TRTOPE

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TOPICAL REPORTS EVALUATION

TOPICAL REPORTS SUMMARY

The topical reports evaluated in this review present results from small break spectrum ($A \leq 0.5\ ft^2$) analyses for B&W's 145[1], 177[2], and 205[3] FA plants with internals vent valves. The three reports were reviewed jointly because they use the same small break model to perform the small break spectrum analyses.

The small break model consists of the three computer programs discussed below used to analyze plant response to small breaks:

1. CRAFT[4]: A multinode representation of the plant primary system to compute blowdown hydrodynamics and water inventory in primary loop components following piping ruptures.
2. FOAM[5]: A single node representation of the core to compute average two-phase mixture height in the core when core uncovery is computed in the heterogeneous reactor inner vessel volume of the CRAFT model.
3. THETA1-B[6]: A multinode representation of the core hot pin fuel and clad to compute temperature transients during the loss-of-coolant accident up through core recovery based on average core coolant conditions determined in CRAFT and FOAM.

The multinode plant representations in CRAFT for small break analyses typically contain approximately half of the nodal detail used for large break studies (~15 compared to ~30). The reduced model has been shown[7] to provide results essentially identical to those of the large break model when using identical assumptions, due to the reduced blowdown rates and internal pressure gradients computed for small breaks. Most of the nod

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detail reduction is made by lumping the two primary loops simulated in the large break model into a single loop, and by lumping the reactor inner vessel regions of core, core bypass, upper plenum, and upper head into a single volume. In add[illegible]ion to the nodal reduction, some large break analysis assumptions imposed for conservatism can be relaxed because of the slower blowdown of the small break. These changes are:

1. Normal system low pressure reactor scram is included.
2. All injected ECCS water is assumed to enter the downcomer and is retained in the CRAFT calculations. No conservative removal of this water at the end of blowdown is used as in the large break analyses.
3. A heterogeneous inner vessel volume is modeled for the small break in CRAFT compared to the homogeneous volumes modeled for the large break analyses.

Results obtained from the topical reports for the small breaks considered for each plant are summarized in Table 1, and show that peak clad hot spot temperatures in any of the three plant types analyzed do not approach 2200°F.

TOPICAL REPORTS EVALUATION

The small break model programs used in the analyses in the three reports reviewed here were evaluated in previous assessments for large break studies in the cases of CRAFT and THETA1-B, and the FOAM program was evaluated in the review of BAW-10064(5). Applications of these programs in the small break analyses reported in the topicals were performed in a manner which provides some conservatism in the calculations of peak clad temperatures; however, an assessment of the extent of this conservatism was not sought because the temperatures obtained were low compared to damaging temperatures.

From the results summarized in Table 1, it is noted that the analysis for the 177-FA plant with raised loops did not include the core flooding tank line break. The introduction of the report (BAW-10075)(2) for this plant indicated that the results of the analysis for this break would be presented in the SAR for each plant application. The 0.5 ft^2 break for this plant was also indicated in the introduction to be reported in BAW-10053(8). As this report presents results for a 177-FA non-vent valve plant using the large break model for the break analyses, it is considered that the 0.5 ft^2 break for the 177-FA plant with raised loops and internals vent valves has been adequately considered. The value shown in Table 1 for this break is considered greater than can be conservatively expected for a small break model analysis when compared to 145 and 205-FA results.

REGULATORY POSITION

Referencing the appropriate report of the three topicals evaluated in this review will be acceptable for small break spectrum analyses for SARs with the exception of SARs for 177-FA vent valve plants with raised loops which require additional documentation for the CFT line break.

The models and programs used for the small break analyses in these topicals predate issuance of Appendix K of 10 CFR 50, but are considered in conformance to the requirements of that rule.

