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

DOCUMENT NO

BNWL-CC- 492 AD

PROJECT

DATE

Feb. 10, 1966

SERIES AND COPY NO

HANFORD CODE

2-65

BATTELLE-NORTHWEST

RICHLAND, WASHINGTON

DECLASSIFIED

ISSUING OFFICE

TITLE AND AUTHOR

COMPARISON OF AVERAGE UPSTREAM AND DOWNSTREAM TEMPERATURES

1963 - 64 and 1964 - 65 Water Years

J. P. Corley

THIS DOCUMENT CONTAINS RESTRICTED DATA AS DEFINED IN THE ATOMIC ENERGY ACT OF 1954 ITS TRANSMITTAL OR THE DISCLOSURE OF ITS CONTENTS TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C., SECS 793 AND 794 THE TRANSMITTAL OR DISCLOSURE OF WHICH TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS TO IT. WHEN NOT IN USE, IT IS TO BE KEPT IN A SECURED REPOSITORY WITHIN AN APPROVED GUARDED AREA. WHILE IT IS IN YOUR POSSESSION AND UNTIL YOU HAVE RETURNED IT TO YOUR CLASSIFIED DOCUMENT RESPONSIBILITY STATION, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF THIS PROJECT AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSMITTAL TO ANY OTHER PLACE OF RESIDENCE OR TO ANY OTHER PERSON WILL BE DUPLICATED ONLY IN ACCORDANCE WITH EXISTING SECURITY REGULATIONS. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED TO SIGN IN THE SPACE BELOW.

ROUTE TO:

PAYROLL NO

LOCATION

FILES ROUTE
DATE

SIGNATURE AND DATE

J. P. Corley

30528

329

FEB 10 1966

J. P. Corley

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

Classification Controlled (Change to CONFIDENTIAL)
By Authority of Classification Coordinator, Battelle-Northwest.

DECLASSIFIED

This document classified by

R. J. Foster

Distribution

#1 RD Wildman, RLOO AEC

#2 RF Nakatani

#3 JF Corley

Classification Cancelled and Changed to

February 9, 1966

DECLASSIFIED

By Authority of WA Snyder

CG-PR-2, 2-15-94

By J E Savely 2-22-94

Verified By Jeri Males 3-5-94

Memorandum to File:

COMPARISON OF AVERAGE UPSTREAM AND DOWNSTREAM TEMPERATURES

1963-64 and 1964-65 Water Years

DECLASSIFIED

Classification Cancelled (Change to

UNCLASSIFIED)

By Authority of Doc

May 1973

By L. Pope 6/14/73

~~The attached Table I shows calculated monthly average temperature~~

~~increases in the Columbia River due to Hanford reactor operations (including~~

~~Table I shows), together with measured river temperatures upstream and downstream from~~

the reactors. The temperature stations are all shoreline locations; each downstream

station record shows a bias, the degree dependent on river flow, reactor

operations, and atmospheric conditions. Since ~~reactor~~ shutdown, the

residual $\Delta^2 T$, approximates the atmospheric effect in the plant reach of the

river. All temperature data is given in degrees Centigrade.

Table II shows summary tables for the same water years, together with data for the 1962-1963 water year previously published. (HW-80888, Secret)

The monthly averages shown are calculated from daily averages of each factor. The flow and temperature data are averaged from hourly readings of continuous recorder charts, with the hourly flow determined from the river elevation at the Priest Rapids gauge and the U.S.G.S. rating table for the gauge. Heat input is obtained from the sum of the daily average power levels

at each reactor as reported by the Douglas-United Nuclear (formerly GE-IPD)

Production Operation.

Classification Cancelled (Change to CONFIDENTIAL)

By Authority of Classification Coordinator, Battelle Northwest

Date 6/14/73

$$\Delta T_q = 8.44 \times \frac{EP \text{ (in MW)}}{Q_r \text{ (in cfs)}}$$

This document contains restricted information in the Atomic Energy Act of 1954 or the disclosure of which in any manner to any person is prohibited.

