lake temperature of 85°F is also assumed in the hydraulic model consistent with the lake temperature used for assessing long term containment cooling and EDG cooling capability. This minimizes the SW cooling capability for cooling both containment and the EDGs. The SW configuration assumed for the LOCA recirculation phase is consistent with the present instructions specified in Emergency Procedure ES-1.3 (Reference 1) for one available SW Pump during transfer to Cold Leg Recirculation. Consequently, SW flow is only re-established to one CCW Heat Exchanger. Additionally, all LOCA non-essential loads are manually isolated by Operations as explained in the Question 6 response. The SW flow distribution calculated by KYPIPE for this scenario (Reference 12) are summarized on Figure 1.

Case B

This case uses the same KYPIPE SW hydraulic model utilized for Case A described above. The two major concerns associated with this case are functionality of the SW Pumps at runout conditions and adequacy of SW flow to the operating EDGs following the LOOP condition. The maximum SW pump flow would occur with a non-degraded SW pump curve and maximum lake level; however, these assumptions maximize flow to the EDGs and therefore, are non-conservative for evaluating the functionality of the EDG for the limiting non-LOCA scenario. Consequently, the functionality of both components are evaluated separately.

The maximum reliable SW Pump flow represents the limiting SW flow that would be expected to occur when the pump available NPSH equals the minimum required pump NPSH curve. In the Reference 7 response, this flow condition was estimated to be approximately 8300 gpm. Based upon recently performed pump testing on an existing Ginna SW Pump, this flow is now estimated to be approximately 7600-7700 gpm. Since the SW Pump would only be expected to operate at this elevated flow rate for a short time due to existing operator procedural guidance, no appreciable degradation in overall pump performance following a reduction in total SW flow would occur. As discussed in the Question 3 response, recent testing of the SW impeller assembly has confirmed that the SW Pumps can operate at a run-out condition for at least thirty minutes without any degradation in pump performance.

For assessing adequacy of the EDGs under this scenario, assumptions are made to minimize SW flow to the EDGs. Consequently, for this case the degraded SW Pump curve used for Case A is assumed. Additionally, the minimum expected lake level is also assumed to minimize SW flow to the EDGs. Finally, although not significant to the total calculated SW flow, the water density and viscosity used are based upon a maximum expected lake temperature of 85°F.

Since this scenario involves a failure of a SW Pump following a reactor with a LOOP condition and without a concurrent SI actuation, the non-safety related SW loads are not automatically isolated for this case. The availability of the non-safety related SW flow paths results in a significantly reduced SW hydraulic resistance when compared to the Case A configuration. To minimize available flow to the EDGs, the overall SW system hydraulic resistance prior to the LOOP is conservatively based upon assuming a three SW pump normal operating condition prior to the LOOP initiating event. This is representative of summer operating conditions where the minimum overall hydraulic resistance of the SW System would exist. Consequently, the limiting single active failure for this one SW Pump scenario would be the failure of the one EDG associated with two of the three normally operating SW Pumps. This assumption maximizes the SW flow to the non-safety related portions of the SW System thereby minimizing the available SW flow to an operating EDG. The SW flow distribution calculated by KYPIPE for this scenario (Reference 12) for evaluating functionality of the EDGs is summarized on Figure 2.

c. *What components are required (or desired) to be available?*

Case A

For the Recirculation Phase of a LOCA, SW flow must be provided to the following major safety related components to support long term containment cooling/depressurization and cooling of the operating EDGs:

- Two of Four Containment Recirculating Fan Coolers (CRFCs)
- One CCW Heat Exchanger
- Operating EDGs.

Case B

For Case B adequate SW flow must be provided to only the operating EDGs. Since there is no LOCA associated with this scenario, reduction in flow to the Containment Air Coolers, CCW Heat Exchangers and the non-safety related SW loads does not adversely affect maintaining the RCS in a stable Hot Shutdown condition (e.g. RCS at Hot Zero Power (HZP) conditions) immediately following a LOOP initiating event.

d. *What are the controls to isolate all other components? Provide the procedure or reference.*

Case A

Emergency Procedure ES-1.3 (Reference 1) controls all plant operations related to transferring from the Injection Phase to the Recirculation Phase of a LOCA. Specific operator actions required by this procedure are discussed in the response to Question 6.

Case B

For this scenario, the reactor trip with LOOP and without SI would result in causing Operations to enter Emergency Procedure E-0 (Reference 2). Step 4 of E-0 directs Operations to enter Procedure ES-0.1 (Reference 3) for responding to a reactor trip without Safety Injection. Step 5 of ES-0.1 requires Operations to verify that at least two SW Pumps are running; and, to start SW Pumps as necessary if two SW Pumps are not running. Consequently, at this point Operations would be aware that only one SW Pump was available. Additionally, low SW header pressure alarms would be annunciated on the plant computer; and, Control Room Annunciator Alarms for low SW flow to the CRFCs and low CCW Heat Exchanger flow may also be present.

These alarms would direct Operations to perform the activities outlined in AP-SW-1 (Reference 4). Although AP-SW-1 specifically addresses leaks in the SW System, a SW Pump runout condition due to one SW Pump operation would create SW flow and pressure indication similar to that expected from a leak. AP-SW-1 also requires Operations to check the number of operating SW Pumps and verify that at least one SW Pump was operating on each SW loop. If the SW header pressure can not be restored to greater than 45 psig due to the runout of the one available operating SW Pump, then the Alarm Response Procedure directs Operations to perform isolation of non-essential SW loads so as to increase the SW header pressure to the desired value to prevent excessive SW Pump runout. The SW flow paths that can be considered for isolation by Operations are listed in an attachment entitled "Attachment SW Isolation" (Reference 5).

