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See Drawings

SUBJECT: Forwards response to NRC 980505 RAI re GL 96-06, "Assurance of Equipment Operability & Containment Integrity During Design-Basis Accident Conditions." W/two oversize drawings.

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Drawings in File

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Public Service

Wisconsin Public Service Corporation
(a subsidiary of WPS Resources Corporation)
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P.O. Box 19002
Green Bay, WI 54307-9002
1-920-433-5544 fax

July 30, 1998

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

10 CFR 50.54(f)

Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
Wisconsin Public Service Corporation's Response to the Request for Additional Information on Generic Letter 96-06

References: 1) Generic Letter 96-06: "ASSURANCE OF EQUIPMENT OPERABILITY AND CONTAINMENT INTEGRITY DURING DESIGN-BASIS ACCIDENT CONDITIONS" dated September 30, 1996

2) Letter from ML Marchi (WPSC) to the Document Control Desk (NRC) dated October 30, 1996

3) Letter from CR Steinhardt (WPSC) to the Document Control Desk (NRC) dated January 28, 1997

4) Letter from ML Marchi (WPSC) to the Document Control Desk (NRC) dated March 6, 1998

5) Letter from WO Long (NRC) to ML Marchi (WPSC) dated May 5, 1998

Reference 1 requested that all licensees evaluate their plants to determine if they are susceptible to:

1. Water hammer in the piping system supplying water to the containment fan coil units (FCUs) following a design basis loss of coolant accident (LOCA) or main steam line break (MSLB) in containment coincident with a loss of offsite power (LOOP),

2 The formation of two phase flow in the containment FCUs or associated piping following a design basis LOCA or MSLB, and

3. The potential to over-pressurize isolated components and piping that penetrate containment following a design basis LOCA or MSLB inside containment.

A072 1/1

Files

The reference also requested Licensees provide the Nuclear Regulatory Commission (NRC) with a 30-day and a 120-day response to these concerns. In Reference 2 and 3 WPSC provided these responses.

Reference 4 provided the NRC with an update on WPSC's efforts to resolve the water hammer issue. In the letter, WPSC stated that an operability evaluation had been completed prior to startup from the 1996-97 outage. WPSC also provided our schedule for the final resolution of the water hammer issue. Since that letter, EPRI has developed a project to better define and understand water hammer in low pressure systems. WPSC has agreed to support EPRI in this project. It is estimated that the EPRI project will take approximately one year to complete. At that time, WPSC will begin to apply the EPRI findings to the Kewaunee Plant. Current plans are to resolve the issue one to two refueling outages after the EPRI work is completed.

Reference 5 requested additional information concerning our evaluation of the water hammer and two phase flow issue. As stated in the previous paragraphs, WPSC has not developed a final resolution to the water hammer concerns. However, as stated in reference 4, WPSC has performed an operability determination and concluded there is not a significant safety concern.

The attachment to this letter provides WPSC's response to the questions raised in reference 5 about the two phase flow issue. As discussed with the NRC staff at the NEI meeting held May 28, 1998, no response is provided on the water hammer issue, since WPSC has not completed our final analysis. When our analysis is completed, WPSC will inform the NRC and provide details of the resolution.

If you have any questions concerning this issue, please contact me or a member of my staff.

Sincerely,

M Marchi

Mark L. Marchi
Site Vice President-Kewaunee Plant

TJW
Attach.
cc - US NRC Region III
US NRC Senior Resident Inspector

Subscribed and Sworn to
Before Me This 30th Day
of July 1998

Jeanne M. Ferris
Notary Public, State of Wisconsin

My Commission Expires:
June 13, 1999

ATTACHMENT 1

Letter from M. L. Marchi (WPSC)

To

Document Control Desk (NRC)

Dated

July 30, 1998

RE: Generic Letter 96-06

As stated in the cover letter, Kewaunee is still pursuing a final solution to the water hammer issue. Where appropriate, the questions have been modified to address only the two phase flow issue.

NRC Question 1:

If a methodology other than that discussed in NUREG/CR-5220, 'Diagnosis of Condensation-induced Waterhammer," was used in evaluating the effects of waterhammer, describe this alternate methodology in detail. Also, explain why this methodology is applicable and gives conservative results for Kewaunee (typically accomplished through rigorous plant-specific modeling, testing, and analysis).

WPSC's Response:

Kewaunee is still pursuing a final solution to the water hammer issue. When this issue has been resolved WPSC will provide the NRC with the requested information.

NRC Question 2.a:

For the two-phase flow analyses, provide the following information:

Identify any computer codes that were used in the two-phase flow analyses and describe the methods used to bench mark the codes for the specific loading conditions involved (see Standard Review Plan Section 3.9.1).

WPSC's Response:

For the two phase flow issue, RETRAN03 was used to model flow through the orifice described in the answer to question 2c.

To benchmark the RETRAN03 model, a series of flow tests were performed using different size orifices installed in the discharge piping of the fan coil units. The flow through the orifices was also calculated using RETRAN03. The results of the flow analysis were then compared to the actual flow results. The RETRAN03 model was then modified to reflect the actual loss coefficient for each orifice. Accident values for pressure and temperature were then inputted into the modified RETRAN03 model to calculate flow under accident conditions for the different size orifices.

Based on the results of the RETRAN03 model, a minimum orifice size was identified which would ensure sufficient postaccident flow.

NRC Question 2.b:

Describe and justify all assumptions and input parameters (including those used in any computer codes) such as amplifications due to fluid structure interaction, cushioning, speed of sound, force reductions, and mesh sizes, and explain why the values selected give conservative results. Also, provide justification for omitting any effects that may be relevant to the analysis (e.g., fluid structure interaction, flow induced vibration, erosion).

WPSC's Response:

The answer to this question is provided in the response to question 2.c.

NRC Question 2.c:

Provide a detailed description of the "worst case scenarios for two-phase flow, taking into consideration the complete range of event possibilities, system configurations, and parameters. For example, water slug scenarios should be considered, as well as temperatures, pressures, flow rates, load combinations, and potential component failures. Additional examples include:

- the effects of void fraction on flow balance and heat transfer,
- the consequences of steam formation, transport, and accumulation;
- cavitation, resonance, and fatigue effects; and
- erosion considerations.

Licensees may find NUREG/CR-6031, "Cavitation Guide for Control Valves," helpful in addressing some aspects of the two-phase flow analyses.

WPSC's Response:

Background

There are four safety related containment fan coil units (CFCUs) at the Kewaunee plant, designated A, B, C, and D. CFCUs A and B are train A safeguards equipment and CFCUs C and D are train B safeguards equipment.

There are two trains of service water, train A supplies CFCUs A and B and train B supplies CFCUs C and D. There are two service water pumps per train of service water. Both pumps are required to be operable in order for the train to be operable.