TABLE 1

B&W PLANTS: SMALL BREAK SPECTRUM

PEAK CLAD HOT SPOT TEMPERATURE - °F

Break Size - ft² (Pump Discharge)	145 FA	177 FA RAISED LOOP	205 FA
0.5	1196	1533(3)	1178
0.3	1030	1090	710(2)
0.1	I.C.(1)	700(2)	710(2)
0.05	I.C.(1)	-	710(2)
0.04	-	700(2)	-
(Pump Suction)			
0.3	-	824	-
0.1	I.C.(1)	-	710(2)
(CFT Line)			
0.35	760	-	-
0.44	-	-	1636

NOTES:

(1) - Initial condition - not specified

(2) - Same as initial condition

(3) - From Reference 8

CFT - Core Flooding Tank

REFERENCES

1. C. E. Parks, R. J. Allen, and L. R. Cartin, "Multinode Analysis of Small Breaks for B&W's 145-Fuel-Assembly Nuclear Plants With Internals Vent Valves," BAW-10062, October 1973

2. L. R. Cartin, J. M. Hill, and C. E. Parks, "Multinode Analysis of Small Breaks for B&W's 177-Fuel-Assembly Nuclear Plants With Raised Loop Arrangement and Internals Vent Valves," BAW-10075, December 1973.

3. R. C. Jones, B. M. Dunn, and C. E. Parks, "Multinode Analysis of Small Breaks for B&W's 205-Fuel-Assembly Nuclear Plant With Internals Vent Valves," BAW-10074, November 1973.

4. B. E. Bingham, W. L. Jensen, and R. A. Hedrick, "CRAFT - Description of Model for Equilibrium LOCA Analysis Program," BAW-10030, October 1971.

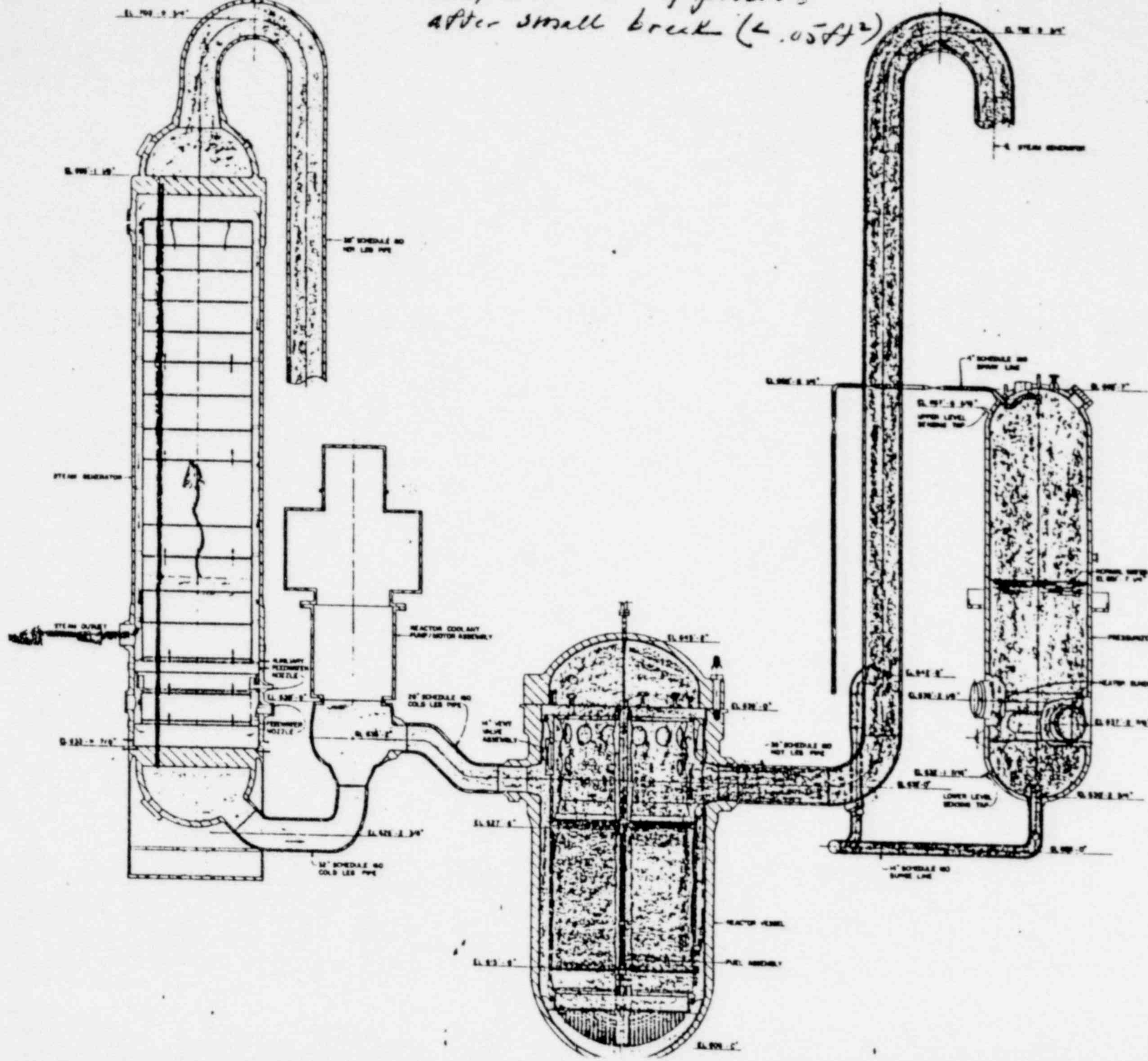
5. B. M. Dunn, C. D. Morgan, and L. R. Cartin, "Multinode Analysis of Core Flooding Line Break for B&W's 2568-MWt Internals Vent Valve Plants," BAW-10064, April 1973.