Included in the list of possible flow paths available for isolation are the motor operated valves that are used to isolate the safety related portion of the SW System from the non-safety related portion of the SW System. These valves are capable of being remotely isolated from the Control Room. Therefore, based upon the existing instructions provided to Operations in References 2-5 and the plant computer and annunciator alarms that would be available to the Operators in the Control Room, manual control room isolation of the non-safety related portion of the SW System would occur following a LOOP with reduced SW header pressure. These manual actions would restore the one SW Pump flow to the flow distribution expected for one pump operation during the Injection Phase of an accident; and, would prevent long term operation of the available SW Pump at a near runout condition.

e. *For each functioning component, what is the minimum flow required for adequate cooling?*

Case A

As stated in RG&E's Question 1 Response in Reference 6, for many of the components cooled by the SW System there is no explicit minimum flow requirement for one SW Pump operation. During the Recirculation Phase of a LOCA, the CRFCs and the CCW Heat Exchangers provide long term cooling of the containment and the core. Inadequate SW

cooling of these components would result in the inability to maintain long term containment cooling and depressurization. Consequently, reductions in SW flow to values less than the nominal design values specified in UFSAR Table 9.2-2 can be accommodated if long term containment cooling can still be demonstrated. The criteria used to verify containment cooling is the ability of these components to maintain the post-LOCA containment pressure and temperature profile within the bounds used to perform Equipment Qualification (EQ) of all components located in containment required to be operable following a LOCA.

To demonstrate that sufficient cooling is provided, RG&E used the SW flow results shown on Figure 1 for the LOCA Recirculation Phase to quantify the heat removal capability of the CRFCs and the one operating CCW Heat Exchanger. Using these heat removal characteristics, the design basis LOCA was re-analyzed (Reference 15) to assess the impact of reduced SW flow on the containment long term transient pressure and temperature profile. The resulting containment profile was then compared to the Ginna containment EQ profile. This comparison which is shown in Figure 3 demonstrates that the EQ pressure and temperature profiles are not exceeded following the LOCA. Consequently, although reduced SW flows lengthens the time required to cooldown and de-pressurize containment, adequate long term containment cooldown and de-pressurization is still provided.

For the EDGs during the LOCA Recirculation Phase, Figure 1 indicates that the minimum SW flow to the EDGs is 162 gpm. This is below the EDG design SW flow of 320 gpm listed in UFSAR Table 9.2-2. However, as shown in UFSAR Table 8.3-2 the maximum EDG loading during the LOCA Recirculation Phase is approximately 16 % below the EDG design rating (1631 kw vs 1950 kw). If only one SW Pump was available during the Recirculation Phase of a LOCA, the Table 8.3-2 loading would be reduced by another 243 kw due to having only one SW Pump loaded on the EDG. Consequently, the actual EDG loading for a one SW Pump case would be 1388 kw or approximately 28 % below the EDG design rating.

Due to the reduced EDG Recirculation Phase loading, the actual heat rejected by an operating EDG to its Lube Oil and Jacket Water Coolers is less than the design ratings of the two coolers. Consequently, the required SW flow for cooling the EDG is less than its design value. RG&E has performed an analyses to assess Lube Oil and Jacket Water Cooler performance based upon a reduced SW flow of 162 gpm and a reduced EDG heat load based upon 1425 kw EDG loading. The analysis also assumed a maximum lake temperature of 85°F along with the limiting fouling allowed for the two coolers. The results of the analysis (Reference 14) indicates that the EDG lubricating oil and jacket water inlet temperatures to their respective coolers could still be maintained at a value below the maximum value allowed by the EDG manufacturer for the conditions defined above. Consequently, the reduced SW flow to the EDGs expected during one SW Pump operation in the LOCA Recirculation Phase is sufficient to maintain EDG cooling.

Case B

The only essential components requiring cooling for this scenario are the EDGs. As shown in

Figure 2, the minimum SW flow to the EDGs is approximately 94 gpm which is below the EDG Lube Oil and Jacket Water Cooler design flow of 320 gpm. However, for this condition the actual load on the EDG is also below the EDG continuous operating design loading of 1950 kw. The only major components that would be required to be continuously loaded on a functional EDG immediately following a LOOP condition to maintain the plant in a Hot Shutdown condition (e.g. RCS at HZP conditions) are:

1 SW Pump	-	243 kw
1 CCW Pump	-	122 kw
1 AFW Pump	-	223 kw
2 CRFC Fans	-	206 kw
1 Charging Pump	-	75 kw
MCC Loading	-	123 kw
<u>Misc. Losses</u>	-	<u>35 kw</u>
Total	-	1027 kw

Due to the reduced loading on the EDG, the actual heat load rejected to the Lube Oil and Jacket Water Coolers is well below the design loading for these coolers. Based upon the expected EDG load and information from the EDG vendor relating EDG heat rejection to EDG loading, an analysis was performed to quantify the maximum expected lubricating oil and jacket water inlet temperatures based upon a SW flow of 94 gpm and maximum expected SW inlet temperature. The analysis also assumed that the EDG coolers were operating at their maximum allowed plugging and fouling conditions. This analysis (Reference 14) has determined that both the Lube Oil and Jacket Water Cooler inlet temperatures are below the EDG manufacturer's values of maximum allowed operating temperatures. Consequently, the reduced SW flow available to the EDGs for this scenario provides adequate cooling for continuous operation with the expected EDG loading. Additionally, as noted in Question 1d above, since isolation of non-essential SW loads would be accomplished in a short time period following the LOOP and EDG start-up, SW flow to the EDG would be restored to a value close to its design flow.

f. Demonstrate quantitatively that the flow through each functioning component, given the maximum load expected, is adequate for cooling.

The information requested by this question is included in the RG&E response to Question 1e above.

QUESTION 2:

Provide the <u>vendor's</u> pump curves for each SW pump and any <u>vendor</u> information regarding the operability range for each pump.

RG&E is in the process of replacing the existing bronze SW Pump impellers with new stainless steel impellers to improve SW Pump performance. The manufacturer pump curve

based upon testing for these new stainless steel impellers is provided in Figure 4 along with the degraded pump curve used by the KYPIPE hydraulic model for determining minimum SW System component flows. Additionally, RG&E recently conducted testing of an existing bronze impeller assembly. The tested pump curve for the bronze impeller assembly is also shown on Figure 4.

