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SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards draft test procedure & FSAR section re verification of UHS performance.One test objective is to suppl & extend wind speed range of previous drift loss testing.Test to be conducted when plant & environ conditions optimum.

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Washington Public Power Supply System
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August 12, 1983
G02-83-727

Docket No. 50-397

Director of Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
NUREG-0892 SAFETY EVALUATION REPORT,
LICENSING CONDITION (1) ULTIMATE HEAT SINK (UHS)

The subject licensing condition requires a description of operation of the Ultimate Heat Sink, performance of an operational test to verify the UHS adequacy, and the conclusions of leakage tests conducted on the spray ponds.

Attached is a draft version of the test procedure to be used to verify performance of the UHS. An objective of this testing is to supplement and extend the wind speed range of the previous drift loss testing. The Supply System will conduct this test when plant and environmental conditions are optimum. As discussed in the test procedure, a wind greater than 6 mph is a prerequisite for commencing the test. These winds occur most frequently in the late winter-early spring and, hence, the Supply System will schedule this test during the first cycle of operation to take advantage of meteorological conditions. It should be noted that this test will further confirm the leakage rates of the ponds since leakage is determined again prior to drift loss testing.

Attachment 2 is a revision of the WNP-2 FSAR section applicable to the UHS. This revision to the UHS safety evaluation incorporates the results of leakage tests completed February 1983, uses a new minimum pond water level, confirms inclusion of fuel pool heat loads previously considered, and details the plan of operation for the spray ponds that conforms to that described in section 2.4.5 of the WNP-2 Safety Evaluation Report. This revised safety evaluation maximizes heat load and drift and evaporation losses and continues to demonstrate adequate margin for a 30-day supply of water.

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The operational test of the UHS, described in Attachment 1, will satisfy the subject licensing condition. With submittal of the revised FSAR sections, UHS Safety Evaluation, adequate margin has been demonstrated to confirm the operational capability of the UHS. It is the Supply System position that the subject licensing condition will not be a restraint on plant operations, but allow an orderly progression of the power ascension program.

Should you have any further questions or comments with regard to these submittals, please provide them to Mr. P. L. Powell, Acting Manager, WNP-2 Licensing, to enable a prompt Supply System response.

Very truly yours,

GC Sorensen

G. C. Sorensen, Acting Manager,
Nuclear Safety and Regulatory Programs

PLP/tmh
Enclosures

cc: R Auluck - NRC
WS Chin - BPA
A Toth - NRC Site

PROCEDURE NUMBER	APPROVED	DATE
*8.2.92		
VOLUME NAME		
8	OPERATING AND ENGINEERING TEST PROCEDURES	
SECTION		
8.2	POWER ASCENSION TEST PROGRAM	
TITLE		
*8.2.92	ULTIMATE HEAT SINK PERFORMANCE	

8.2.92.1 Purpose

It is the objective of the Ultimate Heat Sink (UHS) performance test to determine the drift loss characteristics of the spray ponds. This confirmatory drift loss testing has been committed to the NRC to verify the conservatism of the upper bound drift loss used in FSAR Safety Analyses (9.2.5). The UHS must contain a 30-day supply of water without makeup.

8.2.92.2 Discussion

Drift loss characteristics are determined by measuring total water loss directly, spray evaporation indirectly, and by calculating surface evaporation. Leakage is determined from total water loss measurements without spraying by subtracting surface evaporative losses.

The testing is performed during relatively high winds (average greater than 6 mph) since drift losses then become an important water loss mechanism.

Pond level measurements are taken with hook gauges to determine total water loss, and spray evaporation is determined by measuring the cooling range of the sprays and calculating evaporation from the range and flow rate. Surface evaporation is calculated from the meteorological and surface temperature data.

The results of this test are expressed as drift loss as a function of wind speed. If the results remain below the upper bound value used in the FSAR safety analysis, no additional analyses will be required. If the new data shows drift losses greater than the previous upper bound, further safety evaluation analyses will be required to determine the impact on UHS capability to meet functional criteria (30-day water supply requirement).

8.2.92.3 Acceptance Criteria

A. Level 1

Not Applicable

B. Level 2

Drift loss at the design wind speed of 6.91 mph (RMS average over 30 days for worst water loss meteorology) is less than or equal to 1.02% of spray flow rate.

8.2.92.4 References

A. Regulatory Guide 1.27

B. FSAR Section 9.2.5

C. WNP-2 Safety Evaluation Report Section 2.4.5

D. 1979 Ultimate Heat Sink Spray System Test Results Report, WPPSS-EN-81-01

E. WNP-2 Spray Pond Drift Loss Test Plan

F. Plant Operating Procedure PPM 2.4.5, Standby Service Water System

8.2.92.5 Materials, Tools, Test Equipment and Temporary Installations

A. Two Weather Measure meteorology stations, or equivalent:

1. Cup anemometer (Model W103-3SS), with signal conditioning module MD103-HF. Accuracy to be greater of ± 0.15 mph or 1%.

2. Vane (Model W104-2), with signal conditioning module MD104-540. Threshold 0.75 mph or less, and resolution 0.72 degree or less.

3. Wet and dry bulb temperature unit (Model R020-10). Accuracy ± 0.5^{o}C.

4. Power Supply Module MD910

5. Anemometers and wind vanes to be not more than 15 feet above the ground.

B. Fifty-six (56) catch pans nominally three feet in diameter, with 1 5/8 inch inside diameter drain pipe at apex of pan. RTD holder to be attached to drain pipe. Each catch pan to be put inside an inflated automotive tire innertube for floatation.

C. Hook gauge and stilling well, accuracy to 0.001 foot. One required for each pond.

D. Data logger (Doric Model 220-100.04 or equivalent) with 100 channel capability and temperature resolution of $\pm 0.1^{o}$F, sampling speed two channels/second.

E. Strip chart recorder suitable for continuous recording of wind speed and direction data.

F. Mercury thermometers, as needed to cover temperature range 50^{o}F to 100^{o}F, $\pm 0.1^{o}$F accuracy.

G. Small gasoline stove

H. Ice

I. Insulated containers for water.

J. Surface temperature measurement RTD's mounted in an innertube or other suitable floatation device with RTD probe at least 3" but not more than 9" deep in water. Ten required (see Figure 1).

K. Discharge water temperature measurement RTD's (2) to be installed down stream of valve SW-V-170B.

<u>NOTE</u>: Instrumentation locations to be as shown in Figure 1.

8.2.92.6 <u>Precautions and/or Limitations</u>

A. Standby Service Water System operation is to be in compliance with plant operating procedure PPM 2.4.5.

B. Testing is not to be conducted during periods of precipitation.

8.2.92.7 <u>Prerequisites</u>

A. Loop B of the Standby Service Water System is available to support this test.

B. Wind speed is averaging above 6 mph as estimated from brush recorder.

C. An approved plant operating procedure exists and is used for operation of the Standby Service Water System.

D. This test procedure is that revision currently approved for UHS performance testing.

E. Shift Manager's approval for testing has been obtained on Table 11.1.

F. The test acceptance criteria have been reviewed by the test engineer.

G. Precautions and/or limitations have been reviewed and are understood by the test engineer.

H. All necessary temporary installation has been installed, and instrument calibration due dates are appropriate for the duration of this test (up to 30 days).

I. Spray pond leakage test has been performed per SLT-58.0-4 within four weeks of start of this testing.

J. Initial spray pond levels equal to or greater than 432' 9" elevation and less than 433' 9".

K. Isolate the TMU makeup source to the spray ponds (close TMU-V-10A and TMU-V-10B).

8.2.92.8 Procedure

A. Maintain the test instrumentation in a state of readiness until periods of moderate to high winds occur (above about 6 mph average).

B. Contact the control room when winds are appropriate for testing (greater than 6 mph) and start and operate B loop spray per PPM 2.4.5.

NOTE: The data in Steps C, D, and E are to be taken at 30 minute intervals during testing.

C. Using the hook gauges and stilling wells, measure and record spray pond water level in each pond. Record this data on Data Sheet 11.1.

D. Using Data Sheet 11.2, record the relative position of the spray as it enters the catch pans. This data will be used to determine which catch pan data is most representative of spray temperature.

E. Check the brush recorder and data logger to assure proper operation.

F. Continue testing until test engineer determines that testing should be terminated.

G. Upon decision by the test engineer to terminate the test, contact shift manager to request shut down of the sprays (Reference PPM 2.4.5).