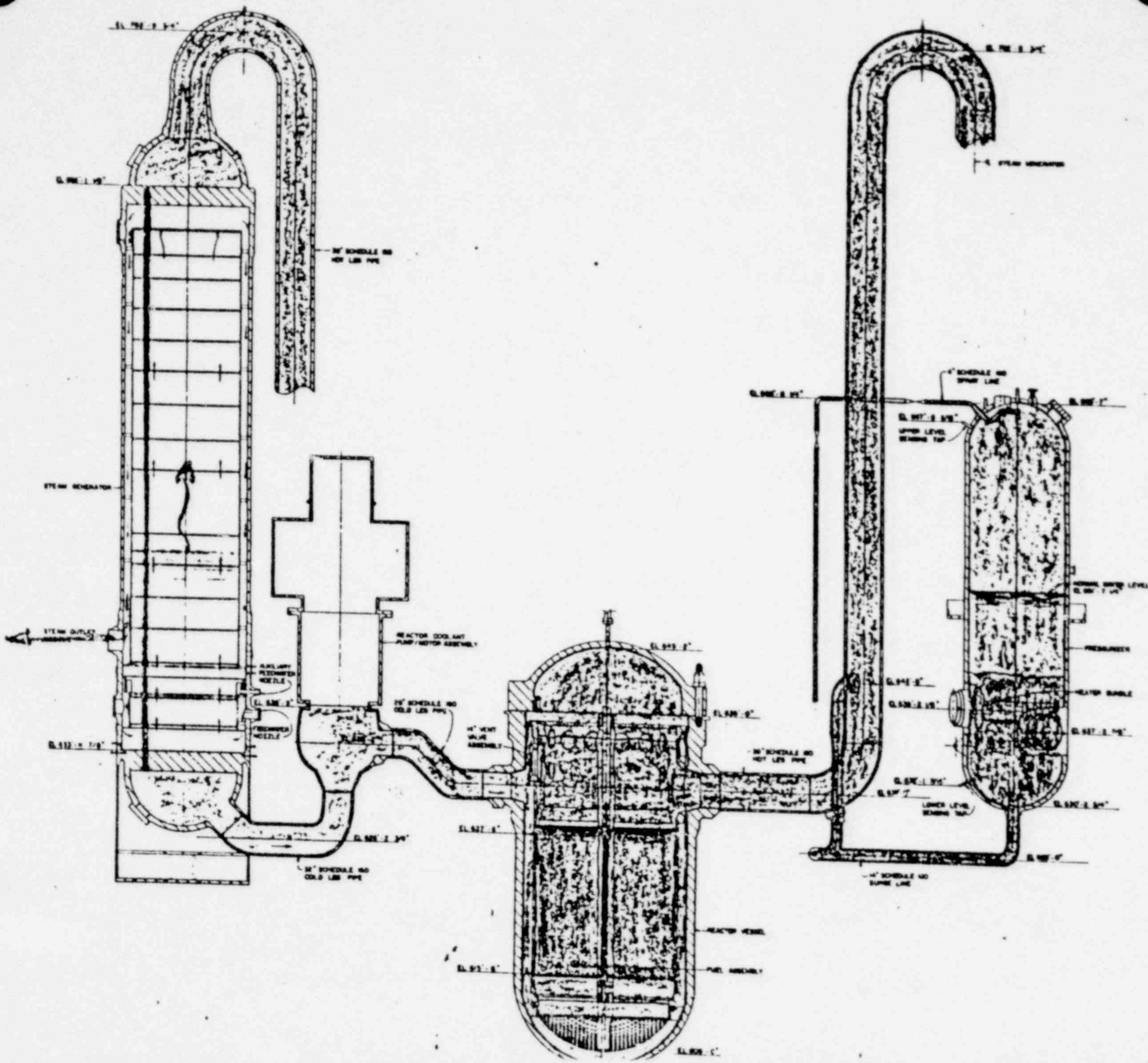
6. C. T. Hocevar, and T. W. Wineinger, "THETA1-B - A Computer Code for Nuclear Reactor Core Thermal Analysis," IN-1445, February 1971.