In addition to CFCUs, Kewaunee is also equipped with two trains of internal containment spray (ICS). The following combinations provide sufficient containment heat removal following a design basis accident:

- Two trains of CFCUs
- Two trains of ICS
- One train of CFCUs and one train of ICS

Analysis Assumptions

To envelop worst case conditions, the following assumptions were made:

- To bound the boiling analysis the CFCUs were considered perfect heat exchangers; i.e., the temperature of the service water leaving the CFCUs was assumed to be containment temperature.
- Containment temperature was assumed to be containment design temperature, which is higher than the calculated LOCA temperature.
- The assumptions used to determine the heat removal requirements from containment were not changed. For example required service water flow was not reduced based on the assumption that the CFCUs were assumed to be perfect heat exchangers.
- Quenching calculations were performed assuming:
    - maximum flow out of the CFCUs and
    - the worse case single failure to determine the minimum quenching flow from the remaining service water loads.
    - the maximum expected temperature for quenching flow.

Method of Analysis

Using these assumptions, WPSC determined the size of an orifice which would maintain service water pressure above the saturation pressure for containment design temperature. The program described in the answer to question 2.a was used to model the flow through the orifice to ensure that the flow rates assumed in the USAR would be available during accident conditions. Testing was then performed to verify the flows and pressures determined by the program could be met.

When service water exits the orifice it enters the auxiliary building standpipe, which is nominally at atmospheric pressure. When the flow enters the standpipe, it is quenched to a subcooled temperature by the other flow streams entering the standpipe. The quenching analysis assumed all four CFCUs operating at maximum flow and temperature with minimum quenching flow at maximum temperature.

Analysis of Two Phase Flow

As stated in the previous paragraphs, two phase flow was eliminated in the SW lines by installing orifices in the lines. The orifices were sized to increase the pressure in the lines above the saturation pressure for the maximum possible service water temperature. Any flashing will be quenched in the standpipe at the exit of the orifice.

If a failure of a single service water pump is assumed, two phase flow will occur in that train of CFCUs until temperature in that line drops below the saturation temperature, conservatively assumed to be 212°F. Assuming one train of CFCUs and one train of ICS are operable, we estimate containment temperature will drop below 212°F approximately 3000 seconds (50 minutes after) accident initiation. Since no credit is taken for the heat removal capabilities of the degraded train, the two phase flow will not affect the containment heat removal analysis. Furthermore in reviewing NUREG/CR-6031, it appears cavitation should not result in significant degradation of the piping or components. This conclusion is based on the short period of time cavitation would occur and that the return to the liquid phase occurs primarily by cooling.

NRC Question 2.d:

Confirm that the analyses included a complete failure modes and effects analysis (FMEA) for all components (including electrical and pneumatic failures) that could impact performance of the cooling water system and confirm that the FMEA is documented and available for review, or explain why a complete and fully documented FMEA was not performed.

WPSC's Response:

The analysis was performed using the assumptions described in the answer to question 2.c. Single failure was considered as part of the analysis and design changes to address this issue. However a failure modes and effect analysis, as described in the question, was not performed. This exceeds the current level of detail contained in Kewaunee's USAR and has not been required as part of past design changes, analysis, or to support past NRC reviews or submittals.

NRC Question 2.e:

Explain and justify all uses of 'engineering judgment.'

WPSC's Response:

The assumptions used to evaluate the two phase flow concern are provided in the answer to questions 2.a, 2.b, and 2.c. These assumptions are justified based on their conservative nature and the fact that they bound the accident conditions. In addition, the results were validated by testing.

NRC Question 3:

Determine the uncertainty in the two-phase flow analyses, explain how the uncertainty was determined, and how it was accounted for in the analyses to assure conservative results for the Kewaunee plant.

WPSC's Response:

WPSC's approach to the resolution of the two phase flow concern was to make bounding conservative estimates of unknown variables. These assumptions are provided in the answer to question 2.c. For example, no credit was taken for a CFCU fouling factor or a heat exchanger efficiency factor to reduce service water temperature. Since these variables could not be quantified or monitored, the extremely conservative assumption was made that service water temperature equaled containment design temperature.

NRC Question 4:

Confirm that the two-phase flow loading conditions do not exceed any design specifications or recommended service conditions for the piping system and components, including those stated by equipment vendors; and confirm that the system will continue to perform its design-basis functions as assumed in the safety analysis report for the facility.

WPSC's Response:

The analysis, testing, and design changes performed during the 1996-97 refueling outage to address the two phase flow concern ensure the operability of the CFCUs. These efforts ensured continued operability of the system while maintaining the design basis of the individual components.

NRC Question 5:

Provide a simplified diagram of the system, showing major components, active components, relative elevations, lengths of piping runs, and the location of any orifices and flow restrictions.

WPSC's Response:

See Attachment 2:
Simplified flow drawings: WPS-SW01, WPS-SW03, WPS-RBV3
Simplified elevation drawings from Calc M-09308-003, Sheets 1 through 8
APM-547, Analytical part Flow Service Water System Containment Cooling

Additional Analytical Part drawings showing pipe lengths for each part referenced on APM-547 can be provided on request (Appx 40 drawings).

NRC Question 6:

Describe in detail all corrective actions that have been taken or are planned to be taken to fully resolve the two-phase flow issues, including anticipated completion schedules for completing all remaining actions.

WPSC's Response:

WPSC believes we have fully addressed all concerns associate with the two phase flow issue described in generic letter 96-06. Our plans for resolving the water hammer issue as described in the generic letter are provided in reference 4 and in the cover letter to this submittal.

ATTACHMENT 2

Letter from M. L. Marchi (WPSC)