H. Test engineers may repeat Steps B through F as appropriate to assure that sufficient data has been acquired. A minimum of 8 hours of data at wind speeds greater than 6 mph should be taken if at all possible.

8.2.92.9 Supporting Information

None required

8.2.92.10 Analysis and Documentation

A. Analysis

The analytical method used in this test for data reduction is referred to as the difference method. The total loss (T), spray evaporative loss (E), surface evaporative loss (S) and leakage (L) are determined from the test data. Drift loss (D) is calculated as the difference between total losses and other components:

$$D = T-E-S-L \quad (1)$$

In equation 1, the terms T and E are large compared to S and L. Since we are dealing with the difference of two relatively large numbers, a small percentage error in T or E can lead to a large percentage error in D if D is small. The percentage error in D due to an error in T or E could be a fraction of T/D or E/D greater than that in T or E. It is, therefore, particularly important that we measure T and E as accurately as possible.

In general it is not possible to have stable meteorological conditions for very long. This is especially true of wind direction and speed, which is one of the key parameters in drift loss. Drift loss is not a linear function of wind speed, and the averaging of wind speed over a wide range of speed should, therefore, be avoided. If total losses must occur for an hour before a change in pond level can be detected, then our data will effectively be averaged over a period of hours. This kind of response time consideration has been factored into measurement techniques.

1. Total Loss Determination

Total water loss is measured directly by the change in water level during the test period. Hook gauges give accuracy ± .001 ft. which corresponds to a resolution of about 500 gallons. Considering that we can expect total losses on the order of 100 gpm, losses can be detected over a four or five minute period.

Level measurements are used directly with pond dimensions to determine total losses.

2. Spray Evaporation

The cooling range and flow rate give the heat dissipation and the meteorological conditions can be used to estimate the fraction of heat transfer that is by evaporation (f_{evap}).

$$E = \frac{(\text{Flow Rate, lbm/min})\ (\ T,\ ^{o}F)\ (C_p\ \text{Btu/lbm}^{o}F)}{h_{fg}\ (\text{Btu/lbm}^{o}\ F)}\ f_{evap}$$

3. Surface Evaporation

Surface evaporation is calculated from meteorological data and pond surface water temperature, using methods from Reference 8.2.92.4.4:

$$M_{es} = 181.6\ \frac{Q_{es}}{\rho h_{fg}} \qquad (2)$$

Where:

M_{es} = Rate of water loss from pond due to surface evaporation, gpm

ρ = Density of water at pond surface temperature, lbm/ft^3

h_{fg} = Heat of vaporization of water at pond surface water temperature, Btu/lbm

Q_{es} = Rate of heat transfer from pond due to surface evaporation, Btu/ft^2 - day

= $(e_s - e_a)\ (70 + .70^2)$

e_s = Saturated vapor pressure at the water surface temperature, mmHg

e_a = Air vapor pressure, mmHg

U = Wind velocity, mph

Equation two is integrated step wise over the period of the testing to determine the water loss due to surface evaporation.

4. Leakage

Leakage is determined just prior to this test by observing pond level changes over a period of several days. Pond level measurements taken with hook gauges are used to determine the leakage rate at full pond level. This rate is then used with test duration to determine leakage rate during the testing period.

5. Drift Loss Verses Wind Speed

The data taken is reviewed to identify time periods when wind speed is relatively constant. For these periods the total loss, spray evaporation, surface evaporation and leakage are determined and drift loss calculated. This is done for as many time periods as are available, and each calculation provides one point on the drift loss verses wind speed plot. An upper bound is determined from the data and compared to the drift loss data used in the FSAR Safety Analysis. The safety analysis will be repeated if the new drift loss data results in higher design basis drift loss values at the design wind speed (1.02% of flow at 6.9 mph).

B. Documentation

The test results will be evaluated and reported to the NRC in an FSAR Amendment. An Internal Report will be prepared which provides details of the data reduction and calculations performed.

8.2.92.11 Attachments

A. Data Sheets

1. 11.1, Spray Pond Level

2. 11.2, Spray Pattern

B. Tables

1. 11.1, Test Authorization

2. 11.2, Acceptance Criteria Verification

3. 11.3, Precautions and/or Limitations Verification

4. 11.4, Prerequisites Verification

C. Figures

11.1, Instrumentation Location

DATA SHEET 11.1

Spray Pond Level Data

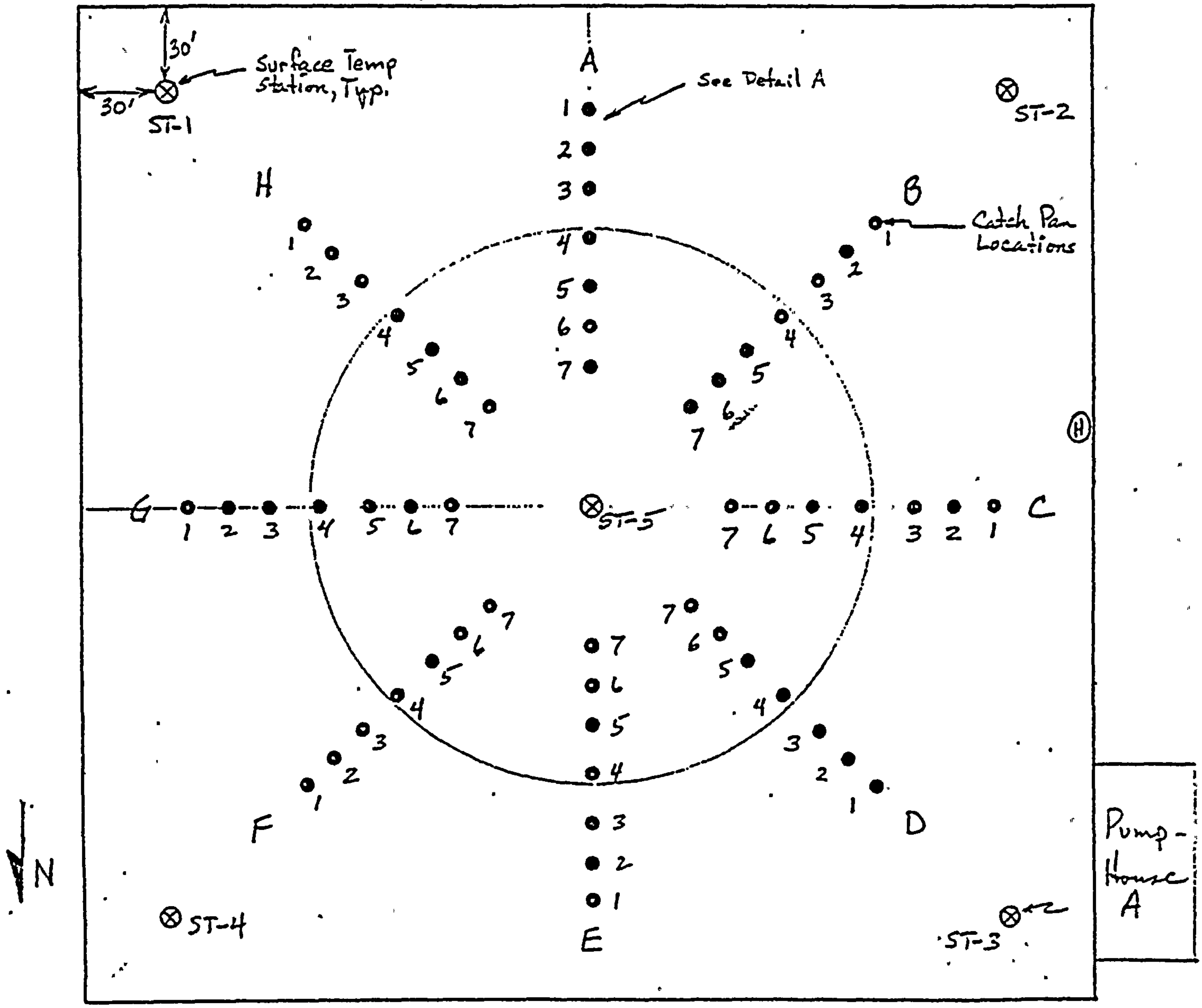
		Pond A Hook Gauge #_____ Cal. Due Date _____		Pond B Hook Gauge #_____ Cal. Due Date _____	
Data Point	Date	Time	Reading (In)	Time	Reading (In)