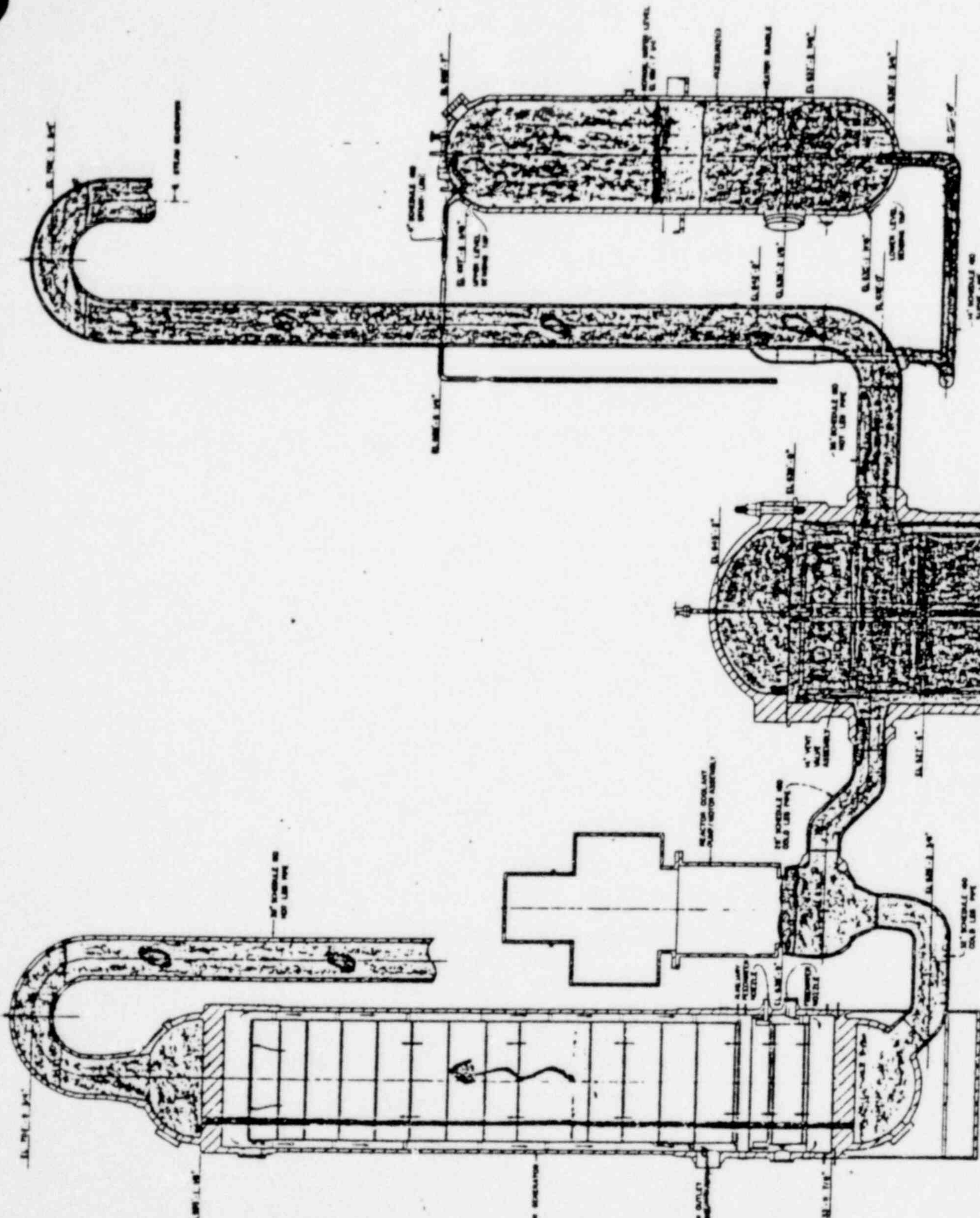
7. C. E. Parks, B. M. Dunn, and R. C. Jones, "Multinode Analysis of Small Breaks for B&W's 2568 MWt Nuclear Plants," BAW-10052, September 1972.