To

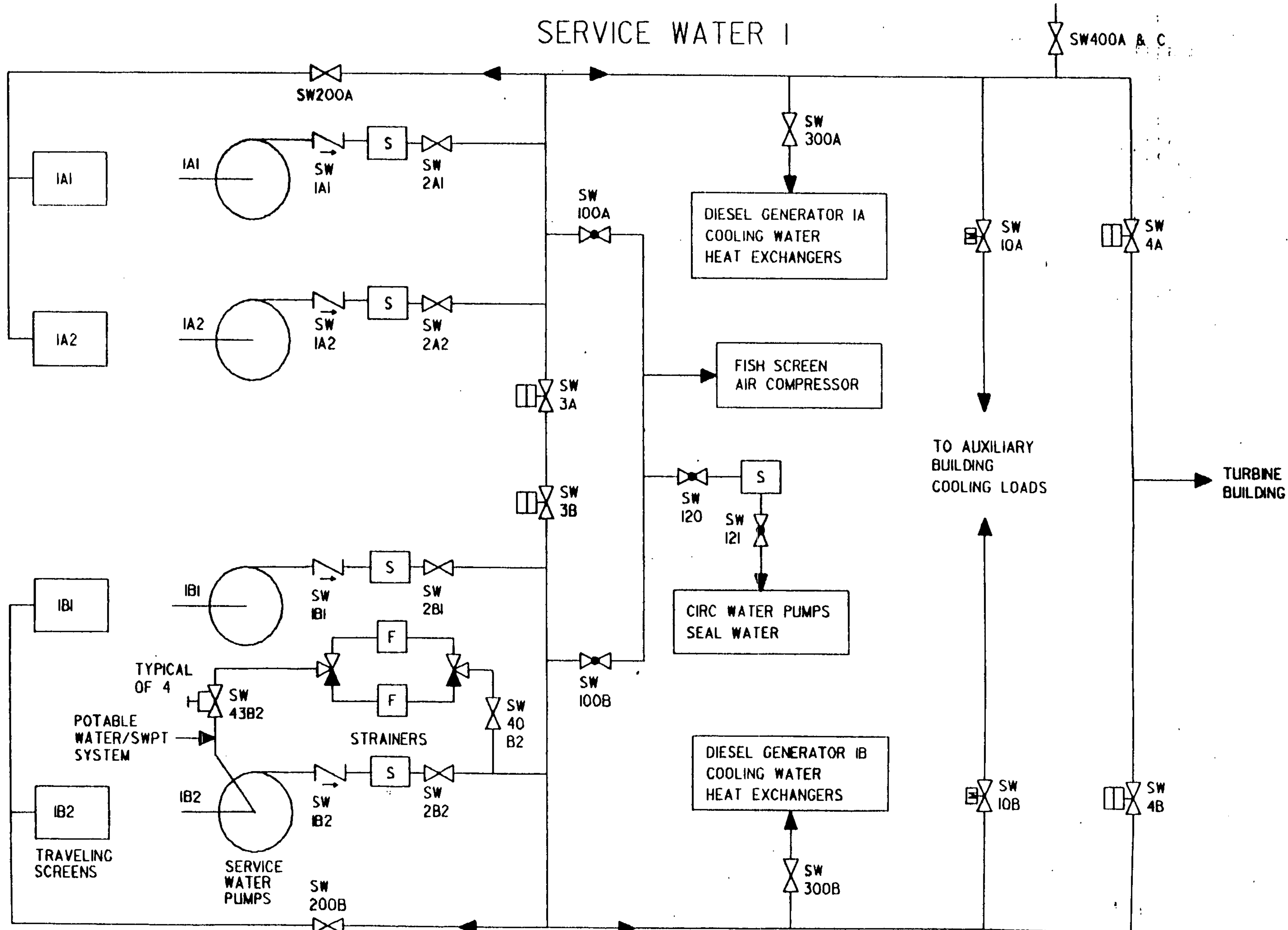
Document Control Desk (NRC)

Dated

July 30, 1998

RE: Generic Letter 96-06

SERVICE WATER I



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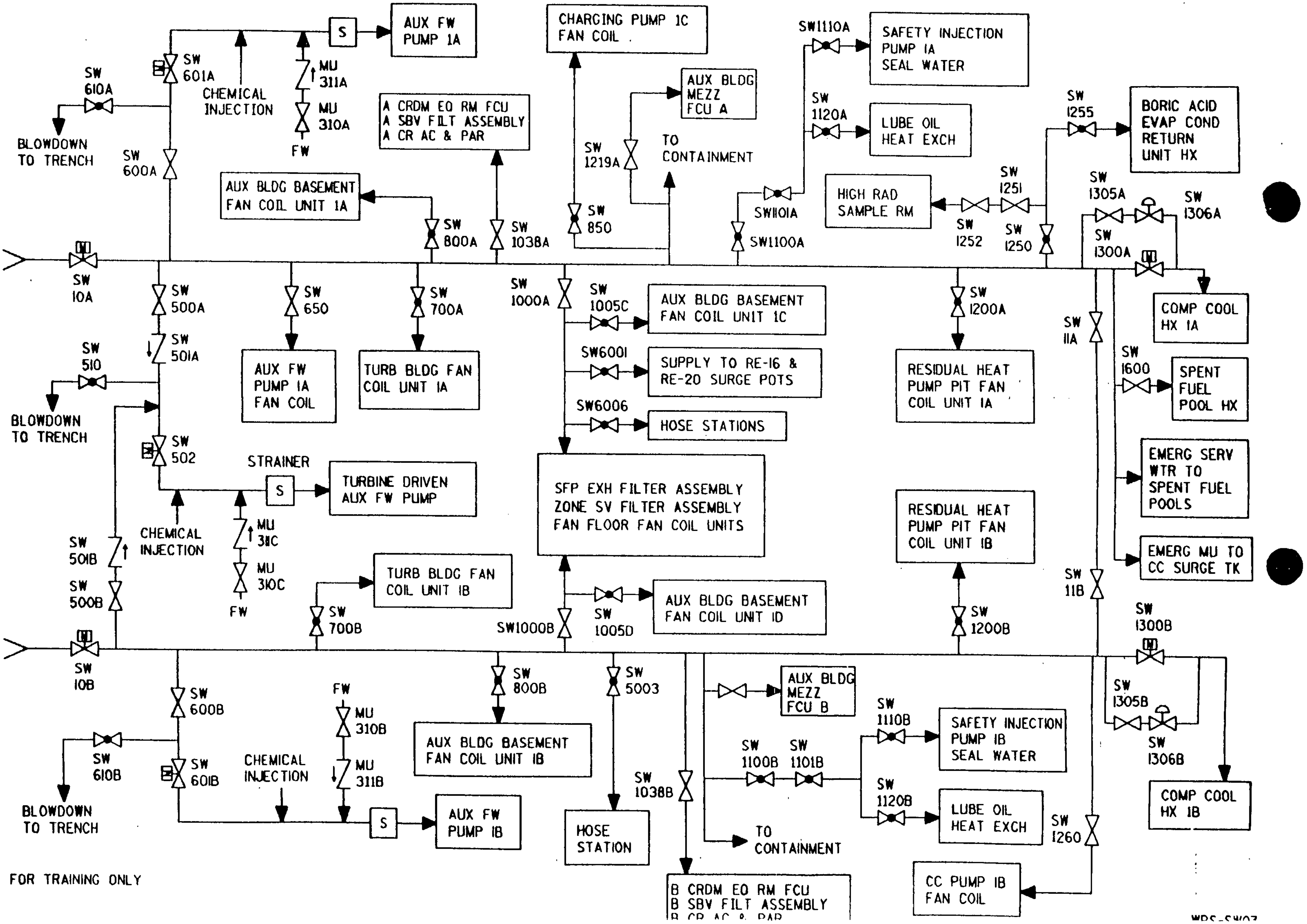