For the maximum expected one SW Pump flow as evaluated for Case B, the manufacturer has confirmed by testing that the stainless steel impeller assemblies are capable of operating at a flow rate up to approximately 7700 gpm for at least thirty minutes without experiencing any degradation in pump performance due to cavitation. Since the manufacturer's test was performed with a reduced pump submergence when compared to the Ginna installed configuration, the actual maximum pump flow prior to cavitation would be higher than the value observed during the manufacturer's test.

QUESTION 3:

In your letter dated March 30, 1994, you state that the pump flowrate of 7632 gpm (a flowrate near the pump runout flow) is acceptable for short term, non-continuous operation. Explain and/or quantify terms "non-continuous" and "short-term" as you expect to use the one SW pump in this case or in your limiting case. Additionally, provide vendor concurrence regarding the pump's capabilities.

For the Case B scenario for maximum SW flow (with pump degradation) which is comparable to the SW configuration assumed in the Reference 7 response, the maximum expected SW flow rate is estimated to be approximately 7100 gpm with the degraded pump curve for the new pump internals and the latest Ginna hydraulic model. Since this scenario is expected to result in a reduced SW header pressure, Operator action to either start a second SW Pump, if possible, or isolate non-essential SW loads is expected to occur as a result of instructions provided by existing plant procedures (See response to Question 1d). Consequently, this flow condition will not occur indefinitely which is the basis for the terms "non-continuous" and "short term" used originally in the Reference 7 response. Since isolation of the non-safety related loads can be accomplished by operator action from the Control Room by closing motor-operated isolation valves, it is expected that the SW Pump runout flow condition would exist for approximately 10-20 minutes before Operator actions occurred to isolate non-essential SW loads. As discussed in the Question 2 response, recent testing of the new stainless steel impeller assemblies by the pump vendor has confirmed no pump degradation following operation of the pump at a runout condition of 7600-7700 gpm for thirty minutes.

QUESTION 4:

In the response to Question 1, part 3, dated July 27,1993, you state that SW flows assumed in the analysis were those itemized in updated final safety analysis report (UFSAR) Table 9.2-2. You further state that, with the exception of the containment recirculation fan coolers, the

flows in the table can be achieved under either one or two pump operation.

In the UFSAR Table 9.2-2, dated December 1992, the design-basis accident nominal flow for the recirculation phase is 11,635 gpm. This value can be lowered to 10,269 gpm because of the isolation of the spent fuel pool heat exchanger by procedure ES-1.3, Revision 15, and the removal of cooling to the SI and containment spray area coolers. Demonstrate how one SW pump can supply this amount or clarify your previous statements from July 27, 1993 and March 30, 1994 (from Question 3).

The intent of the RG&E response to Question 1, Part 3 provided by Reference 6 was not to infer that one SW Pump operation during the Recirculation Phase of a LOCA is capable of satisfying the component flow values listed in UFSAR Table 9.2-2 of the UFSAR for the Recirculation Phase. UFSAR Table 9.2-2 provides a summary of the component design SW flow values along with the number of components receiving SW flow during the LOCA Recirculation Phase when two SW Pumps are available. The SW flow diagram for the LOCA Recirculation Phase with one SW Pump operation provided in the Reference 6 submittal indicated that the total SW flow would be well below the UFSAR Table 9.2-2 tabulated flow for two SW Pump operation in the recirculation Phase (6542 gpm vs 11635 gpm). The revised flow distribution discussed in Question 1 (see Figure 1) also indicates that total SW flow for the one pump scenario would be less than the nominal values listed in UFSAR Table 9.2-2 for two pump operation.

As discussed in the Question 1 response, one SW pump operation for the LOCA Recirculation Phase results in a reduction in SW flow to the available CRFCs and the one operating CCW Heat Exchanger when compared to the UFSAR Table 9.2-2 nominal values. However, since the resulting heat removal capability of these components still provides adequate long term cooling of containment as discussed above in the Question 1 response, these flow reductions are acceptable. Additionally, the EDGs experience a reduction in SW flow when compared to the UFSAR Table 9.2-2 nominal values. However, the available flow is acceptable due to the reduced loading on the EDG during the Recirculation Phase as discussed in Question 1 above.

The other components that could receive SW flow during the Recirculation Phase of a LOCA as listed in UFSAR Table 9.2-2 are:

- CRFC Fan Motor Coolers
- Reactor Compartment Coolers
- MDAFW Pump Oil Coolers
- TDAFW Pump Oil Coolers
- Spent Fuel Pool Heat Exchanger
- Penetration Cooler
- RHR Pump Area Cooler
- SI Pump Bearing Cooler
- Charging Pump Area Cooler

The Spent Fuel Pool Heat Exchanger would be isolated by ES-1.3 during the transfer to the Recirculation Phase with one SW Pump operations as explained in the response to Question 1d above. Although the CRFC Fan Motor Cooler flows shown on Figure 1 are less than the UFSAR Table 9.2-2 nominal value, they exceed the minimum flow determined by Reference 16 to be required for functionality of these coolers. The Reactor Compartment Coolers, Penetration Coolers and Charging Pump Area Coolers are not required during the LOCA Recirculation Phase; therefore, SW flow to these components is not essential during the LOCA Recirculation Phase. The adequacy of SW flow to the SI Pump Bearing Coolers and the RHR Pump Area Coolers was previously provided by RG&E in Attachment A to Reference 9. SW flow to the TDAFW and MDAFW Pumps is not presently modeled in the SW hydraulic model. Due to the low flows associated with these components (less than 10 gpm), their exclusion from the model has a negligible impact on model prediction of SW flow to the other components. Adequacy of SW flows to these pumps is verified by monitoring for the presence of SW flow to the coolers and bearing housings during initial system alignment and periodic testing of pump operation.

