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DESIGN CRITERIA FOR ARCHITECT-ENGINEER USAGE

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By J W Ballowe

EMERGENCY STORAGE BASIN COOLANT -
DESIGN CRITERIA FOR ARCHITECT-ENGINEER USAGE

by

L. B. Brinkman

Plant Design Unit
Design Engineering Subsection
FACILITIES ENGINEERING SECTION

September 12, 1963

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PREPARED BY: L. B. Brinkman DATE 9-11-63
L.B. Brinkman
Plant Design Unit
Design Engineering Subsection
FACILITIES ENGINEERING SECTION

APPROVED FOR GENERAL ELECTRIC COMPANY BY:

D.M. Diediker DATE 9-11-63
D.M. Diediker, Supervisor
Plant Design Unit
Design Engineering Subsection
FACILITIES ENGINEERING SECTION

APPROVED FOR THE ATOMIC ENERGY COMMISSION BY:

R. B. Plum DATE 9-13-63
for R. L. Plum, Chief
Production Reactor Operations Branch
Production Division

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-3-

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EMERGENCY STORAGE BASIN COOLANT -
DESIGN CRITERIA FOR ARCHITECT-ENGINEER USAGE

I. INTRODUCTION

This document defines the objectives, bases, and functional requirements that shall govern the preparation of detail design of the gravity fed water supply to reactor storage basins for all eight reactors.

In the event that it appears advisable and feasible to discharge all metal from the reactors into the metal storage basins, it would be necessary to add water to the storage basins to prevent overheating of the fuel elements. Without the addition of cool water, the storage basin water would soon start to boil and evaporate, eventually exposing the metal to the air. Existing facilities do not permit assurance that sufficient water can be added to the storage basins for the required period of time to protect a complete discharge of fuel elements in the storage basin if the area is left unattended and pumps are shut down.

A positive gravity fed system to the metal storage basins from existing supplies of stored water shall be provided by this project. This new gravity fed system, once it is started, shall operate unattended and shall supply adequate water to the storage basins for the required period of time. It shall not be dependent on any electric or steam-driven pumps for its continuous operation during the critical period; however, provision is to be made to utilize specific electric pumps to refill certain tanks and basins as long as electric power is available in order to maintain the original supply of water as backup for as long a time as possible.

II. OBJECTIVE

The objective of this document is to outline the operational and functional requirements of the gravity fed system to the eight metal storage basins. The ability of the storage basins to withstand the temperatures produced by the discharged fuel elements and the flow rates required for fuel element cooling is as outlined in HW-77276, "Technical Studies Supporting IPD Disaster Planning".

III. GENERAL REQUIREMENTS

The equipment and piping for the gravity fed water supply system to reactor storage basins shall be designed for operation consistent with the requirements for reactor coolant. Unless otherwise stated, the design, the materials used, and the work to be performed shall adhere to the requirements set forth in the latest edition of Hanford Works Standards and the applicable codes approved by these standards.

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IV. PROCESS AND FUNCTIONAL REQUIREMENTS

A. General

The gravity fed water supply system shall provide a means of adding sufficient quantities of water to the storage basins of each of the eight reactors to assure a full basin of water not to exceed 80 C for at least 21 days after completing metal discharge and as long thereafter as possible. During the first two and two-thirds days after shutting down the B, C, D, DR, F and H Reactors, all metal will be discharged into the storage basins and all valving and other work will be performed to put the gravity fed system into readiness. Three and two-thirds days will be required for the same work at the K Reactors. Sources of water for the gravity fed systems shall consist of various combinations of 190 storage tanks, 187 high tanks, sedimentation basins, and the export system. Each supply shall be individually metered and regulated so that the total flow to the storage basin will be that required for adequate cooling. Where new storage basin supply pipe would interfere with plant operations, portable pipe sections of light weight pipe shall be fabricated and placed on a storage rack near the location to be used during an emergency. The line shall be blanked off during normal operation.

When all preliminary work has been completed, the operating 190 pumps will be shut off and flow to the storage basins will be continued by opening the various flow control valves in the gravity fed system. The valves will be regulated to obtain the desired flow, as shown by a flow indicator, in each gravity fed system. The area can then be left unattended.