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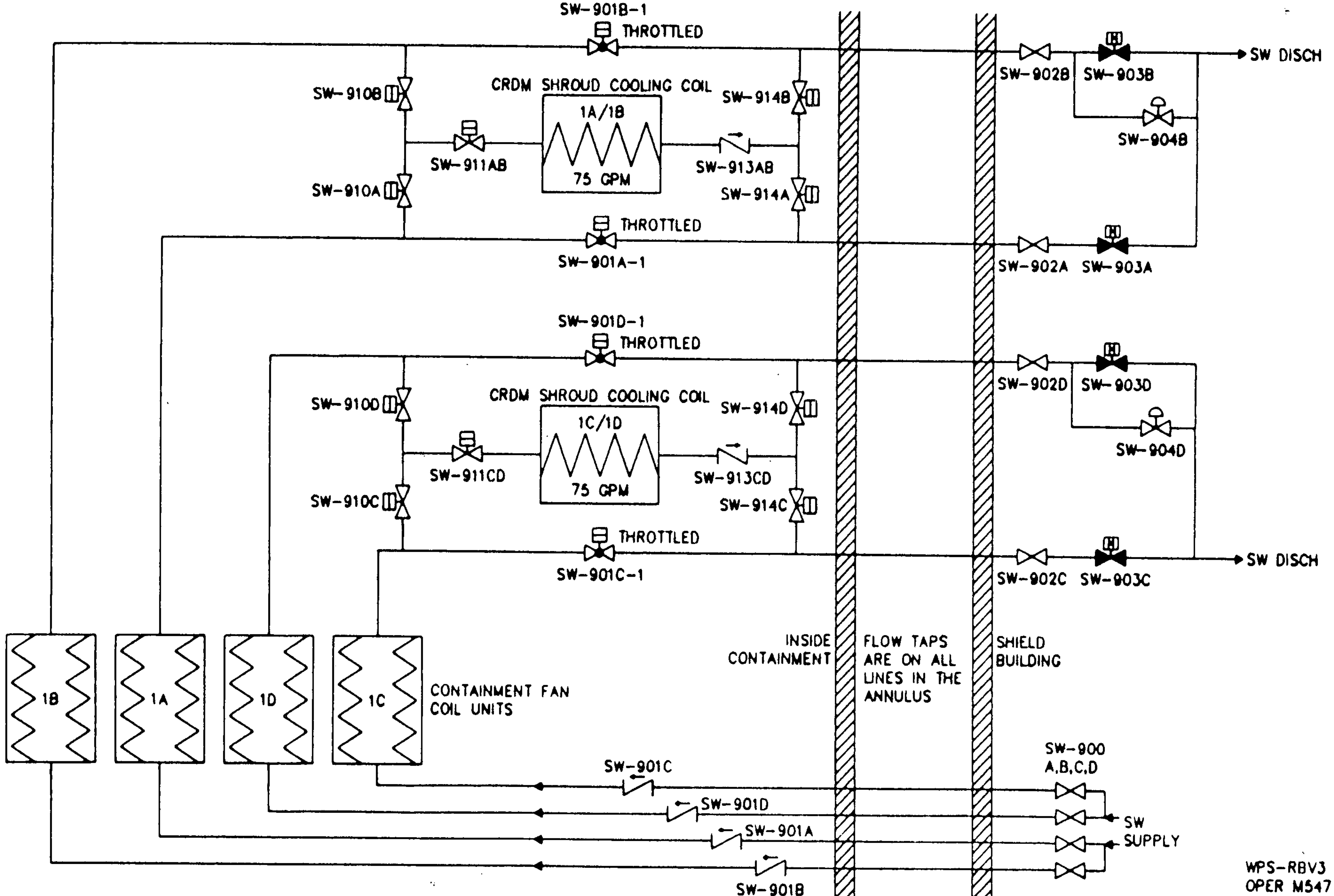