QUESTION 5:

In the current UFSAR, you state that two component cooling water heat exchangers are expected to receive SW flow in the post-LOCA recirculation phase. However, procedure ES-1.3, Revision 15, instructs operators to isolate one CCW heat exchanger and have both CCW Pumps operating. Quantitatively compare the cases when both heat exchangers are operating and when one CCW heat exchanger with two CCW Pumps is operating. Provide any necessary documentation to demonstrate adequate heat removal from the containment sump to the SW system.

For entering the Recirculation Phase of a LOCA with two operating SW pumps, ES-1.3 (Reference 1) requires Operations to un-isolate SW flow to both CCW Heat Exchangers and to adjust total SW flow to the two CCW Heat Exchangers to approximately 5000-6000 gpm. This is accomplished by dispatching Operators to the Auxiliary Building to manually throttle open the CCW Heat Exchanger SW outlet valves. ES-1.3 also requires that the CCW flow be established to both RHR Heat Exchangers. Consequently, even if only one CCW Pump is operating, the design of the Ginna CCW System will result in CCW flow to both CCW and both RHR Heat Exchangers. Therefore, even if only one RHR Heat Exchanger is available to cool the containment sump water, both CCW Heat Exchangers would be available to reject to the ultimate heat sink the heat removed from the RHR Heat Exchanger.

If only one SW Pump is available during the LOCA Recirculation Phase, SW flow will be re-established to only one CCW Heat Exchanger when performing the ES-1.3 transfer to the Recirculation Phase. Additionally, in lieu of locally manually throttling total SW flow to 5000-6000 for two SW Pump operation, the Operators would only throttle one CCW Heat Exchanger SW outlet valve to provide an indicated flow between 2750-3250 gpm so as to prevent SW Pump runout. Therefore, even though CCW flow may still be provided to both

CCW and both RHR Heat Exchangers, only one CCW Heat Exchanger will be available to reject heat to the SW System from the RHR System. This results in a reduction in the heat rejection capability of the combined RHR/CCW/SW Systems when compared to its heat rejection capability when two SW Pumps are available in the LOCA Recirculation Phase. The reduction in heat removal results from both the reduction in total available CCW Heat Exchanger area due to the availability of only one CCW heat Exchanger and from the reduction in total SW flow being provided to absorb heat from the CCW Heat Exchanger. This reduction in Recirculation Phase RHR heat removal capability affects the long term containment transient response during the LOCA Recirculation Phase.

The reduction in RHR heat removal capability was included in the containment analysis results provided by RG&E to the NRC in References 8 and 9 in response to the initial NRC questions on the adequacy of the existing SW Pump Ginna Technical Specification requirements. The reduction in RHR heat removal capability due to the one SW Pump scenario was calculated in 1992 to be approximately 25 % when compared to nominal configuration of SW flow to two CCW Heat Exchangers established by ES-1.3. Recently, the heat removal capability for this configuration was re-analyzed (Reference 13) and was re-confirmed to be approximately 25 % less than the two CCW Heat Exchanger scenario.

The results of this reduction in RHR heat removal capability in combination with the reduction in CRFC heat removal capability in the LOCA Recirculation Phase have been used to re-analyze the long term containment pressure/temperature response. The results of the containment re-analysis provided in Figure 3 are consistent with the results originally provided to the NRC in References 8-9. Specifically, although the long term containment pressure and temperature reduction is slower than that obtained with 2 SW Pumps, the containment profiles are still bounded by the EQ profiles used to qualify components in containment for post-LOCA conditions.

QUESTION 6:

State whether all valves assumed to be operable in the analysis are accessible in the post-LOCA environment. Provide an explanation, if necessary, of your response.

For one SW Pump during the Recirculation Phase of a LOCA, Step 4 of ES-1.3 (Reference 1), requires that the actions defined by ATT-2.1 (Reference 10) be completed. Reference 10 requires Operations to verify that the following SW motor-operated isolation valves are closed:

MOV-4613 & MOV-4670	(Turbine Building Basement - 253' El.)
MOV-4614 & MOV-4664	(North Intermediate Building Basement - 253' El.)
MOV-4609 & MOV-4780	(Screen House Building - 253' El.)
MOV-4663 & MOV-4733	(North Intermediate Building Basement - 253' El.)

These valves automatically close following a LOCA with LOOP to isolate the non-safety

related portions of the SW System from the safety related portions of the SW System. They are also capable of being closed by the Operators from the Control Room as well as being accessible for local manual operation following a LOCA.

Reference 10 also requires that one of the two SW supply lines to the CCW Heat Exchangers be isolated by requiring operator action to isolate one pair of the following motor-operated valves:

MOV-4615 (Auxiliary Building - 253' El.) &
MOV-4734 (Auxiliary Building - 271' El.)
OR
MOV-4616 & MOV-4735 (Auxiliary Building - 253' El.)

These valves automatically close following a LOCA with LOOP to isolate the SW flow to the two CCW Heat Exchangers during the Injection Phase of a design basis LOCA. Typically, for the transfer to the Recirculation Phase of a LOCA with two operating SW Pumps, ES-1.3 requires that a SW flow of 5000-6000 gpm be re-established to the two CCW Heat Exchangers and that CCW flow to the two RHR Heat Exchangers be initiated. However, with only one SW Pump operating Reference 10 only allows SW flow to be established to one CCW Heat Exchanger to prevent run-out of the SW Pump. The SW isolation valves to the CCW Heat Exchangers are capable of being controlled by the Operators from the Control Room as well as being accessible for local manual operation following a LOCA.

In addition to establishing SW flow to one CCW Heat Exchanger by opening the appropriate SW motor-operated isolation valves discussed above, Reference 10 requires that Operations throttle open the SW outlet valve for the operating CCW Heat Exchanger by locally opening one of the following normally throttled manual valves:

V-4619 (Auxiliary Building - 271' El.) OR
V-4620 (Auxiliary Building - 271' El.)