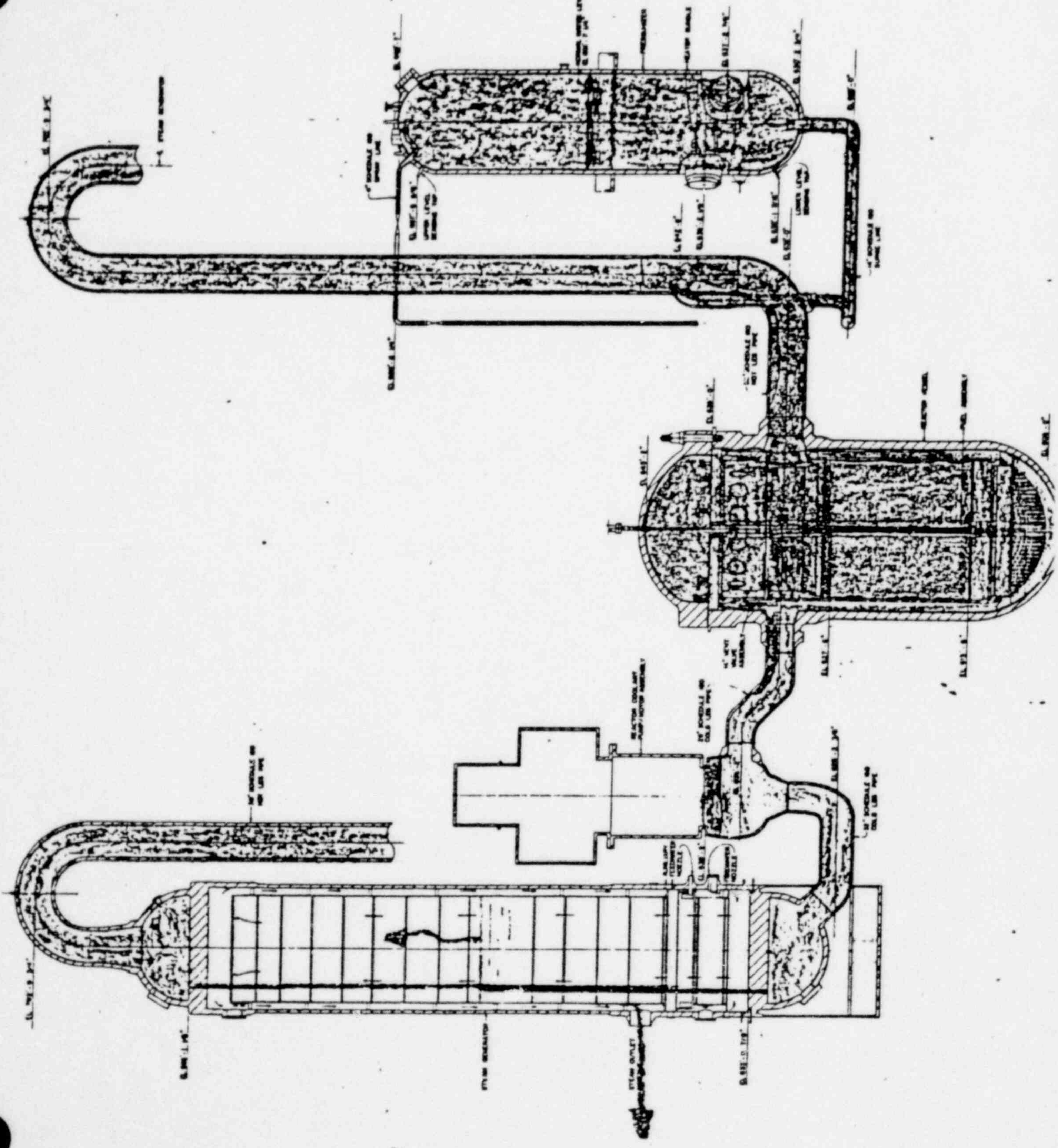
8. C. E. Parks, L. R. Cartin, and K. C. Shieh, "Multinode Analysis of B&W's 177-Fuel-Assembly, Non-Vent Valve Plant During LOCA," BAW-10053, June 1973.