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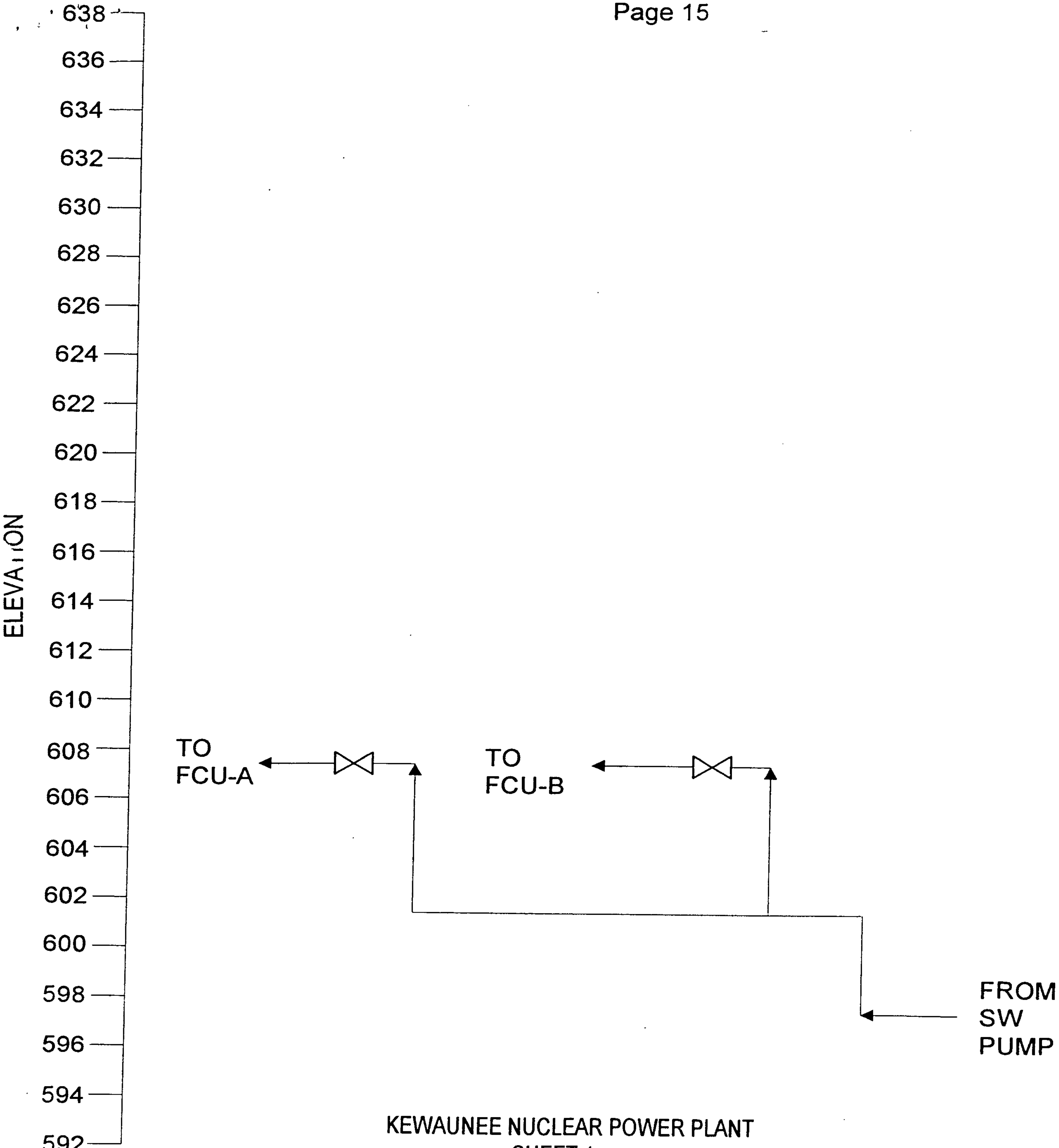
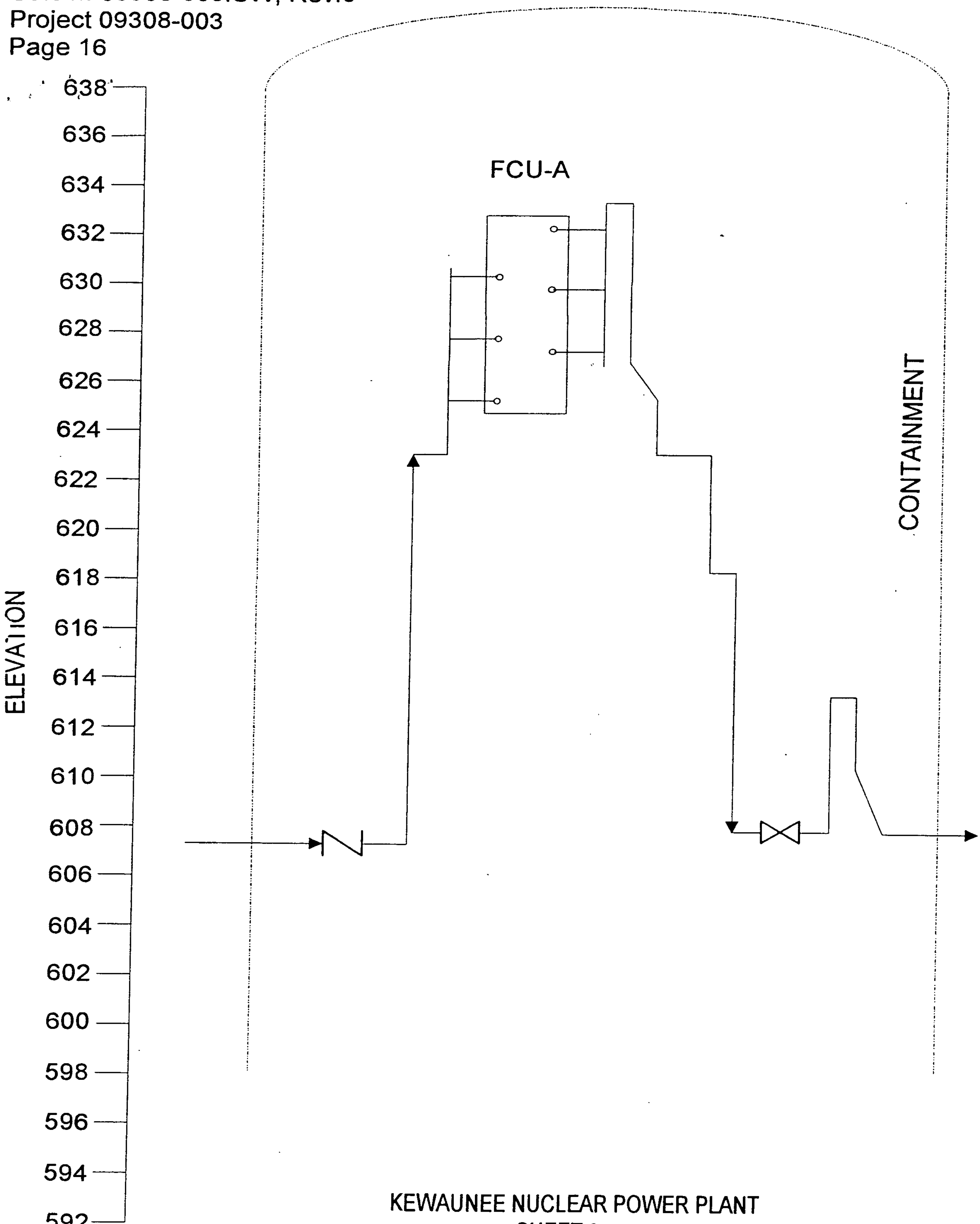


KEWAUNEE NUCLEAR POWER PLANT
SHEET 1



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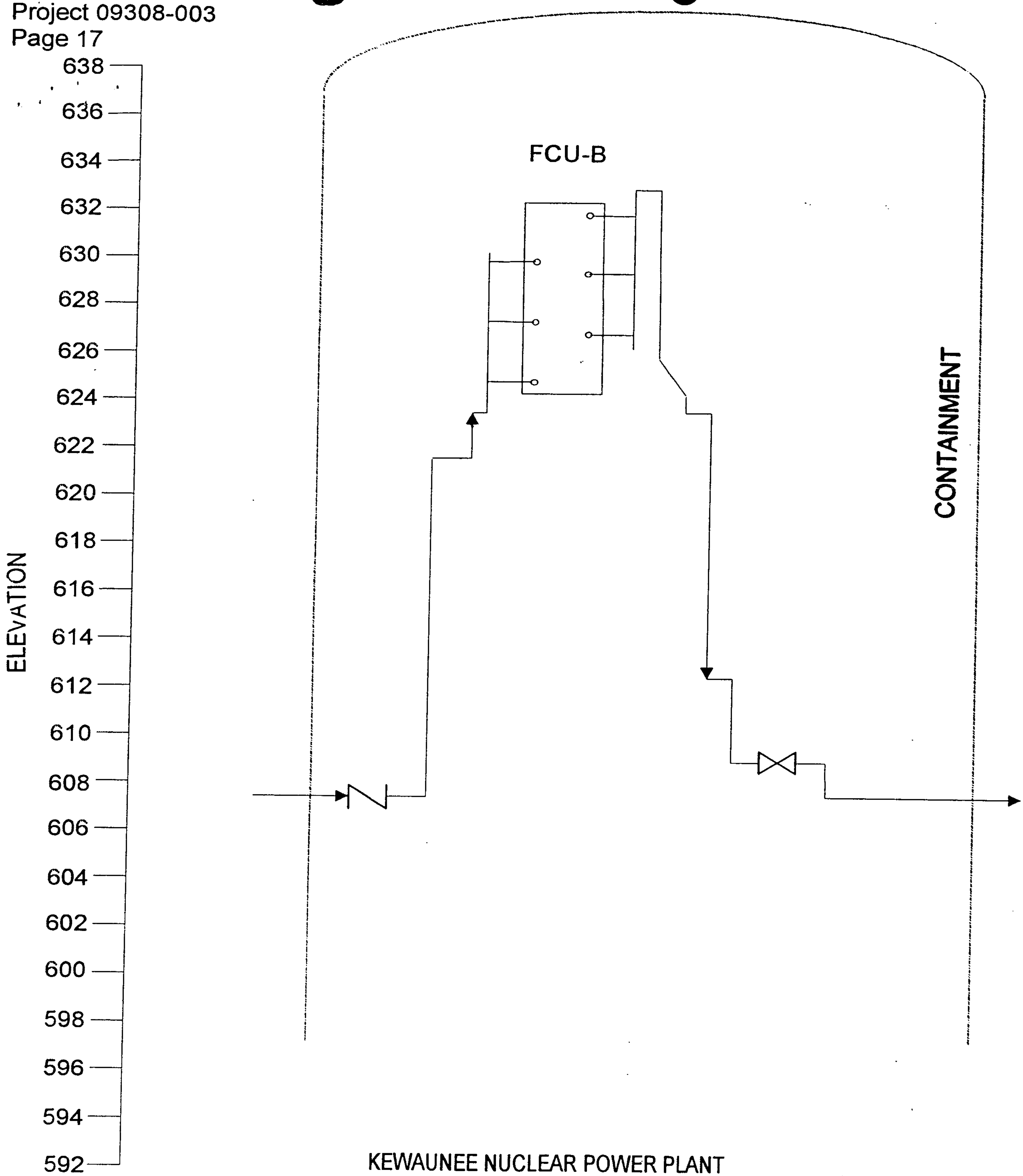