(3) HW-80888 (Secret)

DECLASSIFIED

Effects of the three old reactor shutdowns are less marked in the annual averages since two of the three occurred in the latter half of the water year.

(F) For comparison, if all three had been operating at an overall operating efficiency of 80%, ΔT_q for August, 1965 would have been 0.3°C higher and ΔT_3 about 0.4°C higher. For the same month, if N reactor had been operating at 95% efficiency instead of about 55%, its contribution to ΔT_q would have been about 0.3°C instead of about 0.2°C . Operation of the WPPSS generating station on NPR steam would not have measurably affected observed temperatures at the August, 1965 river flow, but at a low monthly average river flow of about 57,000 cfs, steam generation could reduce river temperatures by as much as 0.2°C .

With current reactor operations, the total reactor heat input from temperature is not apt to exceed 4.2°C during minimum flow periods, 2.5°C during the maximum temperature period, and 0.5°C during the peak of the flood season.

Notation

- (9)
- Q_r - river flow rate, in kcfs.
 - T_{PR} - river temperature at the Priest Rapids gauge.
 - T_3 - river temperature at the PRTR water intake, 300 Area
 - T_p - river temperature at the Pasco water intake.
 - ΔT_q - reactor heat contribution to average river temperature.
 - $\Delta T_3, \Delta T_p$ - $(T_3 - T_{PR}), (T_p - T_{PR})$
 - $\Delta^2 T_3$ - $(\Delta T_3 - \Delta T_q)$

DECLASSIFIED

ORIGINAL SIGNED BY
J. P. CORLEY

J. P. Corley, Senior Engineer
Environmental Studies
ENVIRONMENTAL HEALTH AND
ENGINEERING DEPARTMENT

TABLE I

DECLASSIFIED

MONTHLY AVERAGE TEMPERATURES AND DIFFERENCES

Month-Year	T_g	T_{FR}	T_3	T_p	ΔT_g	ΔT_3	ΔT_p	$\Delta^2 T_3$
September, 1963	71.1	18.3	20.4	19.9 ⁸	1.6	2.1	1.5	0.5
October	61.7	16.3	17.6	17.4 ⁰	1.8	1.3	0.7	-0.5
November	56.9	11.9	12.7	12.5 ⁴	2.1	1.0	0.5	-1.1
December	60.7	7.7	9.0	8.6 ⁵	2.2	1.3	0.8	-0.9
January, 1964	56.8	5.5	7.1	6.8 ⁷	2.3	1.4	1.1	-0.9
February	75.3	4.7	6.2	6.1	1.5	1.5	1.4	0.0
March	63.9	4.7	7.1	6.7 ⁵	2.2	2.4	2.1	0.2
April	65.3	7.2	9.7	9.3 ⁵	1.8	2.5	2.3	0.7
May	168.8	9.7	11.5	11.3 ⁵	1.0	1.9	1.8	0.8
June	388.0	12.8	13.8	13.5 ⁶	0.4	1.0	0.7	0.6
July	295.8	15.3	16.5	16.1 ³	0.5	1.2	1.0	0.7
August	131.1	17.1	18.6	18.2	1.0	1.5	1.1	0.6
Annual Average	124.6	10.9	12.6	12.2	1.5	1.6	1.3	0.1
September, 1964	74.3	16.3	18.2	17.8 ⁷	1.9	1.9	1.4	0.0
October	87.1	14.6	15.5	15.2 ¹	1.2	1.0	0.5	-0.2
November	70.1	10.8	12.1	11.7 ⁴	2.4	1.3	0.7	-1.1
* ** December	68.5	6.3	7.7	7.2 ⁰	2.5	1.4	0.7	-1.1
January, 1965	77.3	4.4	6.0	5.8 ⁶	1.9	1.6	1.1	-0.3
February	99.2	3.3	5.2	-	1.4	1.8	-	0.4
March	88.3	4.1	5.6	-	1.4	1.5	-	0.1
*** April	111.5	6.6	8.5	-	1.3	1.8	-	0.5
May	235.4	10.0	11.0	11.1 ³	0.6	0.9	1.2	0.3
**** June	311.4	13.3	14.0	14.3 ⁴	0.4	0.8	1.1	0.4
July	218.4	16.1	17.1	17.4 ⁶	0.5	1.1	1.5	0.6
August	127.8	18.4	19.6	19.7	0.9	1.2	1.3	0.3
Annual Average	130.8	10.3	11.7	-	1.4	1.4	1.2(est.)	0.0