These two valves are located in the Auxiliary Building adjacent to the two CCW Heat Exchangers and are capable of being accessed by Operations following a LOCA.

Reference 10 also requires that when transferring to Recirculation Phase of a LOCA with only one operating SW Pump that the SW supply to the two Spent Fuel Pool Heat Exchangers be isolated. This is consistent with the design basis LOCA Recirculation Phase discussed in UFSAR Section 9.2.1 which also identifies that the SW to the Spent Fuel Pool Heat Exchangers may be isolated. To perform this function, Operations would be required to locally close the following SW supply valves:

V-4622 (Auxiliary Building - 271' El.)
V-8689 (Auxiliary Building - 271' El.)

Both of these valves are located in the Auxiliary Building in close proximity to the Spent Fuel Pool Heat Exchangers and are capable of being accessed by Operations following a LOCA.

Finally, Step 3 of Reference 10 requires that Operations request the TSC to evaluate the isolation of any inoperable SW loads in the Containment. This could result in the direction to isolate SW flow to any non-functional CRFCs or to the Reactor Compartment Coolers. Isolation of these flow paths, if directed by the TSC, would require Operations to close one or more of the following valves:

V-4629, V-4630, V-4643, V-4644	(North Intermediate Building - 253' El.)
V-4636, V-4758	(South Intermediate Building - 271' El.)

All of these SW valves would be accessible following a LOCA.

QUESTION 7:

In endnote "m" in the current UFSAR Table 9.2-2, dated December 1996, you state the number of SW pumps in operation while the plant is at power is dependent on the lake temperature and pump header pressure. Provide the information or table that determines the number of pumps. If not done in Question 1.B, state the conditions used for Question 1.

Ginna monitors SW header pressure during normal plant operation to determine when to transition from two SW Pump operation to three SW Pump operation. From late Fall to late Spring, the temperature of Lake Ontario is low enough that automatic throttling of SW temperature control valves and manual throttling of SW flow to the CCW Heat Exchangers results in a total SW flow demand that can be satisfied by operation of only two SW Pumps. However, as the lake temperature increases in late spring and early summer, increased SW flow is required to all those components that are temperature controlled. This increased SW System demand is evident by a decrease in SW header pressure due to the increase in SW Pump flow for the two operating SW Pumps. Consequently, monitoring of the SW header pressure is used by Operations to determine when the third pump needs to be started to support normal plant operation.

Ginna Procedure O-6 (Reference 11) describes all of the general monitoring that needs to be performed during normal plant operation. Step 5.3.7 of Procedure O-6 requires that the SW header pressure be indicating greater than 50 psig for two SW Pump normal plant operation and greater than 55 psig for three SW Pump normal operation. In addition to normal Operations monitoring, low SW header pressure alarms are also available on the plant process computer.

If SW header pressure falls below either the Procedure O-6 values or the process computer alarm setpoints, Operations is directed to Station Procedure AP-SW-1 (Reference 4) for further guidance. This procedure directs Operations to start a third SW Pump if the SW

header pressure in either SW loop supply line is less than 45 psig. Consequently, for two SW Pump normal operation, whenever demand on the SW System causes the SW header pressure to fall to 45-50 psig, Operations would transition from two SW Pump operation to three SW Pump operation.

Three SW Pump operation would be maintained throughout the summer months and into fall until the reduction in lake temperature resulted in a high SW header pressure being observed during the normal plant monitoring of SW header pressure. Some time during the fall months (September through November) after the lake temperature has cooled off, Operations would transition back to the two SW Pump operation configuration. The conditions used to respond to Question 1 are provided in the Question 1b response.

QUESTION 8:

Procedure ES-1.3, Revision 15, does not provide success criteria for adequate SW flow from one SW pump. Explain what controls are in place to ensure adequate SW flow.

For one SW Pump operation in the Recirculation Phase of a LOCA two different conditions need to be monitored. For SW flow to the CRFCs and the CCW Heat Exchanger, long term monitoring of the containment pressure and temperature response would be used to assess the adequacy of SW flow to these components. Insufficient SW flow to these components would be reflected symptomatically as an inability to de-pressurize and cooldown containment. One possible cause for this symptom would be insufficient SW flow to these components.

Consequently, the continuous monitoring of core and containment conditions by both the Control Room and the TSC following transfer into the Recirculation Phase of a LOCA would first identify the symptoms associated with inadequate SW flow to these components. This would result in actions to identify the cause of these symptoms and also identify possible action to mitigate the adverse symptoms observed. These actions would include investigation into the adequacy of SW flow to these components and could result in recommendations to increase SW flow to these components by further reductions in SW flow to non-essential loads. Additionally, if one SW Pump operation in the Recirculation Phase of a LOCA was initiated there would be both a heightened awareness of the importance of monitoring SW flow and an increased urgency in re-establishing availability of a second SW Pump as part of intermediate and long term plant recovery actions.

For assessing the adequacy of SW flow to operating EDGs during the Recirculation Phase of a LOCA with one SW Pump, existing annunciator and plant computer alarms would identify the symptoms of inadequate SW flow. Inadequate SW flow to the EDGs would be reflected in increased shell side Lube Oil and Jacket Water Cooler inlet temperatures. High temperature and High-High temperature alarms exist for both of these parameters for each EDG. Therefore, the presence of these alarms during the LOCA Recirculation Phase would be used to identify the possibility that inadequate SW flow is being provided to the operating

EDGs.