DATA SHEET 11.2

Spray Pattern

Data Point ______________

DATE ____________________ TIME ____________________



PROCEDURE NUMBER	REVISION NUMBER	PAGE NUMBER
8.2.92	0	8.2.92-9 of 14

WP-598

TABLE 11.1

Test Authorization

Ultimate Heat Sink Performance Test

Test Period No.	Test Engineer Signature	Shift Manager Signature	Date
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

TABLE 11.2 ACCEPTANCE CRITERIA VERIFICATION

PROCEDURE STEP NUMBER	VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED	
8.2.92.	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DA
3.A																
3.B																

11.3 PRECAUTIONS AND LIMITATIONS VERIFICATION

PROCEDURE STEP NUMBER	VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED	
8.2.92.	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DA
6.A																
6.B																

TABLE 11.4 PREREQUISITE VERIFICATION

PROCEDURE STEP NUMBER																
	VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED		VERIFIED	
8.2.92.	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DATE	INIT.	DA[illegible]
7.A																
7.B																
7.C																
7.D																
7.E																
7.F																
7.G																
7.H.																
7.I.																
7.J.																
7.K																

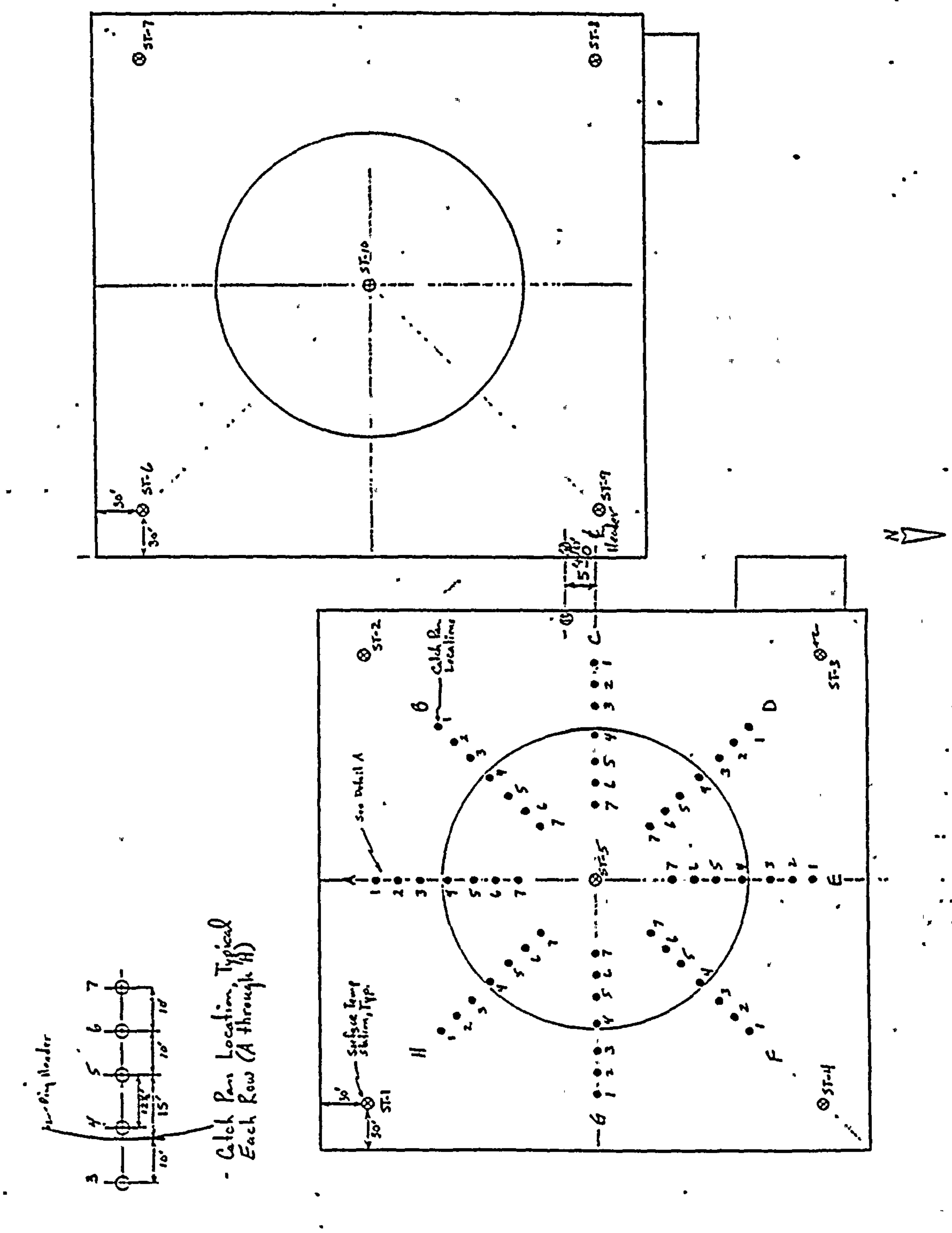


Figure 11.1 - Instrumentation Location

charge header of the pumps stops the jockey pump and starts one of the two main pumps on an increase in demand of system flow. Upon a further increase in flow demand, above 140 gpm, the flow meter automatically starts the second pump. When the flow demand decreases below 140 gpm, the second main pump stops. If flow demand continues to decrease to below 50 gpm, the jockey pump starts and the main pump stops.

During the starting sequence if one pump fails to start, the sequence automatically continues to the next pump and a local alarm and light indicate pump failure. Upon indication of low potable water storage tank level, all pumps stop.

The reactor building potable water booster pumps are automatically cycled on and off by a pressure switch in the pressurizing tanks on the pump discharge in order to maintain header pressure between 20 and 50 psig.

All electric water heaters are thermostatically controlled to maintain the tank at the desired setpoint. The hot water circulating pumps in the service building and radwaste building are cycled by a thermostat with sensor in the hot water recirculation line set to maintain the loop at a minimum setpoint.

9.2.5 ULTIMATE HEAT SINK

9.2.5.1 Design Bases

a. The ultimate heat sink (UHS), a spray pond system, supplies cooling water to remove heat from all nuclear plant equipment which is essential for a safe and orderly shutdown of the reactor and to maintain it in a safe condition.

b. The ultimate heat sink is capable of accomplishing its safety function for a normal cooldown or an emergency cooldown following a loss of coolant accident without the availability of off-site power. The sink provides this cooling capability for a period of 30 days without outside makeup. Provisions are made for replenishment of the sink to allow continued cooling capability beyond the initial 30-day period. The sink will accomplish its safety function despite the occurrance of the most severe site related natural events including earthquake, tornado, flood or drought.

No change

. The ultimate heat sink is designed to satisfy the regulatory requirements of Regulatory Guide 1.27 (Rev. 1). See Appendix C and 2.3.1.2.3.

. System Description

· ll normal operating conditions, including startups and shutdown, waste heat from the reactor auxiliaries is rred to the circulating water system. Heat from this is in turn rejected to the atmosphere by the normal cooling tower system.

..owing any event that would prevent the use of the plant ing towers, the heat rejection duties are transferred to spray ponds. The ultimate heat sink consists of two crete ponds with redundant pumping and spray facilities. pond and pumphouse arrangements are shown on Figure ·11. The ponds and pumphouses are designed to Seismic tegory I requirements. Standby service water (SW) A draws water from pond A, cools the Division I equip-... required for safe shutdown, and discharges through the ray ring in pond B for heat dissipation. Similarly, SW B draws water from pond B, cools Division II equipment, scharges through the spray ring in pond A. The HPCS SW draws water from pond A, cools Division III and dis- without spray into pond A. A syphon between the ponds for water flow from one pond to the other.

ay system illustrated in Figure 9.2-11 consists of two of spray trees -- one for each of the concrete ponds. Each annulus is 140.0 feet in diameter and contains 32 spray trees equally spaced (13.75 feet between vertical centerlines) on the circumference. The vertical trees are serviced by the annulus water pipe, 20 inches in diameter, mounted above the water level. The annulus pipe is fed by the main header from each respective pumphouse. Each spray tree consists of a vertical riser pipe or trunk 8 inches in diameter and 7 horizontal limbs of 1-1/2 inch pipe. The limbs are attached to the riser at 2'8" intervals of heights and are rotated at 90° subsequent angles from each other so that the arms resemble a counter-clockwise helix with increasing height. The arms radial to the annulus are 4'6-7/16" long. The lowermost arm is tangent arm. The arms tangent to the annulus pipe are long. Spray nozzles are located at the end of each arm are connected by fittings. The orientation of every is radially inward with an angle of 55° upward from horizontal. The nozzles are 1-1/2-CX-27-55 Whirljet supplied by Spraying Systems Company. Since each

tree nozzle is located at a different elevation, each nozzle pressure is different. The uppermost nozzle water pressure is 17.0 psig, and the total water flow from a tree is approximately 300 gpm.