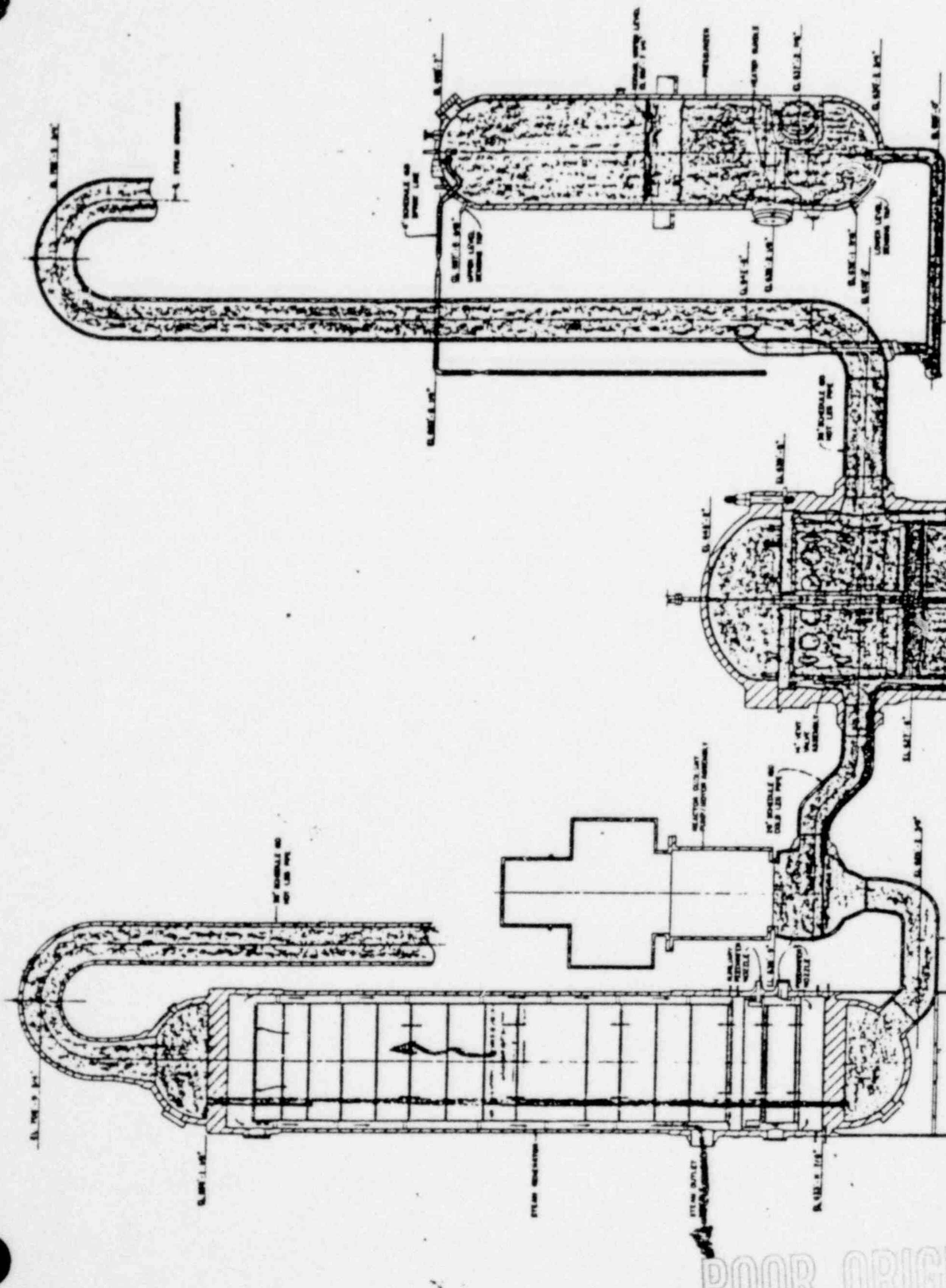
stages in cooling process
after small break (< .05 ft²)