REFERENCES:

1) Ginna Station Procedure ES-1.3, "Transfer to Cold Leg Recirculation", Rev. 25
2) Ginna Station Procedure E-0, "Reactor Trip or Safety Injection", Rev. 24
3) Ginna Station Procedure ES-0.1, "Reactor Trip Response", Rev. 14
4) Ginna Station Alarm Procedure AP-SW.1, "Service Water Leak", Rev. 12
5) Ginna Station Procedure Attachment ATT-2.2, "Attachment SW Isolation", Rev. 4
6) RG&E Letter, R. C. Mecredy (RG&E) to A. R. Johnson (NRC), "Additional Information - Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 7-27-93
7) RG&E Letter, R. C. Mecredy (RG&E) to A. R. Johnson (NRC), "Additional Information - Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 3-30-94
8) RG&E Letter, R. C. Mecredy (RG&E) to S. A. Varga (NRC), "Response to NRC Service Water System Operational Performance Inspection (SWSOPI) of the R. E. Ginna Nuclear Power Plant (50-244/91-201)", 4-6-92
9) RG&E Letter, R. C. Mecredy (RG&E) to S. A. Varga (NRC), "Response to Additional Questions on Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 9-21-92"Response to Additional Questions on Service Water System, R. E. Ginna Nuclear Power Plant, Docket No. 50-244", 9-21-95
10) Ginna Station Procedure Attachment ATT-2.1, "Attachment Min SW", Rev. 4
11) Ginna Station Operating Procedure O-6, "Operations and Process Monitoring", Rev. 64
12) RG&E Design Analysis DA-ME-97-045, "Service Water System Hydraulic Model", Rev. 0
13) RG&E Design Analysis DA-ME-97-016, "CCW and RHR Heat Exchanger Performance Evaluation", Rev. 0
14) RG&E Design Analysis DA-ME-98-138, "EDG Calc", Rev. 0
15) RG&E Design Analysis NSL-0000-DA049, "LOCA Recirculation with One SW Pump", Rev. 2
16) RG&E Design Analysis DA-ME-98-080, "CRFC Motor Cooler Performance Limits", Rev. 0

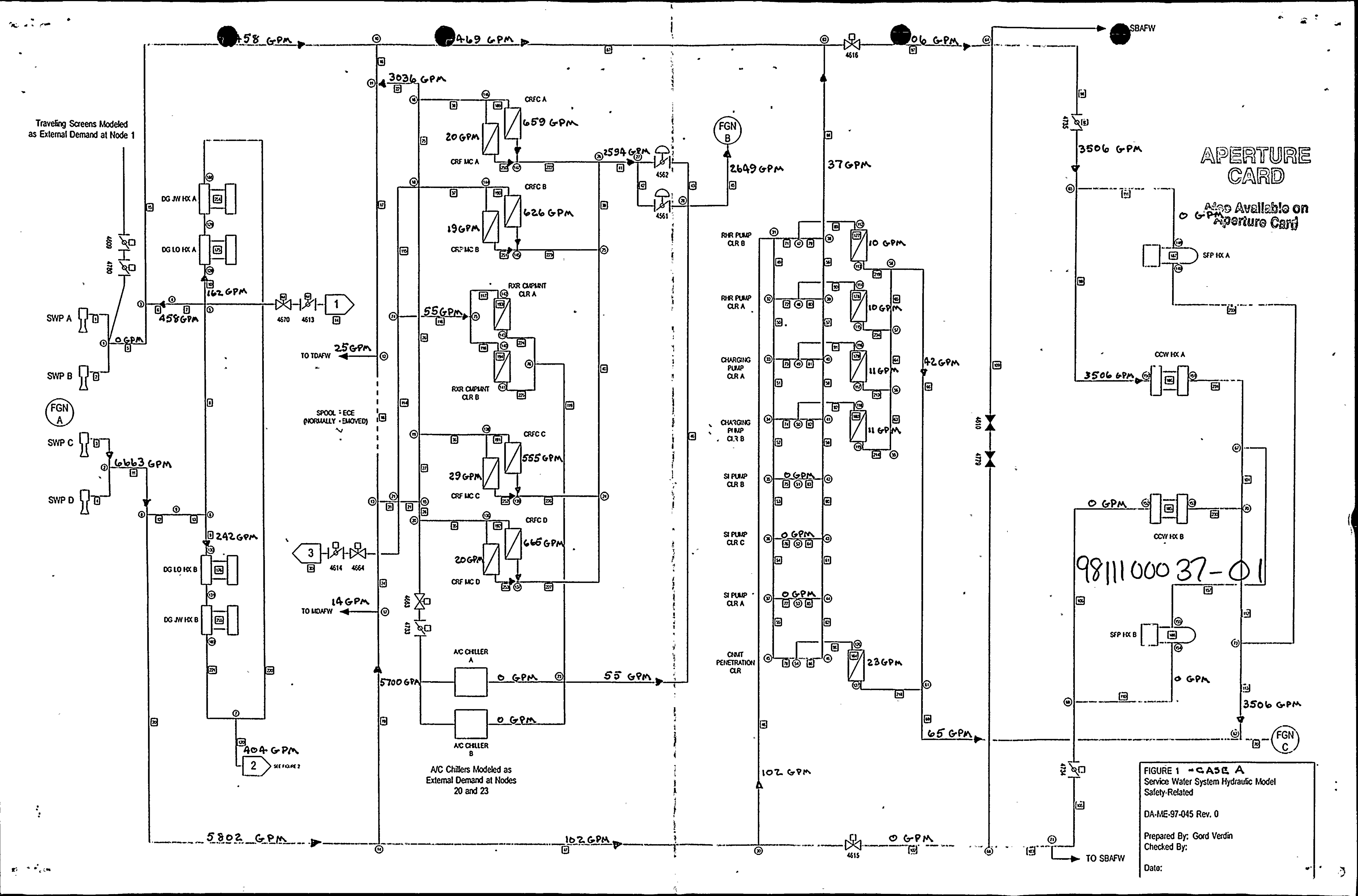


FIGURE 1 - CASE A
Service Water System Hydraulic Model
Safety-Related

DA-ME-97-045 Rev. 0

Prepared By: Gord Verdin
Checked By:

Date:

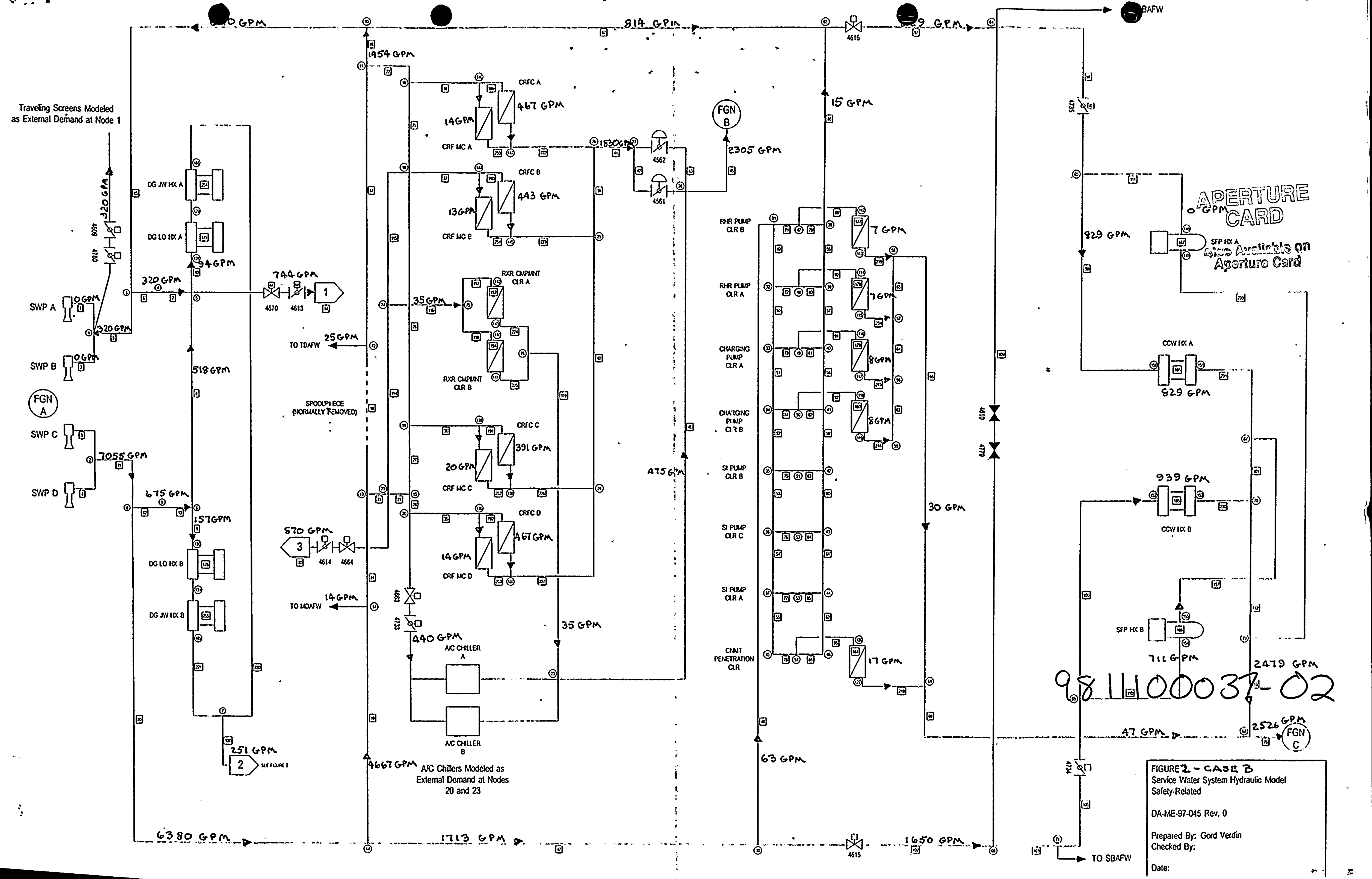


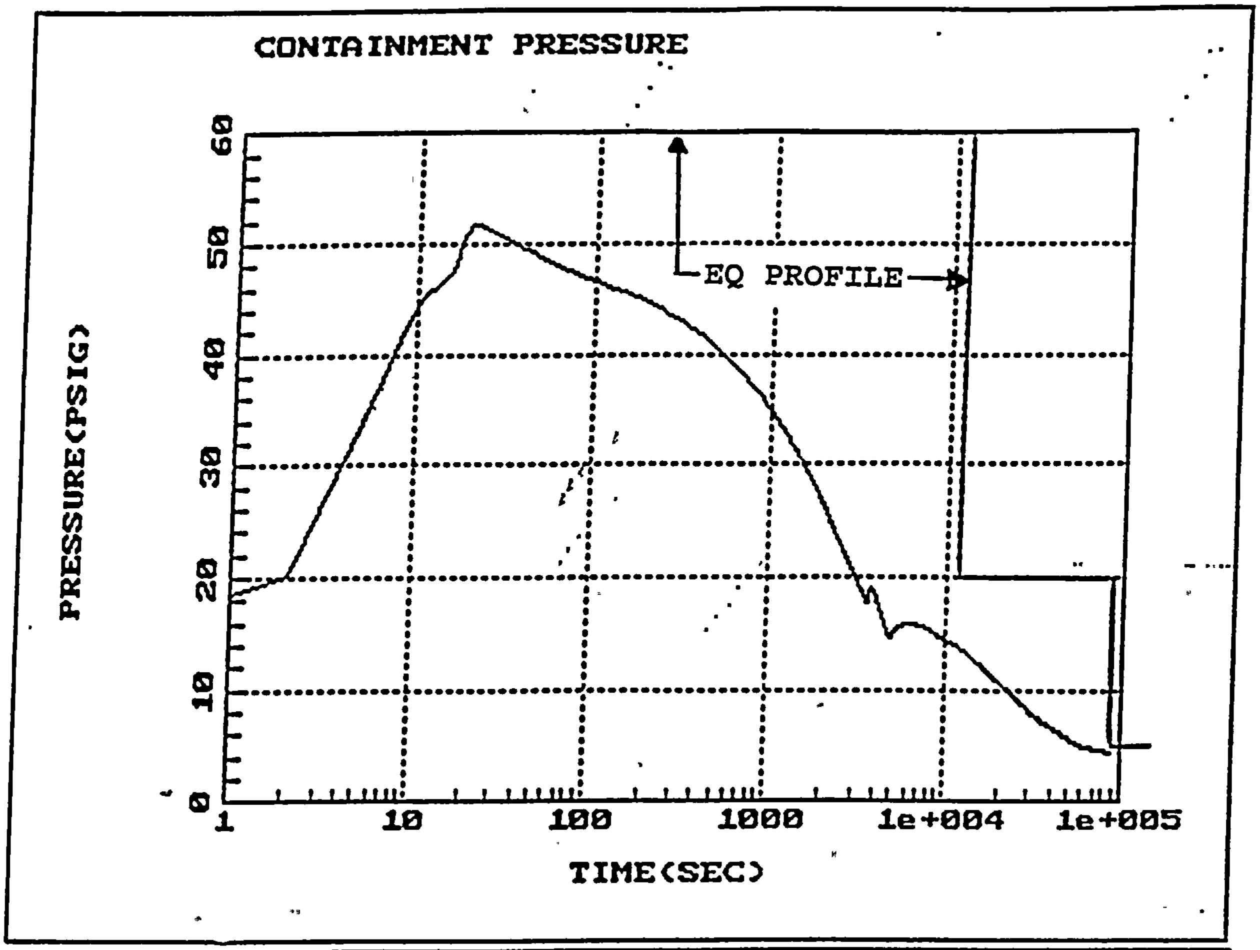
FIGURE 2 – CASE B
Service Water System Hydraulic Model
Safety-Related