The HPCS SSW flow, 1192 gpm, is treated as a straight heat dump in the thermal analyses.

The combined water volume of the spray ponds is adequate to provide cooling water for 30 days without makeup. Although the pond is not used for cooling during normal operation, some small losses are to be expected due to normal evaporation from the surface and occasional blowdown needed to maintain water chemistry. A gravity makeup line is provided from the circulating water pumphouse to the spray ponds to automatically maintain the pond water at the required level. The ponds can also be supplied directly from the plant makeup water pumps (see 10.4.5). Design parameters for the spray pond are given in Tables 9.2-1 and 9.2-2.

A standby service water pump is located in each spray pond pumphouse along with its associated equipment so that an accident, such as a fire or pipe break associated with one pump would not affect the operation of the redundant pump.

The bottom of the pump sump is depressed below the pond bottom. This ensures that there is still sufficient submergence for the pumps at the lowest possible water level in the pond. A sand trap, and screen precede the pump sump to prevent heavy debris from entering the pump sump area. A skimmer wall and fixed screen prevent floating debris from entering the pumps.

A spray ring bypass is provided so that the water temperature may be controlled during cold weather operation. When the pond temperature drops below approximately 60°F, the spray ring may be bypassed by opening the dump valve returning water directly to the pond.

To prevent adverse operation during freezing weather, all SSW piping and components are either below the frost line, within the heated pump houses, heat traced, or, in the case of the spray rings, kept drained by the return header dump when not in operation.

9.2.5.3 Safety Evaluation

An oriented spray cooling system (OSCS) is utilized for cooling the water inventory of the ultimate heat sink. OSCS has been developed as a result of intensive analytical studies and experimental verification over a period of more than six years. Details of the OSCS experimental and analytical developmental efforts are described in Topical Report, Oriented Spray Cooling System (OSCS) for Ultimate Heat Sink Application (UHS), I-R 100 which has been submitted for Nuclear Regulatory Commission staff review.

The thermal performance model is based on the correlation of the Canadys test data described in Section 3.1 of the Topical Report, I-R 100. The resulting KAV/L for this application is 2.66. This includes a 10% derate of the KAV/L to cover conservatively the data scatter experienced at Canadys. Since the KAV/L represents the performance of the specified geometry and nozzle pressure, the KAV/L combined with the meteorological data are sufficient to determine the system cooling performance. The performance predicted by this model is modified as shown below to better correlate with the test data given in Reference A.

$$CR = (-0.761 + 0.009\,TWB) + (0.2677 + 0.004029\,TWB)\,CP + (0.001179 - 7.14\cdot 10^{-6}\,TWB) \times CP^2$$

CR = cooling range
TWB = wet bulb temperature
CP = cooling potential

The system model for both the thermal performance analysis and the mass loss analysis was based on the following assumptions:

a. The pond contains total inventory upon onset of LOCA less 0.5 feet for sedimentation of the pond basin.

b. Water losses result only from drift, leakage, evaporation of the sprayed droplets, and evaporation due to heat rejection on the pond surface.

c. All the heat transfer is accomplished by evaporation, none of the heat transfer is accomplished by sensible heat transfer.

d. The first three days of the thermal performance analysis assume the worst single day of record conditions (Table 9.2-4, Page 1 of 3). It was found that repeating the worst day conditions for

three days resulted in the maximum peak. The fourth through thirtieth days are the average meteorological conditions of the worst 30-day period of record (Table 9.2-4 Page 2 of 3). For conservatism, the RMS average wind speed during each period is used rather than the diurnal variation.

e. The first through thirtieth days of the mass loss analysis are the average meteorological conditions of the worst 30-day period of record (see 2.3.1.2.3 and Table 9.2-4, Page 3 of 3). The analysis assumes a mass loss due to drift of 1.02% of the spray flow. This value is an upper bound obtained from test results performed on the spray ponds.

f. For the design basis mass loss case evaluation, ~~the spray flow is continuous~~ for one spray ring for the first three days, with one standby service water pump in operation. ~~For the mass loss case evaluation,~~ the sprays are cycled on and off for the fourth through thirtieth day depending on pond temperature. The sprays are turned on when the standby service water temperature reaches 85°F and are turned off when the temperature drops below 80°F. This method of operation resulted in one cycle on and off per day.

g. Minor leakage was observed in testing of the spray ponds, so test results were used to establish a leakage rate of 3.94 gpm total for both ponds (170,000 gal per 30 days.)

h. While not a design basis case, mass loss was also evaluated assuming two spray rings in continuous operation for 2 days, followed by one ~~spray~~ spray ring in cyclic mode described in f above.

i. Analyses are performed assuming the fuel pool cooling system upgrade has been completed. This maximizes heat load on the UHS, and maximizes drift and evaporation losses. Inclusion of the fuel pool cooling system adds to the analysis the fuel pool heat load, pump room cooler load, and fuel pool cooling pump work.

(For design basis analysis)

j g. Offsite power is lost and Division 2 diesel fails to start, resulting in a loss of the pond A spray header. (Division 1 heat loads are slightly higher.)

k h. The major heat loads considered are reactor core decay heat, sensible heat from both the coolant and the reactor, fuel pool decay heat, pump work, and the heat removed from the station auxiliaries. These heat loads are detailed in Table 9.2-5 (using the calculated heat load values), Table 9.2-8, and Figures 9.2-7a through 9.2-7e. The fuel pool decay heat values, listed in Table 9.2-5 as variable, is found in Table 9.2-8. No credit was taken for heat sinks in the primary containment other than the suppression pool volume.

The RMS average wind speed during the selected thirty-day period for the mass loss analysis was 5.91 mph. The drift loss was based on the calculated drift value at the RMS wind speed. The mass loss analysis thus demonstrates that the spray ponds contain sufficient water inventory to meet drift losses significantly higher than expected.

The analyses assume an initial temperature of 77°F. This is approximately the highest monthly average temperature expected if the sprays are not operated. To maintain the pond temperature below this limit, the spray headers will be operated and/or river water makeup to the cooling towers will be diverted through the spray ponds. Analyses have been performed which demonstrate that the above operations can maintain the spray pond below 77°F.

An analysis was conducted which verified failure of Division 1 or Division 2 power results in the most severe service water transient. If the failure was postulated in Division 3 (HPCS) instead of Division 1 or 2, the peak pond temperature is lower. The HPCS SW flow is a straight heat dump; therefore, inasmuch as the spray pond is concerned, it raises rather than lowers the temperature transient.

The resulting peak spray pond temperature, 88.6°F, predicted by the "worst case" analysis is considerably below the 95°F service water temperature assumed in the analysis performed in 6.2.1 for containment heat removal, adding further conservatism to the containment temperature and pressure transients therein presented. The service water temperature, however, exceeds the design basis temperature, 85°F, for short periods

of time as shown in Figure 9.2-7a. This results in a predicted peak temperature for some of the electrical equipment rooms served by emergency HVAC equipment of, at most, 3°F higher than the continuous operating temperature limit for the equipment.

Provisions are being made to assure that the small temperature difference will have no significant deleterious effect on equipment functional performance.

A sensitivity study was performed to determine the effect of the RHR heat exchanger effectiveness on the suppression pool and spray pond temperature transients. The RHR heat exchanger effectiveness varies with the amount of fouling and with the flow rates. RHR heat exchanger flows different from the rated values in Table 6.2-2 are anticipated only ~~if~~ the operator delays or fails to close the RHR heat exchanger shellside bypass valve as discussed in 6.2.2.3. Anticipated variations in flow and fouling were determined to have essentially no affect on the spray pond temperature transient following a design basis LOCA, but were determined to have an impact on the suppression pool temperature transient. The most severe postulated suppression pool transient results from assuming a fully fouled RHR heat exchanger and no operator action to close the shellside bypass valve. This suppression pool transient, presented in Figure 9.2-7b, is slightly less severe than the suppression pool transient presented in 6.2.1 which assumed a steady 95°F service water temperature and that the operator closed the RHR heat exchanger bypass valves.