* H Reactor reached nominal full power level

** DR Reactor out of service

*** H Reactor out of service

**** F Reactor out of service

TABLE II

ANNUAL SUMMARIES
Averages, Maximums, and Minimums

	1962 - 1963			1963 - 1964			1964 - 1965		
	<u>Avg.</u>	<u>Max.</u>	<u>Min.</u>	<u>Avg.</u>	<u>Max.</u>	<u>Min.</u>	<u>Avg.</u>	<u>Max.</u>	<u>Min.</u>
Q	111.8	308.0 (6/16)	48.7 (9/16)	124.6	457.0 (6/17)	39.2 (4/5)	130.8	337.0 (6/21)	38.3 (12/13)
T _{FR}	11.0	19.5 (8/13)	3.0 (2/2)	10.9	19.3 (9/10)	4.1 (3/10)	10.3	19.1 (8/15)	2.9 (2/16)
T ₃	12.9	21.8 (8/11)	3.7 (1/31)	12.6	21.6 (9/8)	4.9 (2/25)	11.7	20.3 (8/8)	4.4 (3/4)
ΔT ₃	1.8	3.8 (3/24)	-1.0 (1/10)	1.6	3.2 (3/30)	-0.2 (11/21)	1.4	3.2 (1/31)	-0.7 (12/16)
ΔT ₄	1.2	2.6 (9/16)	0.3 (6/20)	1.5	3.6 (1/1)	0.2 (6/14)	1.4	4.9 (11/22)	0.2 (6/24)
Δ ² T ₃	0.5	2.4 (5/21)	-2.1 (1/10)	0.1	1.7 (4/27)	-3.3 (1/12)	0.0	1.7 (4/14)	-3.0 (11/22)

() - Date of occurrence

DECLASSIFIED

BNWL-CC. 492

ADDENDUM - BNL-CC-492-RD

Range of Single Daily Temp. Reading

Range of
Daily
Average
Pasco

<u>Dates</u>	<u>Kiona</u>	<u>Ice Harbor</u>	<u>McNary</u>	<u>Dalles</u>	<u>Bonneville</u>	<u>P. R.</u>	<u>Pasco</u>
<u>1962</u>							
July 1/3		66-66	61-64	62-63	62-64	58-59	60-59
July 4/10	66-75	66-67	62-64	62-63	62-64	58-60	62-60
July 11/17		67-69		63-64	63-64	61-61	-
July 18/24		69-70	64-68		64-68	60-62	65-62
July 25/31	79-81	72-76	67-73		68-70	63-64	66-65
Aug. 1/7	69-80	74-76	68-72		68-71	63-64	-
Aug. 8/14	65-78	73-74	66-71	66-68	67-69	63-63	-
Aug. 15/21	73-78	73-74	69-70	68-70	69-69	63-64	67-67
Aug. 22/28	68-74	72-74	68-71	68-70		62-64	68-65
Aug. 29/Sept. 4		70-72	67-70	66-68	66-68	62-64	67-65
Sept. 5/11	63-70	69-71	66-70	66-68	66-68	62-64	67-65
Sept. 12/18	62-65	66-69	65-66	65-66	64-66	62-62	66-65
Sept. 19/25		66-68	66-67	65-65	64-65	63-64	68-65
Sept. 26/Oct. 2	59-68	66-68	66-67	63-66	64-65	62-64	67-63
<u>1963</u>							
June 26/July 2	65-72	62-63	62-63	61-61	61-62	58-60	60-62
July 3/9	70-78	63-68	62-64	62-63	62-65	60-61	63-62
July 10/16	68-73	68-70	64-64	63-65	64-66	60-62	64-62
July 17/23	69-74	70-70	64-66	64-66	65-67	62-64	65-63
July 24/30		70-71	66-66	65-67	66-67	63-63	66-64
July 31/Aug. 6		70-72	66-68	66-68	66-68	63-66	68-65
Aug. 7/13	75-77	71-76	68-70	68-70	67-70	66-67	70-67
Aug. 14/20	70-78	75-76	70-71	70-71	70-70	65-67	69-67
Aug. 21/27	67-70	72-75	69-70	67-69	68-70	64-65	67-66
Aug. 28/Sept 3	68-72	70-72	69-71	68-69	68-69	64-65	68-66
Sept. 4/10	64-69	70-72	69-71	67-70	68-70	65-67	69-68
Sept. 11/17	63-72	71-72	70-71	67-70	68-70	64-66	69-66
Sept. 18/24	62-67	67-70	68-70	66-67	66-68	64-65	67-66
Sept. 25/Oct. 1		66-66	68-68	66-67	66-67	64-65	68-66