DA-ME-97-045 Rev. 0

Prepared By: Gord Verdin
Checked By:

Date:

FIGURE 3
CONTAINMENT PRESSURE & TEMPERATURE RESPONSE



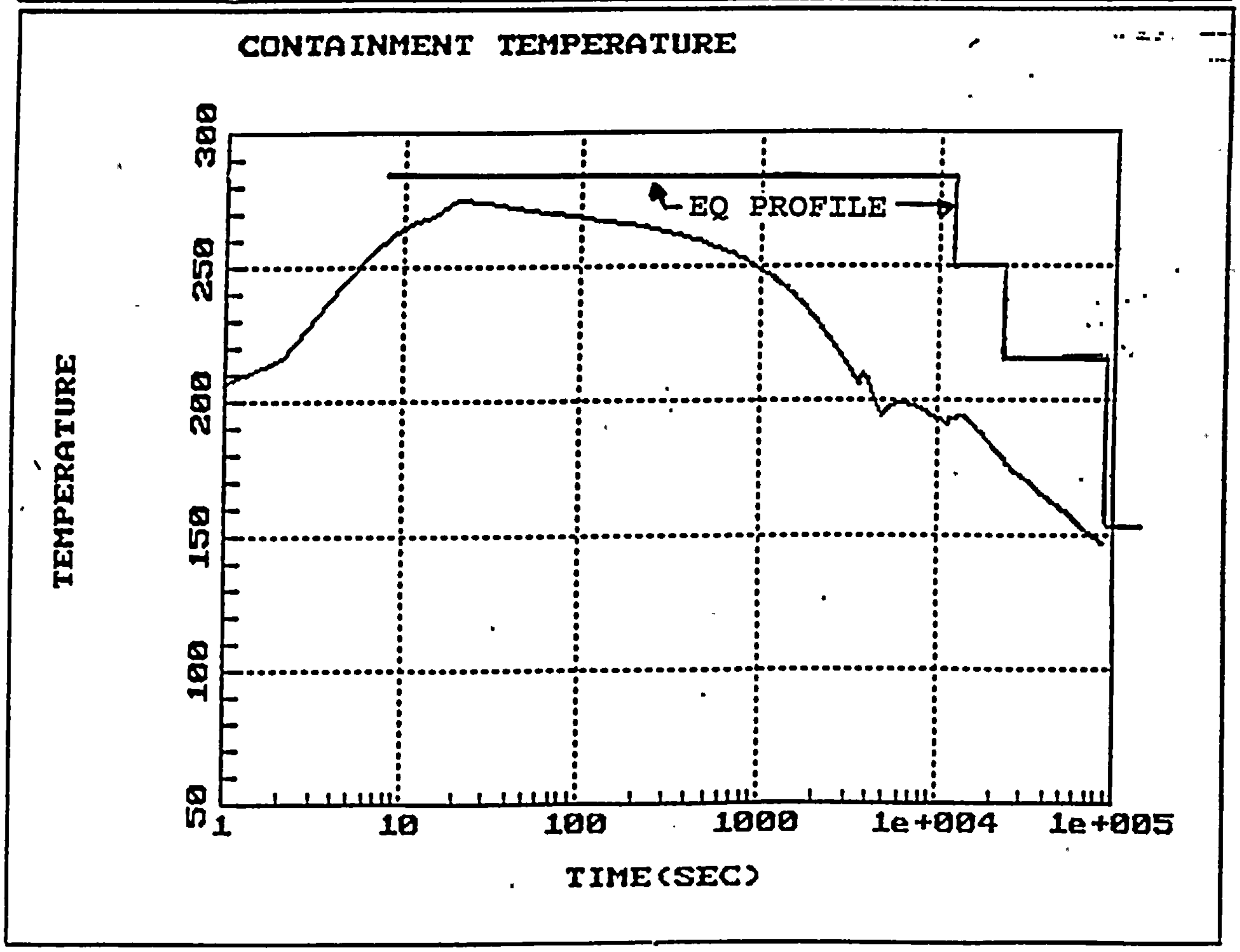


FIGURE 4
PUMP CURVE COMPARISON