The results of the (design basis) mass loss analysis assuming an unfouled heat exchanger is shown in Figure 9.2-8 and is tabulated in Table 9.2-3. For the design basis mass loss analysis, remaining pond volume (both ponds) is 2.65x10⁶ gal. With 1.4x10⁶ gal required for operation of the system, ~~the water volume margin is 1.25x10⁶ gal.~~ Drift losses following loss of makeup to the ponds ~~are~~ may be controlled during two spray ring operations by bypassing the spray header on one pond whenever spray pond temperatures drop below approximately 80°F. Continuous, simultaneous operation of both spray rings is not required after a LOCA. Since the two SW loops are redundant to each other, the operators will be able to secure any redundant safe shutdown equipment when they determine that the peak temperatures have been past. ~~In addition, the difference between assumed and calculated drift losses for continuous operation of one spray ring, is more than adequate to account for drift losses from the operation of the second spray ring or several days after the accident.~~

The mass loss analysis done assuming (continuous) two spray ring operation for the first two days showed that 2.28 million gallons would remain after 30 days of cooling without makeup. Since only 1.4 million gallons are required for system operation, a margin of 880 000 gallons exists.

Table 9.2-7 lists the available sources of makeup water to provide continued cooling beyond the initial 30-day period. This table assumes that offsite power is restored within the 30 days. No credit is taken for the water stored in the cooling tower basins. However, it is expected that this water will not be instantaneously lost and will flow to the pond for the same period of time. Table 9.2-7 also summarizes the effects of natural phenomena and of a LOCA on the water supplies to the spray pond.

The possibility of a tornado passing over the spray pond and removing a significant amount of water is considered a credible event. For this reason, the makeup water pumphouse is designed to be tornado proof, with all piping and electrical power supply between the plant and the pumphouse

underground. Since it is not credible to assume an earthquake coincident with a tornado, this system need not be Seismic Category I. Two 12,500 gpm plant makeup water pumps are provided, one powered from each emergency diesel generator. Should pond water be lost due to a tornado, one of these pumps will be started to provide makeup. Makeup supply to the spray ponds is controlled by level switches that automatically open a supply valve to allow gravity drain from the circulating water pump basin to replenish spray pond level when it reaches the makeup setpoint.

9.2.5.4 Testing and Inspection Requirements

After completion of the spray pond, an inspection and test program has been established to ensure that the spray system will accomplish its safety function as discussed in 14.2. Included in this program is a drift loss test to be performed before the first refueling outage. The test will be done to further confirm the adequacy of the UHS water volume. All valves and piping in the system have been hydrostatically tested in the shop per ASME Section III, Class 3. After installation the system is hydrostatically tested and visually inspected. During plant operation the system is periodically tested.

Preservice and inservice inspections for the spray system will be in accordance with 6.6.

9.2.5.5 Instrumentation Requirements

The spray pond is equipped with redundant level and temperature sensors which are alarmed and indicated in the main control room as well as locally.

In the event that the spray pond level falls below the minimum level required for 30 days of cooling, an alarm is sounded and makeup automatically is provided directly from the plant makeup water line to the spray pond.

High and low temperature alarms are provided. In the event that the pond water temperature approaches the design limit, the spray system is initiated to lower the temperature. Upon low water temperature signal, return water is dumped directly into the ponds to prevent spray trees and spray headers from icing.

TABLE 9.2-1

ULTIMATE HEAT SINK SPRAY COOLING
POND DESIGN DATA

Pond configuration	Square (250' x 250')
Surface area (two ponds)	125,000 sq. ft.
Normal water elevation (above MSL)	433'6" ~~434'-0"~~ ~~[illegible]~~"
Maximum water elevation (above MSL)	434'-6"
Pond bottom elevation (above MSL)	420'-0"
Pump sump bottom elevation (above MSL)	408'-3"
Freeboard above normal water level	~~0'-6"~~ 1'-0"
Sedimentation allowance	0'-6"
Normal pond capacity (two ponds) el. 433'6"	12,400,000 gallons
Minimum pond capacity (two ponds) el. 432'9")	11,700,000 gallons

TABLE 9.2-2

DESIGN PARAMETERS FOR THE SPRAY SYSTEM

Number of systems	2
Number of trees per system	32
Diameter of the ring headers	140'-0"
Circumferential spacing between trees	13'-9"
Number of horizontal arms per riser	7
Pressure at top nozzle	17.3* psig
Pressure at interface (flange)	24.5* psig
Flow rate per tree at design pressure	321.9* gpm
Total flow rate per system	10,300* gpm
Nozzle type	Spraying Systems Company 1-1/2-CX-27-55
Height of vertical riser	17'-9"
Spacing between arms	32"
Height of bottom nozzle elevation from system interface (flange) riser pipe diameter	6-11/16"
Riser pipe	8", Schedule 80
Horizontal branch arm pipe	1-1/2", Schedule 80

* Flow rates and pressures are for final design with fuel pool cooling system upgraded ~~by first refueling outage~~ (See Section 9.1.3) Prior to completion of fuel pool cooling upgrade, total flow is (approximately) 9750 gpm.

TABLE 9.2-3

TOTAL SPRAY POND WATER LOSSES AND CONTENT 30 DAYS AFTER DESIGN BASIS LOCA EVENT

Drift losses	~~2,845,952~~ 2.84 x 10⁶ gal
Spray evaporation	~~4,986,676~~ 4.99 x 10⁶ gal
Surface evaporation	~~876,842~~ 0.88 x 10⁶ gal
Hydrogen recombiner	~~172,510~~ 0.17 x 10⁶ gal
Leakage	~~170,000 gal~~ 0.17 x 10⁶
Total	~~8,871,620~~ 9.05 x 10⁶ gal
Remaining inventory	~~3,761,661~~ 2.65 x 10⁶ gal
Min. Volume Required for System Operation	1.4 x 10⁶ gal
Margin	1.25 x 10⁶ gal.

TABLE 9.2-4

DIURNAL VARIATION IN METEOROLOGICAL DATA (FOR WORST SINGLE DAY OF RECORD USED TO ANALYZE THE POND THERMAL RESPONSE DURING FIRST THREE DAYS FOLLOWING LOCA)

Hour	Dry Bulb (°F)	Dew Point (°F)	Wet Bulb (°F)	Wind* Speed (mph)	Solar Radiation ($\frac{BTU}{hr}$)
Noon	100.91	59.41	72.98	6.60	290.81
1:00 p.m.	103.09	59.69	73.58	6.60	282.71
2:00	105.20	58.91	73.96	6.60	261.30
3:00	105.71	56.00	72.80	6.60	226.27
4:00	104.93	54.11	71.78	6.60	180.98
5:00	102.48	55.88	71.81	6.60	127.56
6:00	101.15	56.05	71.50	6.60	70.89
7:00	98.27	56.13	70.68	6.60	16.86
8:00	96.21	56.59	70.27	6.60	0.00
9:00	90.72	60.53	70.57	6.60	0.00
10:00	91.33	57.68	69.31	6.60	0.00
11:00	91.49	60.48	70.77	6.60	0.00
Midnight	90.91	58.03	69.35	6.60	0.00
1:00 a.m.	85.92	59.17	68.39	6.60	0.00
2:00	84.24	57.28	66.88	6.60	0.00
3:00	80.61	56.21	65.14	6.60	0.00
4:00	80.24	58.48	66.21	6.60	0.00
5:00	78.27	59.55	66.15	6.60	16.86
6:00	83.25	62.99	69.65	6.60	70.89
7:00	86.77	62.91	70.67	6.60	127.56
8:00	90.64	61.09	70.83	6.60	180.98
9:00	92.64	62.00	71.90	6.60	226.27
10:00	95.23	63.36	73.38	6.60	261.30
11:00	98.32	62.40	73.73	6.60	282.71

Data based upon 10 July 1975.

* Wind speed is average wind speed for period.

