AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

Est 26961
Bin 202

DECLASSIFIED
DECLASSIFIED

(CLASSIFICATION)

RECORD CENTER FILE

DOUGLAS UNITED NUCLEAR, INC.

RICHLAND, WASHINGTON

NA

DOCUMENT NO.
DUN-4565
Hanford Code C-65
SERIES AND COPY NO.
A- 20
DATE
August 14, 1968

RESTRICTED DATA AS OF 1954.
ITS TRANSMITTAL OR THE DISCLOSURE OF ITS
CONTENTS IS PROHIBITED.

TITLE
WASHINGTON STATE WATER QUALITY TEMPERATURE
STANDARDS AS RELATED TO REACTOR OPERATION

INFORMATION
AFFECTING
THE NATIONAL DEFENSE
WITHIN THE MEANING OF THE ESPIONAGE LAW
TITLE 18, U.S.C. SECTIONS 793 AND 794, THE TRANS-
MISSION OF INFORMATION IN ANY MANNER
TO AN UNAUTHORIZED PERSON IS PROHIBITED BY
LAW

AUTHOR
J. W. Ballowe
Plant Design Unit
PD Sub-Section
Engineering Section

READING FILE
CIRCULATING COPY
RECEIVED 700 AREA
SEP 6 1968
RETURN TO
DOUGLAS UNITED NUCLEAR, INC.
DOCUMENT CONTROL CENTER

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN APPROVED LOCKED REPOSITORY WITHIN AN APPROVED GUARDED AREA. WHILE IT IS YOUR POSSESSION AND UNTIL YOU HAVE OBTAINED A SIGNED RECEIPT FROM CLASSIFIED FILES, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF THIS PROJECT AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSMITTAL TO, AND STORAGE AT YOUR PLACE OF RESIDENCE IS PROHIBITED. IT IS NOT TO BE DUPLICATED. IF ADDITIONAL COPIES ARE REQUIRED, OBTAIN THEM FROM THE RELATED ISSUING FILE. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE PROVIDED BELOW.

ROUTE TO:	PAYROLL NO.	LOCATION	FILES ROUTE DATE	SIGNATURE AND DATE
DUN Record		703-700		
REC 10-6-75	37028	703-700	10-6-75	
RECORD COPY			10/7/75	
DUN RECORDS DISPOSITION				
Indefinite Retention				
Destruction Date	Until facility is abandoned			
Authority	B-5-2			
DECLASSIFIED				

DECLASSIFIED

-1-

✓ DUN-4565
Hanford Category C-65

This document consists of
6 pages. No. [redacted]
[redacted] pies. Series A.

WASHINGTON STATE WATER QUALITY TEMPERATURE
STANDARDS AS RELATED TO REACTOR OPERATION

by

J. W. Ballowe
Sr. Engineer

Classification Control and Change To
DECLASSIFIED
By Authority of CG-NMP-1
DS Lewis 5/16/94
By WJ [redacted] 5/11/94
Verified By PM Eick 5-18-94

Plant Design Unit
Process Design Sub-Section
Engineering Section

August 14, 1968

Distribution

1. TW Ambrose	14. RS Peterson
2. JW Ballowe	15. JW Riches
3. RS Bell	16. RW Reid
4. DL DeNeal	17. OC Schroeder
5. DM Diediker	18. JO Skolrud
6. RE Dunn	19. AP Vinther
7. RG Geier	20. DUN Record
8. AK Hardin	21. DUN File
9. RT Jessen	22-26. Extra
10. VV Johnson	
11. CW Kuhlman	
12. AR Maguire	
13. JS McMahon	

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED 875

DECLASSIFIED

DECLASSIFIED

-2-

DUN-4565

WASHINGTON STATE WATER QUALITY TEMPERATURE
STANDARDS AS RELATED TO REACTOR OPERATION

I. INTRODUCTION

The purpose of this report is to provide a basic working tool for determining the relationship between the allowable temperature increase within the Columbia River reach at the Hanford Site and the actual temperature increase as associated with various reactor operating modes. This basic tool can be utilized for day-to-day operating purposes or for the achievement of historical information.

II. SUMMARY

Certain modes of reactor operation in combination with specific river flows and temperature can result in reactor coolant discharge which will violate the permissible thermal loading of the river.

The data and information presented in this report provide the tools for determining both the permissible thermal loadings and the actual thermal loading at the reactor for any combination of river flow and temperature at any given reactor operating level. The heat loss to the environs between the reactor and the effluent discharge in the river has not been determined as yet; therefore, the thermal loadings to the river presented herein are somewhat conservative. A study to evaluate the heat loss from the reactor to the river is underway, and information on this aspect of thermal discharge will be provided when available.