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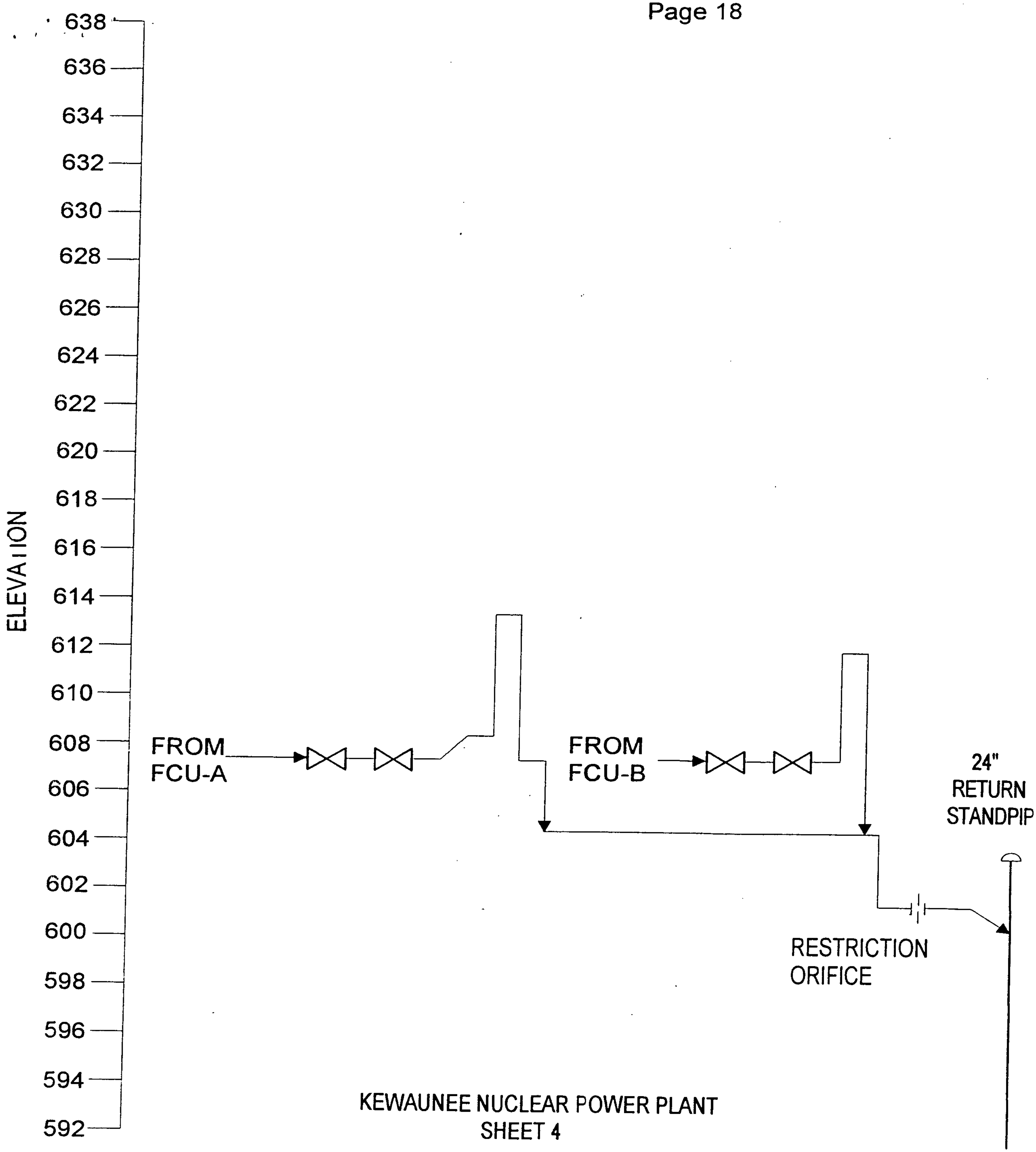