TABLE 9.2-4 (Continued)

DIURNAL VARIATION IN METEOROLOGICAL DATA (FOR DAY 4 THRU 30 USED TO ANALYZE POND THERMAL RESPONSE FOLLOWING LOCA)

Hour	Dry Bulb (°F)	Dew Point (°F)	Wet Bulb (°F)	Wind * Speed (mph)	Solar Radiation (BTU/hr)
Noon	95.40	45.9	65.5	5.50	290.81
1:00 p.m.	96.80	46.1	66.0	5.50	282.71
2:00	97.30	46.1	66.2	5.50	261.30
3:00	96.80	46.2	66.0	5.50	226.27
4:00	95.40	46.2	65.5	5.50	180.98
5:00	93.10	46.0	64.7	5.50	127.56
6:00	90.10	45.6	63.6	5.50	70.89
7:00	86.60	45.6	62.3	5.50	16.86
8:00	82.80	45.6	61.0	5.50	0.00
9:00	79.00	45.2	59.6	5.50	0.00
10:00	75.60	45.6	58.4	5.50	0.00
11:00	72.50	46.0	57.3	5.50	0.00
Midnight	70.20	46.2	56.5	5.50	0.00
1:00 a.m.	68.80	46.0	56.0	5.50	0.00
2:00	68.30	46.3	55.8	5.50	0.00
3:00	68.80	46.1	56.0	5.50	0.00
4:00	70.20	46.2	56.5	5.50	0.00
5:00	72.50	45.8	57.3	5.50	16.86
6:00	75.60	46.0	58.4	5.50	70.89
7:00	79.00	46.6	59.6	5.50	127.56
8:00	82.80	45.8	61.0	5.50	180.98
9:00	86.60	45.6	62.3	5.50	226.27
10:00	90.10	45.8	63.6	5.50	261.30
11:00	93.10	45.8	64.7	5.50	282.71

Data based upon average values for the period 9 July - 8 August 1961.

* Wind speed is average wind speed for the period.

TABLE 9.2-4 (Continued)

DIURNAL VARIATION IN METEOROLOGICAL DATA (FOR DAY 1 THRU 30 USED TO ANALYZE MASS LOSS FOLLOWING LOCA)

Hour	Dry Bulb (°F)	Dew Point (°F)	Wet Bulb (°F)	Wind* Speed (mph)	Solar Radiation (BTU/hr)
Noon	96.40	42.50	64.70	6.91	290.81
1:00 p.m.	98.00	43.50	65.40	6.91	282.71
2:00	98.50	43.50	65.60	6.91	261.30
3:00	98.00	43.50	65.40	6.91	226.27
4:00	96.40	42.50	64.70	6.91	180.98
5:00	93.90	42.00	63.70	6.91	127.56
6:00	90.70	42.00	62.30	6.91	70.89
7:00	86.90	40.50	60.70	6.91	16.86
8:00	82.90	40.00	59.00	6.91	0.00
9:00	78.90	40.00	57.30	6.91	0.00
10:00	75.10	39.00	55.70	6.91	0.00
11:00	71.90	39.00	54.30	6.91	0.00
Midnight	69.40	39.00	53.30	6.91	0.00
1:00 a.m.	67.80	39.00	52.60	6.91	0.00
2:00	67.30	39.00	52.40	6.91	0.00
3:00	67.80	39.00	52.60	6.91	0.00
4:00	69.40	39.00	53.30	6.91	0.00
5:00	71.90	39.50	54.30	6.91	16.86
6:00	75.10	39.00	55.70	6.91	70.89
7:00	78.90	40.00	57.30	6.91	127.56
8:00	82.90	40.00	59.00	6.91	180.98
9:00	86.90	40.70	60.70	6.91	226.27
10:00	90.70	42.00	62.30	6.91	261.30
11:00	93.90	42.20	63.70	6.91	282.71

Data based upon average values for the period 2 July - 1 August 1960.

* Wind speed is the RMS average wind speed for the period.

TABLE 9.2-5

EQUIPMENT REQUIRING STANDBY SERVICE
WATER TO ENSURE PLANT SHUTDOWN

	Equipment Cooled	Required Flow-gpm[1]	Design Heat Load (Btu/hr)	Calculated Heat Load (Btu/hr)
Division I				
1.	Standby Service Water Pumphouse "A" Cooler	80	404,000	380,600
2.	Diesel Generator "A"	1650 (2)	15,600,000	11,692,427
3.	Diesel Generator Building "A" Coolers	144	716,000	716,000
4.	LPCS Pump Motor Bearings	4 (3)	-	~0
5.	LPCS Pump Room Cooler	56	280,000	270,860
6.	RHR "A" Pump Seals	12 (2)	-	~0
7.	RHR "A" Room Cooler	33	165,000	149,650
8.	D.C. Motor Control Center Room Cooler	20	84,200	40,533
9.	Motor Control Center Room Cooler	15	71,280	43,130
10.	Control Room Cooler	120	285,000	256,500
11.	Cable Spreading Room Cooler	40	160,000	74,600
12.	Switchgear Room Cooler	60	370,000	327,100
13.	Hydrogen Recombiner "A" MCC Room Cooler	11	52,500	36,174
14.	Hydrogen Recombiner "A" Aftercooler	50	-	250,000
15.	Hydrogen Recombiner "A" Scrubber	10	-	50,000
16.	RHR "A" Heat Exchanger	7400 (2)	(4)	Variable
17.	Analyzer Room Cooler	10	42,500	23,571
18.	Fuel Pool Pump Room Cooler RRA-CC-20	35	134,120	121,930
19.	Fuel Pool "A" Heat Exchanger (5)	575	4,000,000	Variable
	TOTAL	10,325 (6)		

TABLE 9.2-5 (Continued)

1) Based on 85°F Standby Service Water Supply unless otherwise noted.
2) Design based on 95°F Standby Service Water Supply
3) Design based on 90°F Standby Service Water Supply
4) See Table 6.2-2 for design parameters
~~5) Fuel Pool load b~~
5) Fuel Pool load begins at first refueling outage. Safety analysis of UHS includes fuel pool heat load, fuel pool pump room cooler load, and fuel pool pump work.
6) 9742 gpm prior to completion of fuel pool cooling upgrade (See 9.1.3)

TABLE 9.2-5 (Continued)

Equipment Cooled	Required Flow-gpm(1)	Design Heat Load (Btu/hr)	Calculated Heat Load (Btu/hr)
Division II			
1. Standby Service Water Pumphouse "B" Cooler	80	404,000	358,100
2. Diesel Generator "B"	1650 (2)	15,600,000	11,692,427
3. Diesel Generator Building "B" Coolers	144	716,000	716,000
4. Diesel Generator Area Cable Cooler (Corridor)	40	149,000	109,680
5. RHR "B" Pump Seals	12 (2)	-	∿0
6. RHR "C" Pump Seals	12 (2)	-	∿0
7. RHR "B" Room Cooler	33	165,000	145,650
8. RHR "C" Room Cooler	33	165,000	160,530
9. RCIC Pump Room Cooler	12	60,000	37,270
10. Motor Control Center Room Cooler	15	71,280	43,130
11. Control Room Cooler	120	285,000	256,500
12. Cable Spreading Room Cooler	40	160,000	74,600
13. Switchgear Room Cooler	60	320,000	305,400
14. Hydrogen Recombiner "B" Aftercooler	50	-	250,000
15. Hydrogen Recombiner "B" Scrubber	10	-	50,000
16. Hydrogen Recombiner "B" MCC Room Cooler	11	52,500	36,174
17. RHR "B" Heat Exchanger	7400 (2)	(3)	Variable
18. Analyzer Room Cooler	10	42,500	23,571
19. Fuel Pool Pump Cooler RRA-CC-19	35	134,120	121,930
20. Fuel Pool "B" Heat Exchanger (4)	575	4,000,000	Variable
TOTAL	10,342 (5)		

TABLE 9.2-5 (Continued)

1) Based on 85°F Standby Service Water Supply unless otherwise noted.
2) Design based on 95°F Standby Service Water Supply
3) See Table 6.2-2 for design parameters
4) Fuel Pool load begins after first refueling outage. Safety analysis of UHS includes fuel pool cooling heat load, fuel pool pump room cooler load, and fuel pool pump work.
5) 9732 gpm prior to completion of fuel pool upgrade (See 9.1.3).