As the water level in the various supplies drops, the flow to the storage basins will decrease. However, the required amount of water will also decrease with time as shown on Graphs A, B, C and D. The original setting of the valves must be such as to provide the initial flow as shown on Table I. This initial flow must assure a flow equal to or greater than that shown as required on the graphs for at least 21 days after shutdown. Adequate provision for draining the required overflow from the storage basin to the river shall be provided.

One electric process pump at 181-C, 181-D, 181-F, and 181-H and one fire and sanitary pump at 183-B, 183-D, 183-F, and 183-H will be left running to keep the 190 storage tanks and sedimentation basins filled. The excess water will flow out the overflow drain into the sewer. These pumps will remain running as long as electric power and water are available and shall be provided with automatic shutoff upon loss of water supply.

Flow from the 187 high tanks to the B, C, D, DR, F and H storage basins will be accomplished without any further modification since Project CGI-905 has provided the flow indicator and regulating valves. Flow will be controlled by regulating the existing valves.

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B. 100-B Area

1. 105-B

The 105-B storage basin will be supplied water from the 190-B storage tanks, the 187-B high tanks, and the 183-C sedimentation basins. Flow from the storage tanks will be regulated by the front face valves on the two lowest crossheaders. All rear caps will be left off of the tubes supplied by these crossheaders. Taps for flow metering will normally be capped and the flow measuring instrumentation will be installed only when required for an emergency. The taps on the crossheaders shall be drilled under pressure to eliminate the possibility of getting metal shavings into the water.

The 183-C sedimentation basin, rather than the 183-B sedimentation basin should be used to help supply the water to the 105-B storage basin because the 183-C basin is higher and offers a greater head, and also has a greater capacity.

2. 105-C

The 105-C storage basin will be supplied water from the 190-C storage tanks and the 187-C high tanks. The 190-C storage tank water should be diverted to the filtered water line in the 190-C Building and flow to the 105-C storage basin.

C. 100-D Area

1. 105-D

The 105-D storage basin will be supplied water from the 190-D storage tanks and the 187-D high tanks and 183-D and DR sedimentation basins. The modification and instrumentation on the two bottom crossheaders and the method of operation shall be similar to that at 105-B.

2. 105-DR

Since the water surface of the 190-DR storage tanks is lower than the 105-DR Reactor, the storage tanks cannot be used for gravity flow to the 105-DR storage basin. Consequently, water for the 105-DR storage basin must be provided from the 183-D and 183-DR sedimentation basins, the 187-DR high tanks, and the leg of water in the export line up to the 200 Areas. By proper valving of the existing D Area piping system, water can be made to flow from either the 183-D or 183-DR sedimentation basins to the filtered water line at 105-DR. Provisions shall be made to utilize as much of the 183-DR basin water as possible for storage basin cooling.

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-6-

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The export lines from D Area to the 200 Areas contain roughly 3,800,000 gallons of water (does not include the water in the line to B Area or to F and H Areas). Allowing for a small leakage in the export system, approximately 2,000,000 gallons of this water can be used for cooling the 105-DR storage basin during an emergency. The 100-N Area will not draw water from the export system during this type of emergency.

This water will flow through the existing last-ditch coolant system piping to the reactor and through the lower crossheader. Flow indicating instrumentation similar to that proposed for 105-B shall be installed on the lower crossheaders at 105-DR.

D. 100-F Area

The 105-F storage basin will be supplied water from the 190-F storage tanks, the 187 high tanks and the 183-F sedimentation basins. The modification and instrumentation on the two bottom crossheaders and the method of operation shall be similar to that at 105-B.

E. 100-H Area

The 105-H storage basin will be supplied water from the 190-H storage tanks, the 187-H high tanks, and the 183-H sedimentation basin. Flow indicating instrumentation similar to that proposed for 105-B shall be installed on the lower crossheaders at 105-H.

F. 100-K Area

The 105-KE and 105-KW storage basins will be supplied from the KE and KW sedimentation basins respectively. Existing filtered and process water lines shall be used to transfer the water to the two lowest crossheaders.