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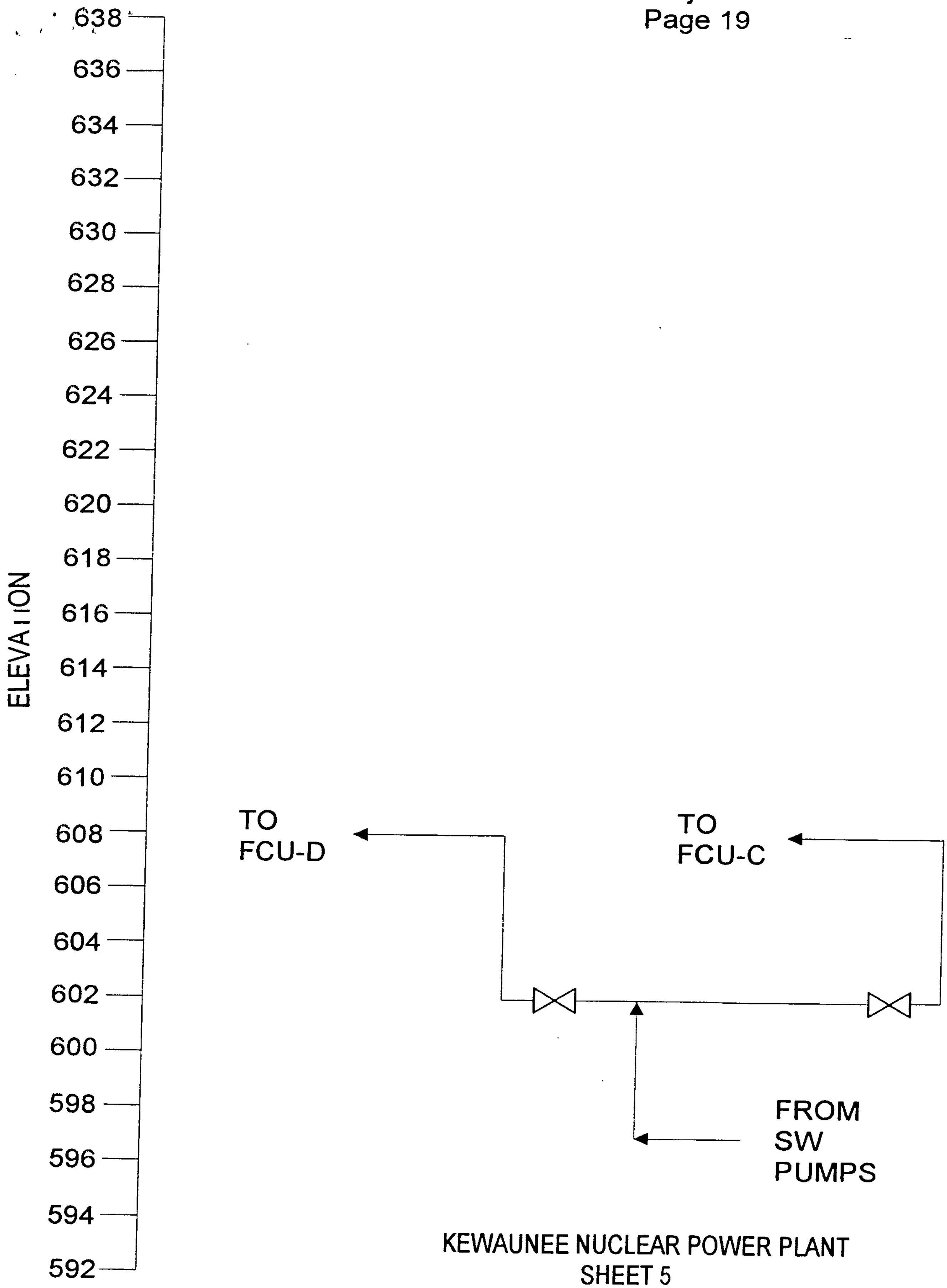

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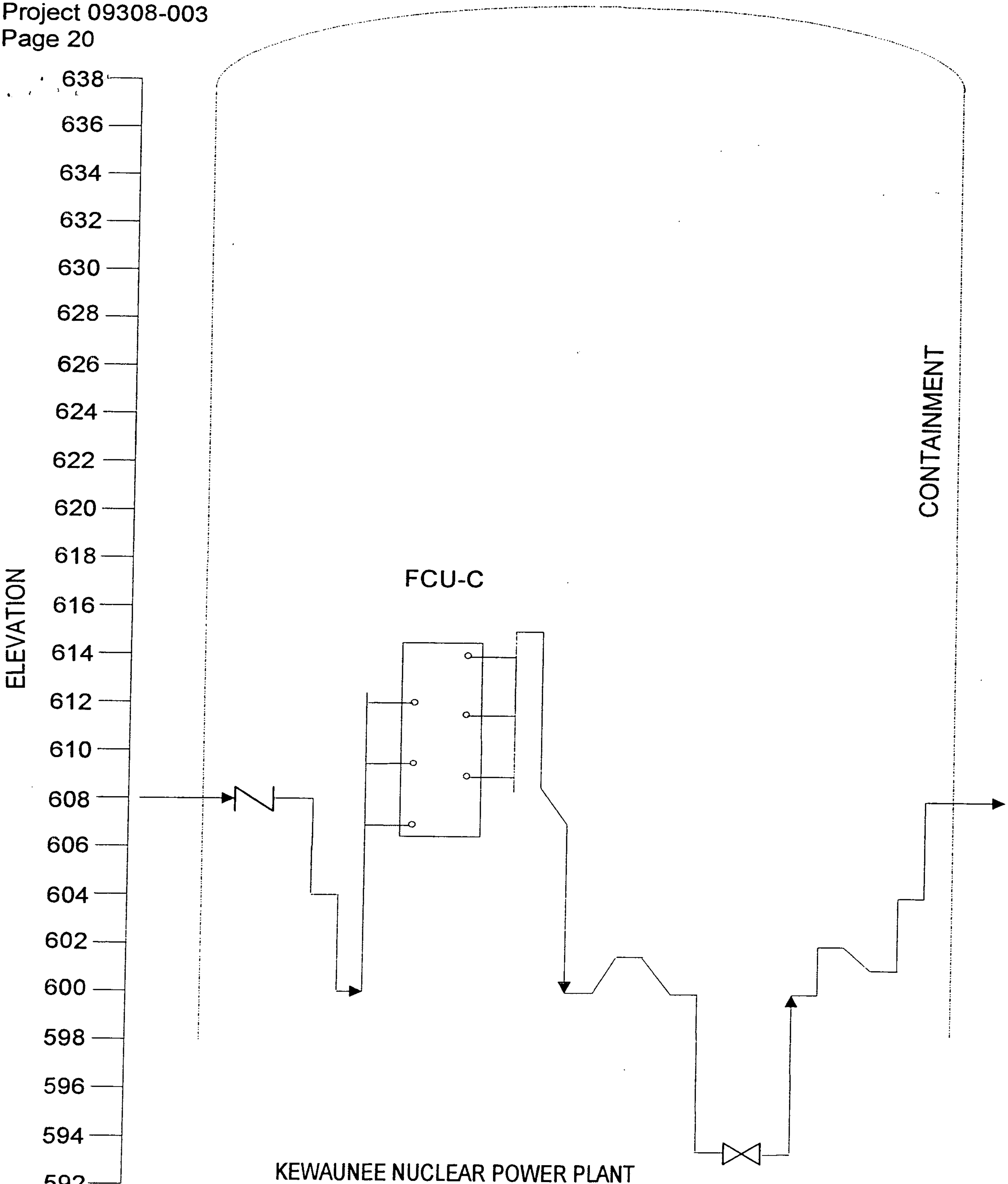