TABLE 9.2-5 (Continued)

Equipment Cooled	Required Flow-gpm(1)	Design Heat Load (Btu/hr)	Calculated Heat Load (Btu/hr)
Division III			
1. HPCS Diesel Generator	910 (2)	8,872,000	7,401,000
2. HPCS Diesel Building Coolers	144	716,000	716,000
3. HPCS Pump Room Cooler	50	500,000	473,580
TOTAL	1104		

1) Based on 85°F Standby Service Water Supply unless otherwise noted.
2) Design based on 95°F Standby Service Water Supply

TABLE 9.2-6

STANDBY SERVICE WATER SYSTEM

FAILURE ANALYSIS

Single Active Failure	Analysis
1. Loss of power on one emergency bus due to failure of a diesel generator to start or loss of offsite power.	The service water pump powered by the redundant emergency bus will be automatically started to provide the necessary cooling water.
2. Failure of pump to automatically start.	Same analysis as above.
3. Failure of an isolation valve in the service water piping to the cooling tower.	Redundant valve is operated to perform the isolation function.
4. Failure of ECCS pump room air cooling.	Essential plant cooling requirements met by the redundant ECCS subsystems which have their own independently cooled pump rooms.
5. Failure of a single service water pump during operation.	Essential plant cooling requirements met by the remaining operable redundant emergency core cooling subsystems.
6. Failure of system pressure controller.	Valve fails open on loss of air pressure. In addition, limit stops provided on valve ensures that minimum safe flow exists.
7. Failure of a pump discharge or RHR outlet isolation valve to open.	Essential plant cooling requirements met by the remaining operable redundant emergency core cooling subsystems.

FAILURE ANALYSIS

Single Passive Failure	Analysis
8. Failure of any supply or return piping.	Essential plant cooling requirements met by the remaining intact emergency core cooling subsystem which includes its own independent supply and return service water headers. Passive failures, i.e., pipe whip, missiles, jet loads are discussed in 3.5 and 3.6.1. The SSW system is a moderate energy fluid system since it is operated at less than 275 psig and 200°F.
9. Failure of RHR heat exchanger.	Essential plant cooling requirements met by the remaining intact redundant RHR subsystem which includes its own 100% capacity heat exchanger.
10. Fire	All credible fires and their consequences were evaluated in Reference 9.5-1. Because of physical separation, redundancy, and low inventories of combustibles, there are no credible fires which could impede the SSW from performing its function.

TABLE 9.2-7

SOURCE OF SPRAY POND MAKEUP WATER

Water Source	Design Basis Earthquake	Probable Maximum Flood	River Blockage or Drought	Tornado	LOCA
Plant makeup water pumps	NA	NA	NA	A	A
Cooling tower basin by gravity	NA	A	A	A	A
Tank truck or rail	A	A	A	A	A

NA = not available

A = available

TABLE 9.2-8

HEAT LOAD RATES USED IN UHS ANALYSIS

I. Core Decay Heat Load (1)

See Table 6.2-11

II. Reactor Coolant Sensible Heat Load (1)

The energy (414×10^6 BTU referenced to 32°F) of the reactor coolant is accounted for by starting the suppression pool at 150°F.

III. Reactor Vessel, Piping, and Core Sensible Heat Load (1)

Time (hours)	Rate (10^6 BTU/hr)
$t \leq 24$	8.14
$t > 24$	negligible

IV. Metal-Water Reaction Heat Load (1)

Time (hours)	Rate (10^6 BTU/hr)
$t \leq 1$	0.47
$t > 1$	negligible

V. ECCS Pump Work Load (1) (2) (3)

Time (hours)	Rate (10^6 BTU/hr)
$t \leq 8$	13.168
$t > 8$	5.534

VI. HPCS (Div. 3) Service Water System Heat Load (3) (4)

Time (hours)	Rate (10^6 BTU/hr)
$t \leq 8$	9.17
$t > 8$	0

TABLE 9.2-8 (Continued)

VII. Constant Div. 1 Service Water System Heat Load[5],[6]

Time (hours)	Rate (10^6 BTU/hr)
t ≥ 0	19.202

VIII. Fuel Pool Heat Load[7]

Time (hours)	Rate ($x10^6$ BTU/hr)
t ≥ 0	5.0

TABLE 9.2-8 (Continued)

Notes:

(1) Rejected initially to the suppression pool and subsequently transferred by the RHR heat exchangers to the UHS.

(2)

RHR pump	1.972×10^6 BTU/hr	
LPCS pump	3.5623×10^6 BTU/hr	
HPCS pump	7.6335×10^6 BTU/hr	

(3) HPCS system and HPCS SW system shut down after 8 hours. LPCS system and RHR loop A maintain long-term cooling.

(4)

HPCS service water pump work	0.132314×10^6 BTU/hr
HPCS diesel coolers	9.0377×10^6 BTU/hr
HPCS coolers (Table 9.2-5)	9.0377×10^6 BTU/hr

(5)

Div. 1 Service water pump work	3.91853×10^6 BTU/hr
Div. 1 Diesel Generator	15.2834×10^6 BTU/hr
Coolers and misc. equip. (Table 9.2-5)	15.2834×10^6 BTU/hr

(6) Excludes fuel pool and RHR heat exchanger heat loads

(7) Added to the RHR service water system after first refueling outage. Included in analysis for conservatism.

TABLE 9.2-9

INTEGRATED HEAT DATA - WNP-2 UHS RE-ANALYSIS

Time After LOCA Min.	(1) Q Decay	(2) Q Sens	(3) A Aux 1	(4) Q Aux 2	(5) Q Aux 3	(6) Q Total	(7) Q SW(8)
	10^7 BTU						
0	0	0	0	0	0	0	0
1	3.26	0.014	0.022	0.040	0.015	3.35	0.150
2	4.03	0.027	0.044	0.081	0.031	4.49	0.304
4	5.38	0.054	0.088	0.161	0.061	5.74	0.615
10	8.77	0.136	0.219	0.403	0.153	9.69	1.580
20	13.81	0.271	0.439	0.804	0.306	15.20	3.410
40	20.92	0.543	0.878	1.610	0.635	24.60	6.900
90	36.43	1.220	1.970	3.630	1.380	44.67	16.170
120(2H)	44.59	1.630	2.630	4.840	1.830	55.57	21.750
240(4H)	72.67	3.260	5.270	9.680	3.670	94.59	45.220
360(6H)	97.01	4.880	7.900	14.520	5.500	129.90	69.740
480(8H)	119.50	6.510	10.530	19.360	7.340	163.30	94.800
720(12H)	160.10	9.770	12.750	29.040	7.340	219.10	143.600
960(16H)	197.30	13.020	14.960	38.720	7.340	271.40	194.400
1200(20H)	232.20	16.280	17.180	48.400	7.340	321.50	242.100
1440(1D)	265.40	19.540	19.390	58.100	7.340	369.80	285.100
2160(1.5D)	356.20	19.560	26.030	87.130	7.340	496.30	417.700
2880(2D)	435.50	19.560	32.670	116.200	7.340	611.30	549.200
4320(3D)	570.40	19.560	45.960	174.200	7.340	817.60	803.600
5760(4D)	686.10	19.560	59.430	232.300	7.340	1004.60	1010.100
7200(5D)	792.30	19.560	72.520	290.400	7.340	1182.00	1190.000
8640(6D)	891.90	19.560	85.800	348.500	7.340	1353.00	1371.000
11520(8D)	1073.00	19.560	112.400	464.700	7.340	1677.00	1711.000
14400(10D)	1238.00	19.560	138.900	580.800	7.340	1984.00	2032.000
17280(12D)	1391.00	19.560	165.500	697.000	7.340	2280.00	2341.000
23040(16D)	1673.00	19.560	218.600	929.400	7.340	2848.00	2894.000
28800(20D)	1931.00	19.560	271.800	1162.000	7.340	3392.00	3454.000
34560(24D)	2174.00	19.560	324.900	1394.000	7.340	3919.00	4004.000
43200(30D)	2518.00	19.560	404.600	1742.000	7.340	4692.00	4816.000

TABLE 9.2-9 (Continued)

Notes:

(1)	Q Decay	Integrated core decay heat suppression pool.
(2)	Q Sensible	Integrated sensible heat rejected by the reactor vessel, piping, and core to the suppression pool.
(3)	Q Auxiliary 1	Integrated heat from ECCS pump work rejected to the suppression pool.
(4)	Q Auxiliary 2	Integrated heat from auxiliary systems rejected to Division 1 service water system. This heat includes all sources of heat into Division 1 SW system except for the RHR heat exchanger. The RHR heat exchanger transfers heat from the suppression pool to Division 1 SW system.
(5)	Q Auxiliary 3	Integrated heat from HPCS service water system. This heat is a straight heat dump into spray pond A.
(6)	Q Total	Sum of Q Decay, Q Sensible, Q Auxiliary 1, Q Auxiliary 2, and Q Auxiliary 3.
(7)	Q Service	Sum of Q Auxiliary 2 and the heat rejected Water by the RHR heat exchanger into Division 1 service water system, i.e., the sum of the heat rejected through the spray nozzles.
(8)		The RHR heat exchangers provide suppression pool cooling from 10 minutes through to the end of an accident (30 days). No heat exchanger cooling is assumed for the first 10 minutes of an accident. See 6.2.2.2 and 6.3.2.8 for further information on containment cooling.