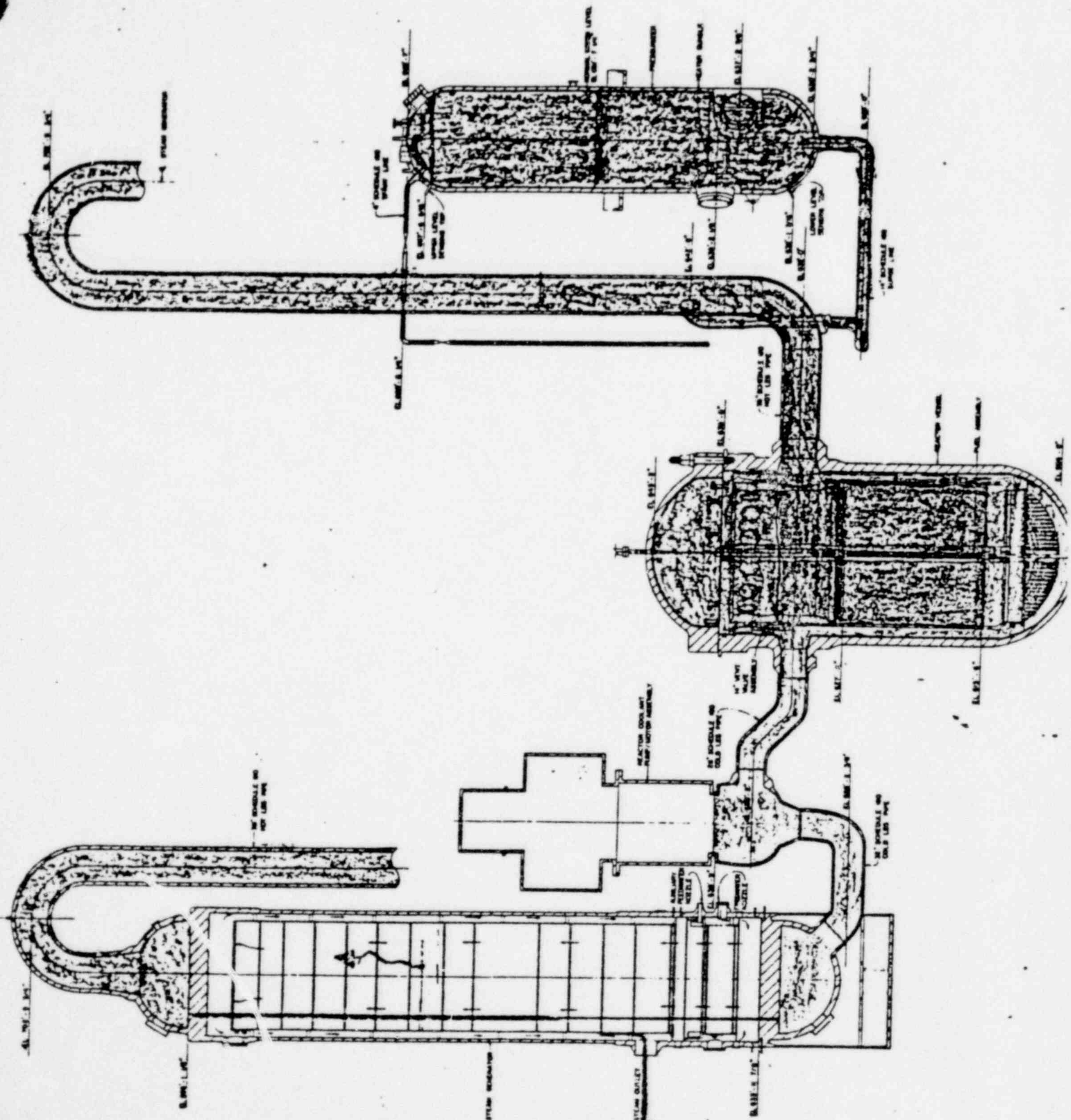

STEAM GENERATOR
STEAM OUTLET
REACTOR COOLANT PUMP/MOTOR ASSEMBLY
FEEDWATER NOZZLE
REACTOR VESSEL
FUEL ASSEMBLY
PRESSURIZER
HEATER BUNDLE
UPPER LEVEL SENSING TAP
LOWER LEVEL SENSING TAP