DECLASSIFIED

Range of Single Daily Temp. Reading

<u>Date</u>	<u>Kiona</u>	<u>Ice Harbor</u>	<u>McMury</u>	<u>Dalles</u>	<u>Bonneville</u>	<u>P. R.</u>	<u>Range of Daily Average Pasco</u>
<u>1964</u>							
July 1/7	66-69	60-62	60-61	60-61	60-61	57-58	59-58
July 8/14	69-75	63-68	61-63	61-65	62-65	58-60	61-60
July 15/21	68-73	69-70	63-64	64-65	64-65	60-60	62-61
July 22/28	68-73	69-72	64-64	64-66	64-66	60-62	64-62
July 29/Aug. 4	65-74	71-72	65-66	66-66	65-67	62-63	65-63
Aug. 5/11	65-72	70-70	66-67	66-67	66-68	61-63	66-63
Aug. 12/18	68-69	70-72	67-68	67-67	66-67	63-63	66-65
Aug. 19/25	67-70	69-72	68-68	66-69	66-69	62-65	67-64
Aug. 26/Sept. 1	60-69	68-70	66-68	64-69	63-68	61-64	65-63
Sept. 2/8	61-62	64-66	64-65		63-64	61-62	66-63
Sept. 9/15	59-62	64-64	64-65	63-64	63-64	61-62	66-64
Sept. 16/22	57-63	64-64	64-65	63-64	62-64	60-62	65-64
Sept 23/29	59-62	61-64	64-65	63-64	62-63	61-62	65-63
Sept. 30/Oct. 6	54-62	61-62	62-64	59-62	61-63	59-60	62-60

<u>1965</u>							
June 30/July 6	61-63	60-65	60-62	61-63	61-64	58-60	62-60
July 7/13	67-74	65-67	63-64	63-65	64-64	60-61	63-62
July 14/20	67-74	66-68	64-66	65-66	65-66	60-62	64-62
July 21/27	65-73	70-70	65-66	66-67	66-67	61-63	65-62
July 28/Aug 3	72-76	70-63	66-69	67-70	67-69	63-65	68-66
Aug. 4/10	71-77	73-65	71-71	69-71	68-71	64-66	69-67
Aug. 11/17	68-76	75-75	70-71	70-71	71-71	66-66	69-67
Aug. 18/24	68-72	73-75	69-70	71-71	70-72	65-65	69-67
Aug. 25/31	62-68	69-72	68-70	67-70	67-70	63-65	68-65
Sept. 1/7	61-63	67-68	67-68	65-68	65-66	63-64	67-65
Sept 8/14	61-64	66-67	66-67	65-67	64-66	64-65	68-66
Sept. 15/21	54-63	61-65	65-67	63-66	62-64	62-64	66-63
Sept. 22/28	59-61	60-61	64-64	63-64	62-63	62-63	66-63
Sept. 29/Oct. 5	57-58	60-60	63-64	62-74	61-62	62-63	65-63

DECLASSIFIED

**DATE
FILMED**

10/20/94

END