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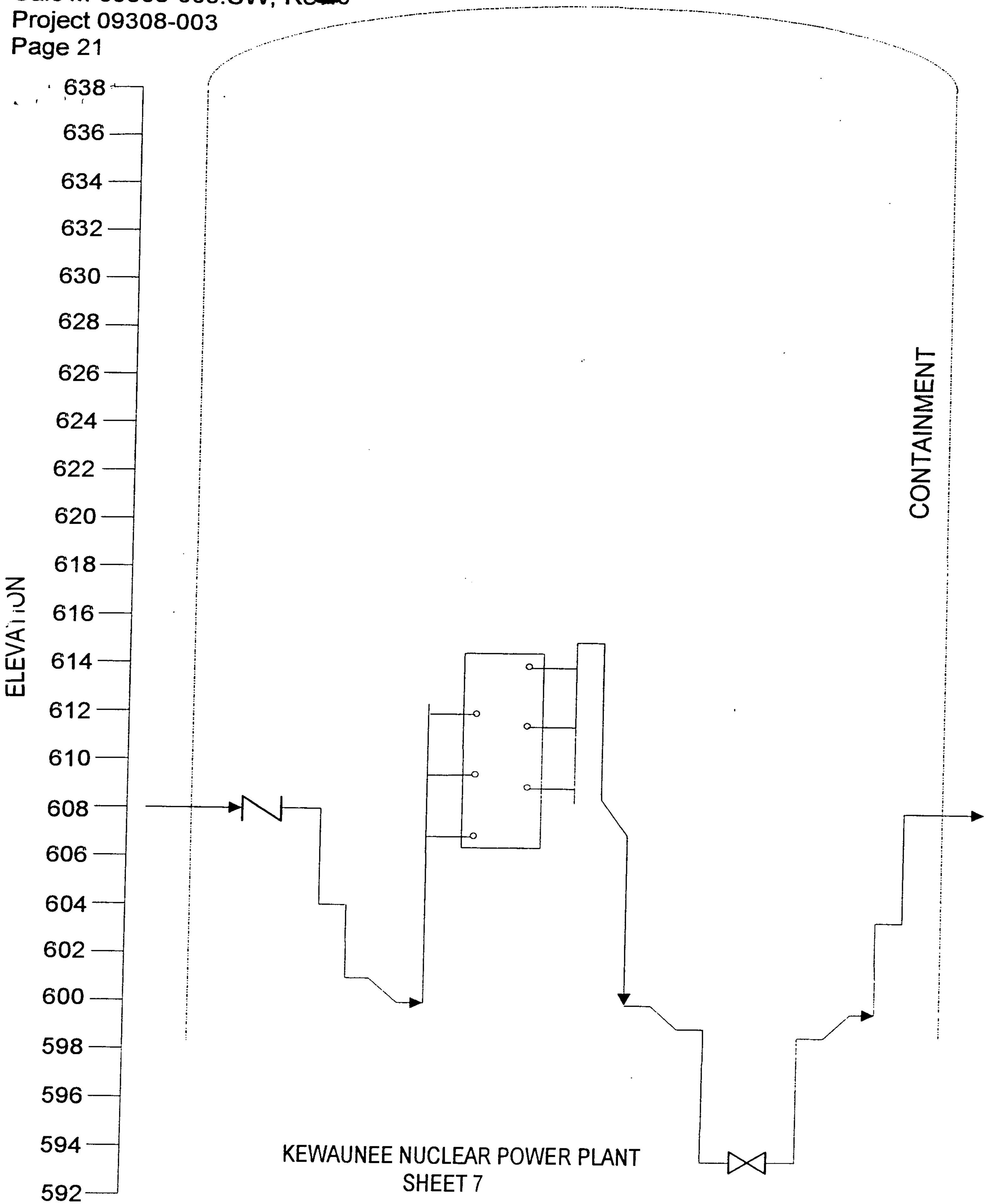
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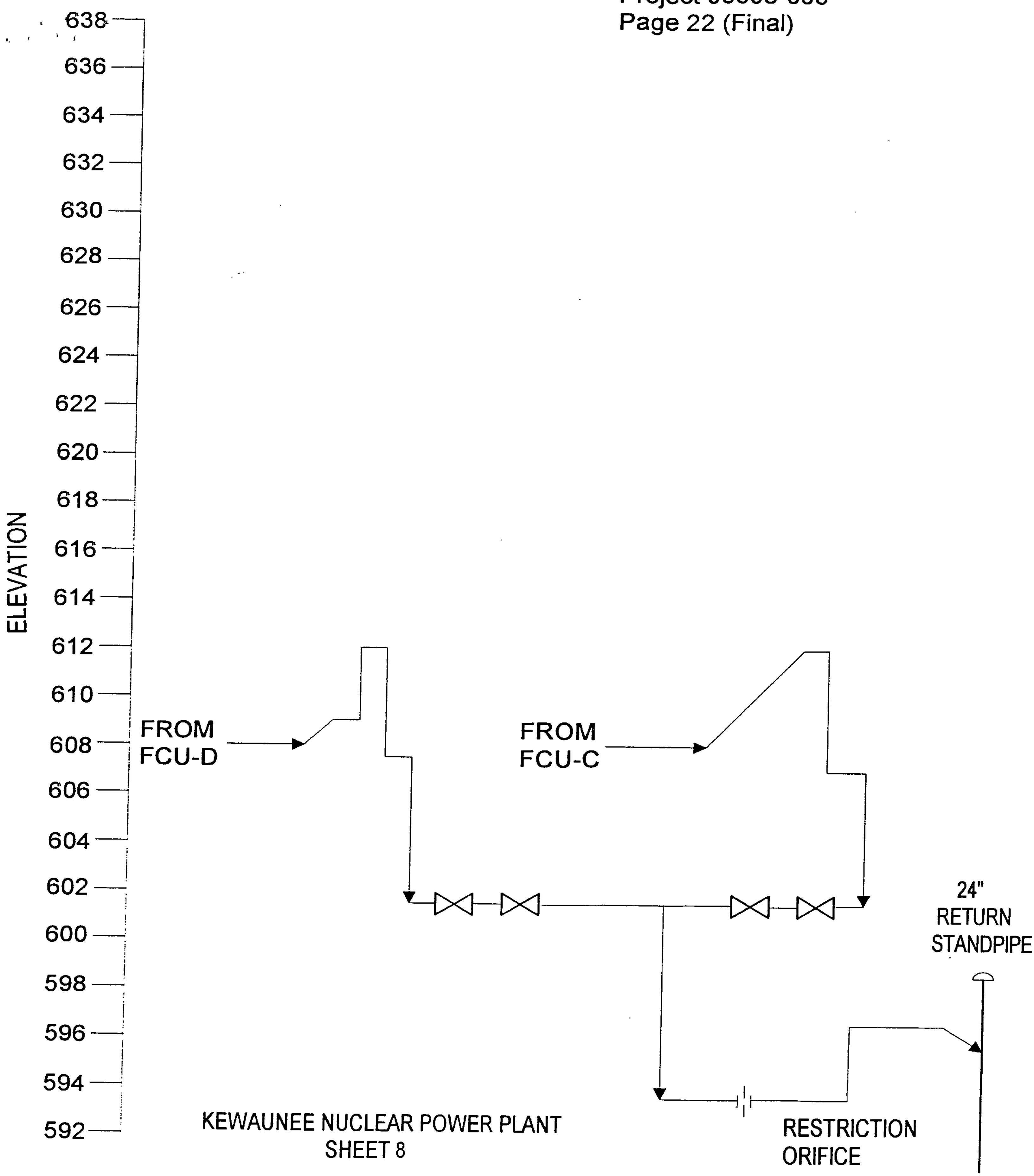
SHEET 7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SHEET 8

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