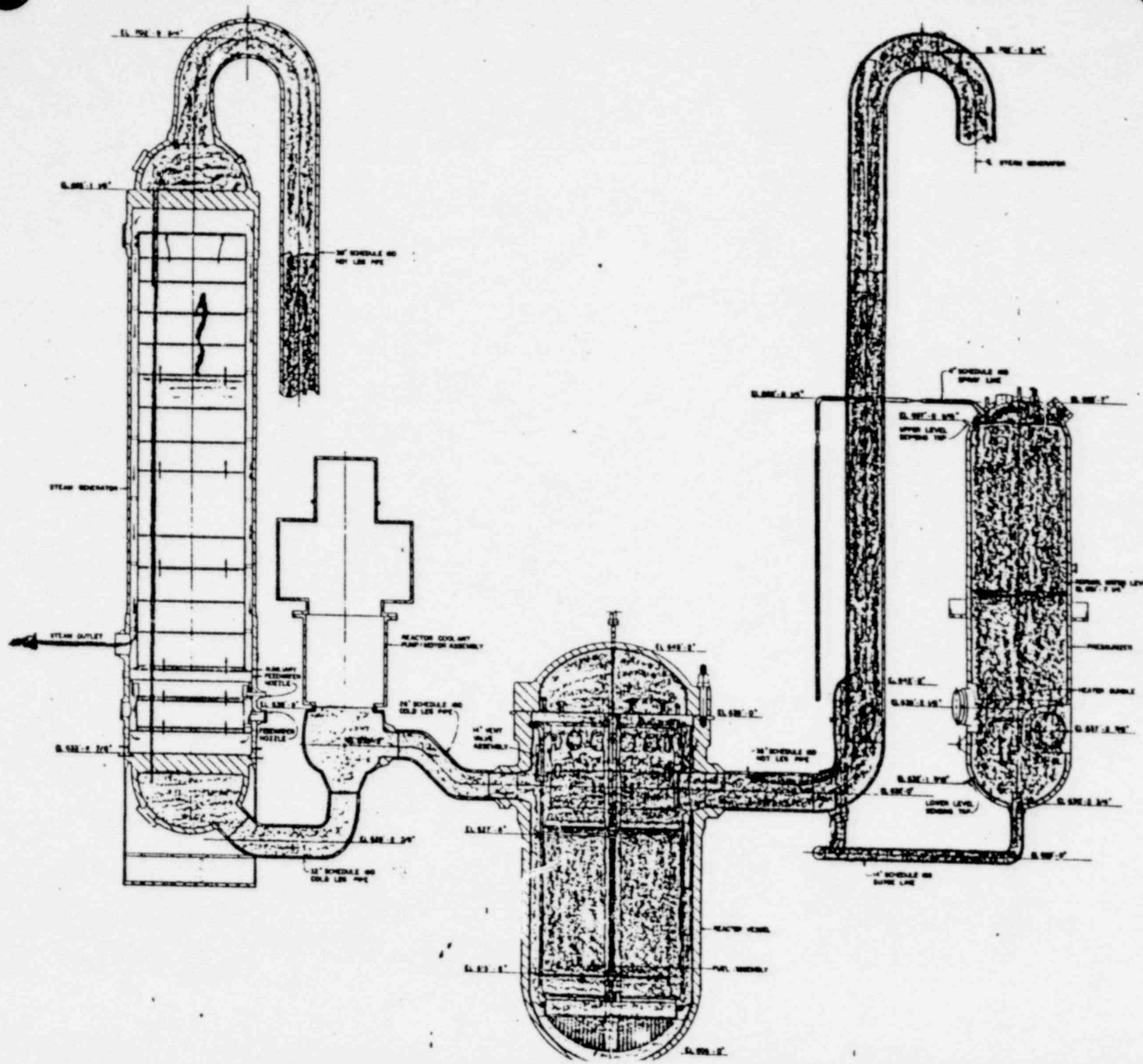






Stable cooling but




STEAM GENERATOR
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