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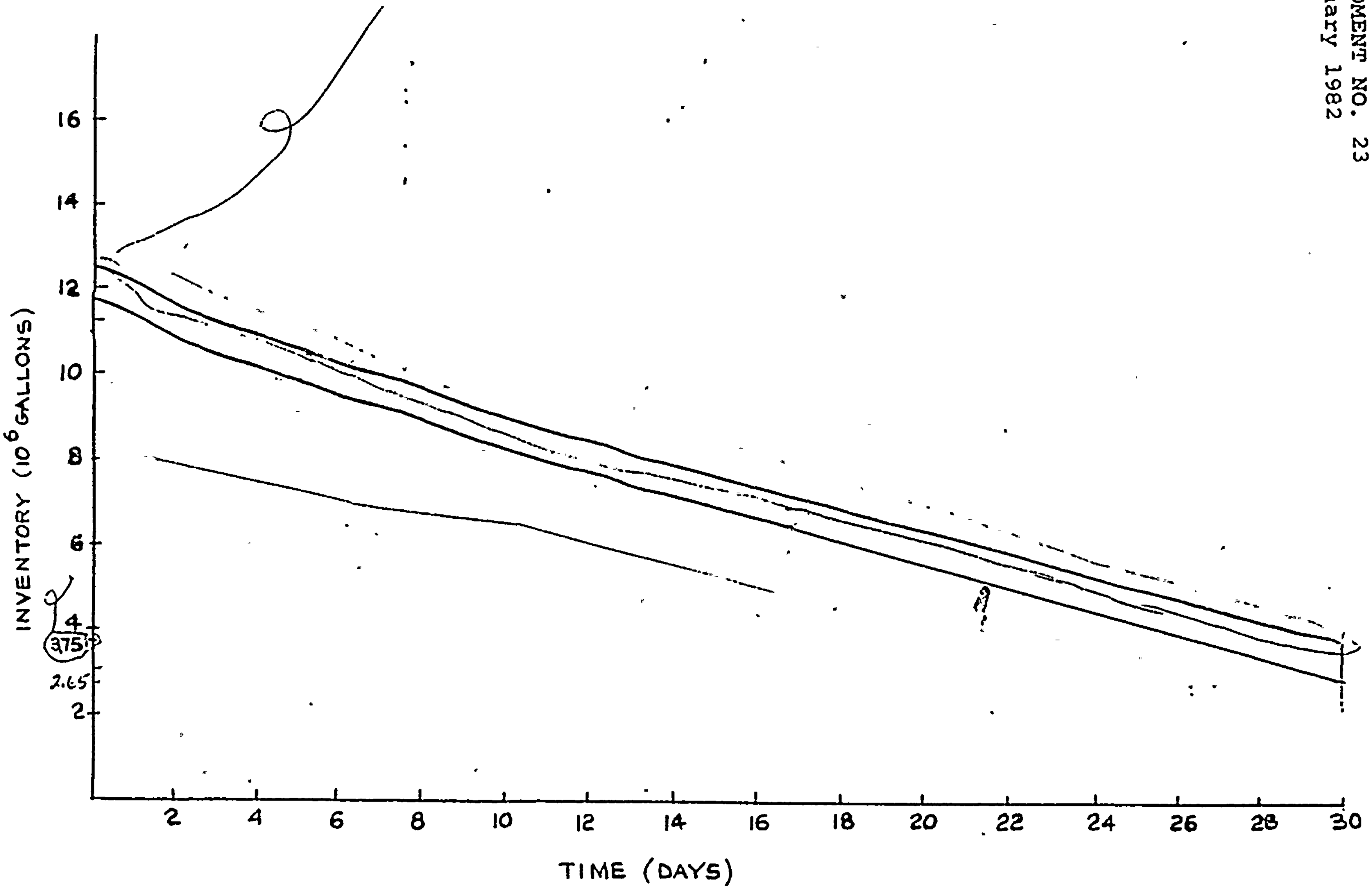

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
NUCLEAR PROJECT NO. 2

WATER INVENTORY IN UHS FOLLOWING
DESIGN BASIS LOCA

FIGURE
9.2-8

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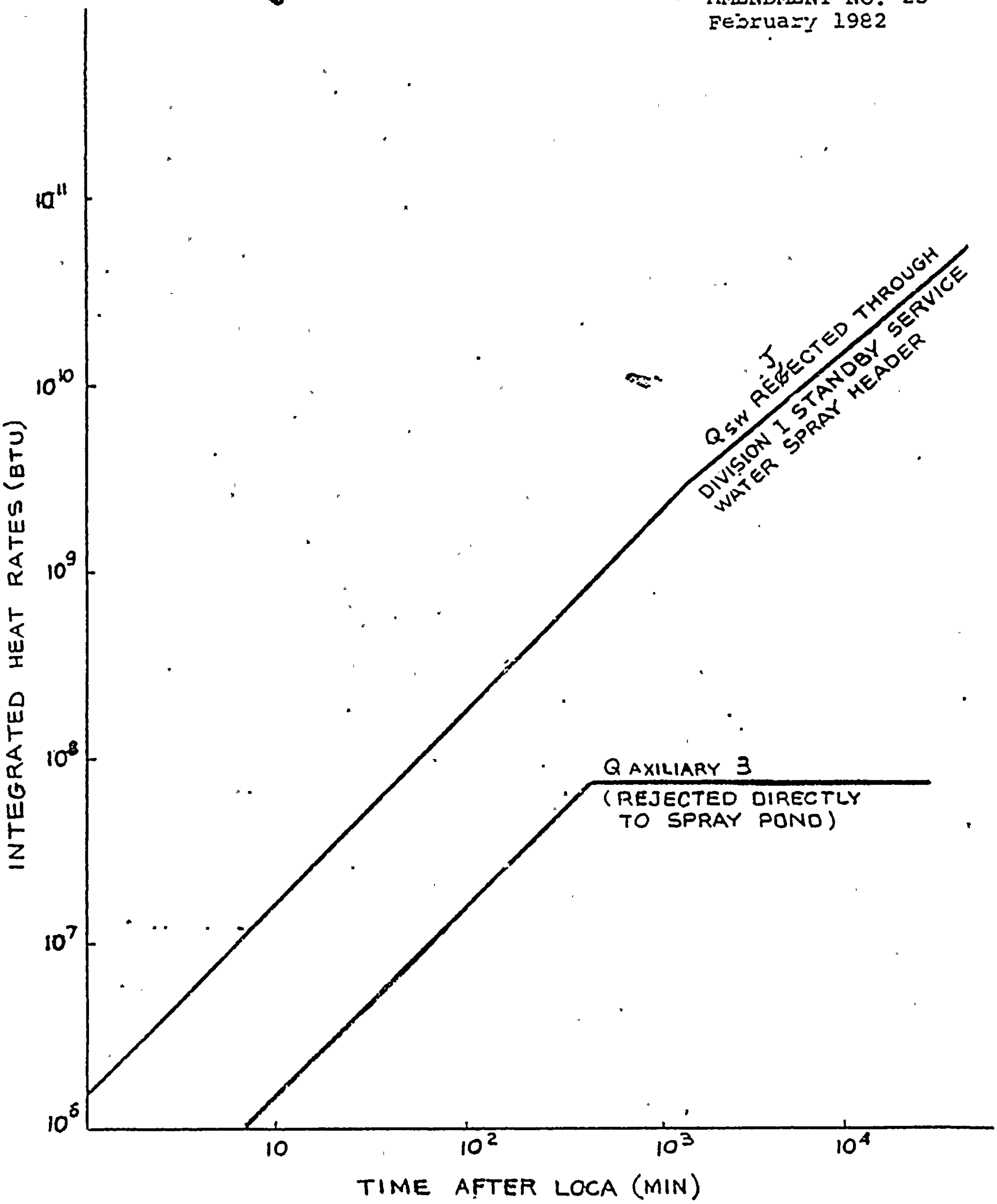

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	INTEGRATED HEAT LOADS REJECTED TO UHS	FIGURE 9.2-7e

[illegible]