III. DISCUSSION

The water quality standards for interstate and coastal waters of the State of Washington⁽¹⁾, state in part, for the Columbia River from the Washington-Oregon Border to Priest Rapids Dam, "No measurable increases shall be permitted within the waters designated which result in water temperatures exceeding 68 F nor shall the cumulative total of all such increases arising from non-natural causes be permitted in excess of $t = \frac{110}{T-15}$; for purposes hereof "t" represents the permissive increase and "T" represents the resulting water temperature." Therefore,

(1) Water pollution Control Commission, State of Washington, "A Regulation to Water Quality Standards for Interstate and Coastal Waters of the State of Washington under Plan for Implementation and Enforcement of such Standards," December 4, 1967.

DECLASSIFIED

DECLASSIFIED

-3-

DUN-4565

at any given natural river temperature, a restriction is placed on the amount of thermal load increase to the river resulting from the reactor operation.

Figure I illustrates the above restriction and provides a working tool for determining the relationship of reactor operation to this restriction; heat loss to the environs between the effluent discharge at the reactor and the exit point in the river is, however, not considered. Therefore, the thermal loadings shown for various river flows and reactor power levels are somewhat conservative. However, these are instantaneous values and state standards, when further defined, may allow averaging by the month or week. Information relative to this heat loss to the environs is being developed and will be made available when current studies are completed.

Utilization on Figure I is as follows:

- A. The vertical axis represents Δt in $^{\circ}\text{F}$ for either allowable conditions or actual conditions.
- B. The horizontal axis represents river flow in terms of cubic feet per second (cfs) times 10^3 and the natural river temperature, T_1 , in $^{\circ}\text{F}$.
- C. Determine T_1 from existing data, such as the Priest Rapids Gaging Station slave recorder in the 183-C Building.
- D. Read "up" from T_1 to the intersection with the allowable Δt curve.
- E. Read "across" from this intersection to the allowable Δt axis.
- F. The actual Δt associated with a particular mode of operation is determined by the point of intersection of the river flow with the MW_t curve. Therefore, any mode of reactor operation (as determined from the MW_t curves and river flow axis) lying above the imaginary horizontal line determined by Step E, above, yields an incremental thermal loading to the river in excess of the permissible limit, assuming no credit for environmental heat losses.

EXAMPLE

1. Assume that T_1 is determined to be 60°F , Step C, above.
2. The allowable Δt , then, is 2.3°F , Steps D and E, above.

DECLASSIFIED

DECLASSIFIED

-4-

DUN-4565

3. It can be readily observed, then, that any combination of river flow and MW_t reactor operating mode that results in an actual delta t greater than 2.3°F is in excess of the permissible incremental temperature limit. Again, actual delta t is conservative since no credit is taken for environmental heat loss.

Table I, below, presents additional data for the construction of other MW_t curves, if necessary.

P	Q	Δt	Q	Δt	Q	Δt	Q	Δt	Q	Δt	Q	Δt	Q	Δt
15	40	5.70	80	2.84	120	1.89	160	1.42	200	1.13	240	0.93	280	0.81
13	"	4.95	"	2.46	"	1.63	"	1.22	"	0.99	"	0.81	"	0.70
11	"	4.19	"	2.08	"	1.38	"	1.04	"	0.82	"	0.68	"	0.59
9	"	3.42	"	1.71	"	1.13	"	0.84	"	0.68	"	0.55		
7	"	2.66	"	1.33	"	0.88	"	0.66	"	0.52				
5	"	1.89	"	0.93	"	0.63	"	0.46	"	0.37				
3	"	1.13	"	0.55	"	0.37	"	0.27	"	0.21				
1	"	0.37	"	0.18	"	0.12	"	0.9	"	0.07				

$$P = MW_t \times 10^3$$

$$Q = \text{River Flow Rate} \times 10^3$$

$$\Delta t = ^\circ\text{F}$$

IV. FORMULAS

The following formulas were utilized in developing the data related to Figure I and Table I:

A. Allowable delta t curve

$$\text{delta } t = \frac{110}{T-15}$$

where: T is the resultant river temperature in $^\circ\text{F}$

B. Actual delta t

$$P = K \times Q_r \times \Delta t$$

where: $P = MW_t$

$K = 0.118$ where Q_r is in cfs, or

$K = 0.264$ where Q_r is in thousands of gpm

$Q_r = \text{river flow rate}$

$\Delta t = ^\circ\text{C}$

DECLASSIFIED

DECLASSIFIED

-5-

DUN-4565

V. ACKNOWLEDGEMENT

The contributions of J. O. Skolrud, Engineer, Plant Design, in the development of portions of the information presented herein are gratefully acknowledged.

J. W. Ballowe
Sr. Engineer
Plant Design

JWB:tba

DECLASSIFIED

DECLASSIFIED

DECLASSIFIED

**DATE
FILMED**

8/18/94

END