Flow indicating equipment to handle flow as indicated on Table I for 105-K shall be installed on the two lowest crossheaders of 105-KE and 105-KW.

V. ACCEPTANCE TEST PROCEDURES

Suitable acceptance test procedures shall be prepared and tests shall be performed to demonstrate the adequacy and operability of the new gravity fed system for initial flow. Tests shall simulate as near as practical the actual emergency condition. The test procedure shall contain an operating procedure specifying which valves are to be closed and opened, which check valves are to be locked open, and all other work necessary for preparing the water plants for the gravity fed system.

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-7-

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HW-78889

VI. REFERENCES

- A. HW-75779 (Secret), "Minimizing Consequences of an Attack Threat," C.A. Priode, December 7, 1962.
- B. HW-77276 (Secret), "Technical Studies Supporting IPD Disaster Planning," P.A. Carlson and R.T. Jaske, July 1, 1963.
- C. HW-76690 (Secret), "Gravity Fed Water Supply to Reactor Storage Basins," J.W. Hedges, April 1, 1963.
- D. HW-77687, "Project Proposal, Gravity Fed Water Supply to Reactor Storage Basins for Plant Stabilization," J.V. Loftus/T.H. Lyons.

L. B. Brinkman

Plant Design Unit
Design Engineering Subsection

LB Brinkman:dl

TABLE I

GRAVITY FLOW TO 105 STORAGE BASINS

BUILDING TO BE SUPPLIED	GRAVITY FEED SOURCE	INITIAL HEAD (FEET)	FINAL HEAD (FEET)	INITIAL FLOW SETTING (GPM)	FLOW AT MINIMUM HEAD (GPM)	CAPACITY AVAILABLE IN M GALS.	DURATION OF FLOW DAYS
105-B	190-B Tanks	40.5	7	210	88	6,300	29
	187-B High Tanks	154	122	31	28	600	14
	183-C Sedim. Basins	22.5	18	125	112	5,800	34
				Total 366		Total 12,700	
105-C	190-C Tanks	22.5	1	380	80	14,800	45
	187-C High Tanks	163.5	141.5	31	28	600	14
				Total 411		Total 15,400	
105-D	190-D Tanks	43.5	6.7	300	118	7,000	23.2
	187-D High Tanks	155	123	21	18	600	21
	183-DR, D Sedim. Basin			50	21	1,260	24
				Total 371		Total 8,860	
105-DR	183-D, DR Sedim. Basin	14.5	7.5	260	108	6,340	24
	Export System	240	50	90	41	2,000	21
	105-DR High Tanks	153.5	121.5	21	18	600	21
				Total 371		Total 8,940	
105-F	190-F Tanks	40.7	5	280	96	6,800	25
	187-F High Tanks	153	121	31	28	600	14
	183-F Sedim. Basins	14.7	11.0	60	50	2,000	25
				Total 371		Total 9,400	
105-H	190-H Tanks	43	3	260	68	7,600	32
	187-H High tanks	155	123	31	28	600	14
	183-H Sedim. Basins	4.5	1	80	38	2,600	30
				Total 371		Total 10,800	
105-K	183-K Sedim. Basins	20	3	900	350	33,000	36.5

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-8-

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GRAPH A
EMERGENCY STORAGE
BASIN COOLANT
105-B FWH REACTORS

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GRAPH
EMERGENCY STORAGE
BASIN COOLANT
FEED RATE REACTORS

GRAVITY FED FLOW RATE 105-DK
GRAVITY FED FLOW RATE 105-DK

* FROM MW 77276

REQUIRED BASIN FLOW RATE

TIME AFTER SHUTDOWN - DAYS

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GRAPH C
 EMERGENCY STORAGE
 BASIN COOLANT
 125 C REACTOR

GRAVITY FEED FLOW RATE

REQUIRED FLOW RATE

*FROM HW 77276

TIME AFTER SHUTDOWN - DAYS

24

22

20

18

16

14

12

10

8

6

4

2

500

400

300

200

100

WATER - GPM

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