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Hanford Production Reactor Heat Releases 1951-1971

L. D. Kannberg

April 1992

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HANFORD PRODUCTION REACTOR HEAT RELEASES 1951-1971

L. D. Kannberg

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Pacific Northwest Laboratory
Richland, Washington 99352

SUMMARY

Beginning in 1944, nine nuclear materials production reactors were constructed and operated on the Hanford Reservation. Eight of the reactors operated from 1955 through 1964; nine operated most of 1964. Operating reactor levels grew throughout the period reaching highest levels in the middle 1960's. Maximum average reactor power reached 23,501 MW_t in December of 1964. For 13 of 15 months maximum average power levels exceeded 20,000 MW_t. For over 8 years maximum average power levels exceeded 15,000 MW_t. Only one reactor now remains in operation.

All of the thermal energy produced in the reactors was released to the environment; 90 to 97% of that energy entered the Columbia River directly. The remaining 3 to 10% was transferred from retention basins to the atmosphere or ground water by surface heat transfer and leakage, respectively. The reactors operated with direct once-through cooling with effluents being discharged primarily at 70 to 90°C.

Numerous studies have been performed investigating the mixing characteristics of the effluent plumes. These studies have shown that the effluents mix rapidly vertically but slowly laterally until major topographic features in the river force extensive mixing by wakes and secondary flows. Flow management by dams also appears to have a significant influence on Columbia River thermal dynamics.

Studies on the persistence of the Hanford thermal discharges have indicated that the free flowing reach near the Hanford discharges experiences much more surface heat transfer than impounded waters either upstream or downstream of the Hanford reach. As a result, the bulk of the thermal additions introduced by the production reactors was dissipated before effluents reached the Washington-Oregon border.

Extensive study of the Hanford ecosystem and anadramous fish migrating through, to, and spawning in the Hanford reach has detailed the effects of thermal exposures on the local ecosystem and on salmonid fish. The general conclusion is that Hanford thermal discharges caused no detectable harm to the aquatic ecology nor did they injure in any measurable manner the salmon

or trout fisheries. However, dam effects on the aquatic ecology of the river, especially salmon and trout fisheries, may have masked Hanford thermal effects within natural variation.

CONTENTS

SUMMARY iii

INTRODUCTION. 1

DESCRIPTION OF THE REACTOR COOLING SYSTEMS. 4

N REACTOR COOLING SYSTEM 9

HISTORICAL HEAT RELEASES. 12

ENERGY OUTPUT. 12

ENERGY TRANSFER 19

FATE OF EFFLUENTS 20

THERMAL CHANGES. 22

ECOLOGICAL EFFECTS OF THE HANFORD DISCHARGES 26

REFERENCES 29

TABLES

1. Reactor Startup and Deactivation 1

2. Retention Basin Statistics 9

3. Selected Dam Statistics 23

FIGURES

1. Hanford Reservation. 2

2. Typical Limited Area for Dual Production Reactor Plants. . . . 5

3. Water Flow for a Typical Production Reactor Plant. 6

4. Schematic of Cooling Systems for N Reactor and Hanford Generating Plant 10

5. 14

6. 15

7. 16

8. 17

HANFORD PRODUCTION REACTOR HEAT RELEASES 1951-1971

INTRODUCTION

The Hanford Reservation consists of about 570 square miles of semiarid lands in southeastern Washington. The Reservation was created in the early 1940's to permit production of weapons-grade nuclear materials. The Hanford site was ideally suited to the task for several reasons, including sparse population, ample cooling water supply, proximity to large electrical supply facilities, favorable geology and geohydrology, and low precipitation. Development of the site began with construction of B Reactor which was completed in September 1944. Eventually nine reactors were constructed; eight of which were employed solely for production of nuclear materials. The remaining N Reactor has produced steam for Washington Public Power Supply System's Hanford Generating Plant since 1966. The initial startup and deactivation dates of the nine reactors are given in Table 1.

TABLE 1. Reactor Startup and Deactivation

Reactor	Initial Startup	Deactivation
B	September 26, 1944	February 12, 1968
D	December 17, 1944	June 26, 1967
F	February 25, 1945	June 25, 1965
H	October 29, 1949	April 21, 1965
DR	October 3, 1950	December 30, 1964
C	November 18, 1952	April 25, 1969
KW	January 4, 1955	February 1, 1970
KE	April 17, 1955	January 28, 1971
N	December 31, 1963	Currently in Operation

Because all of the reactors operated with once through cooling water from the Columbia River, the plants were distributed along the river as it flowed through the Reservation. Reactor areas (100 Areas) as well as other major facility sites and roads are shown in Figure 1 as they currently exist.

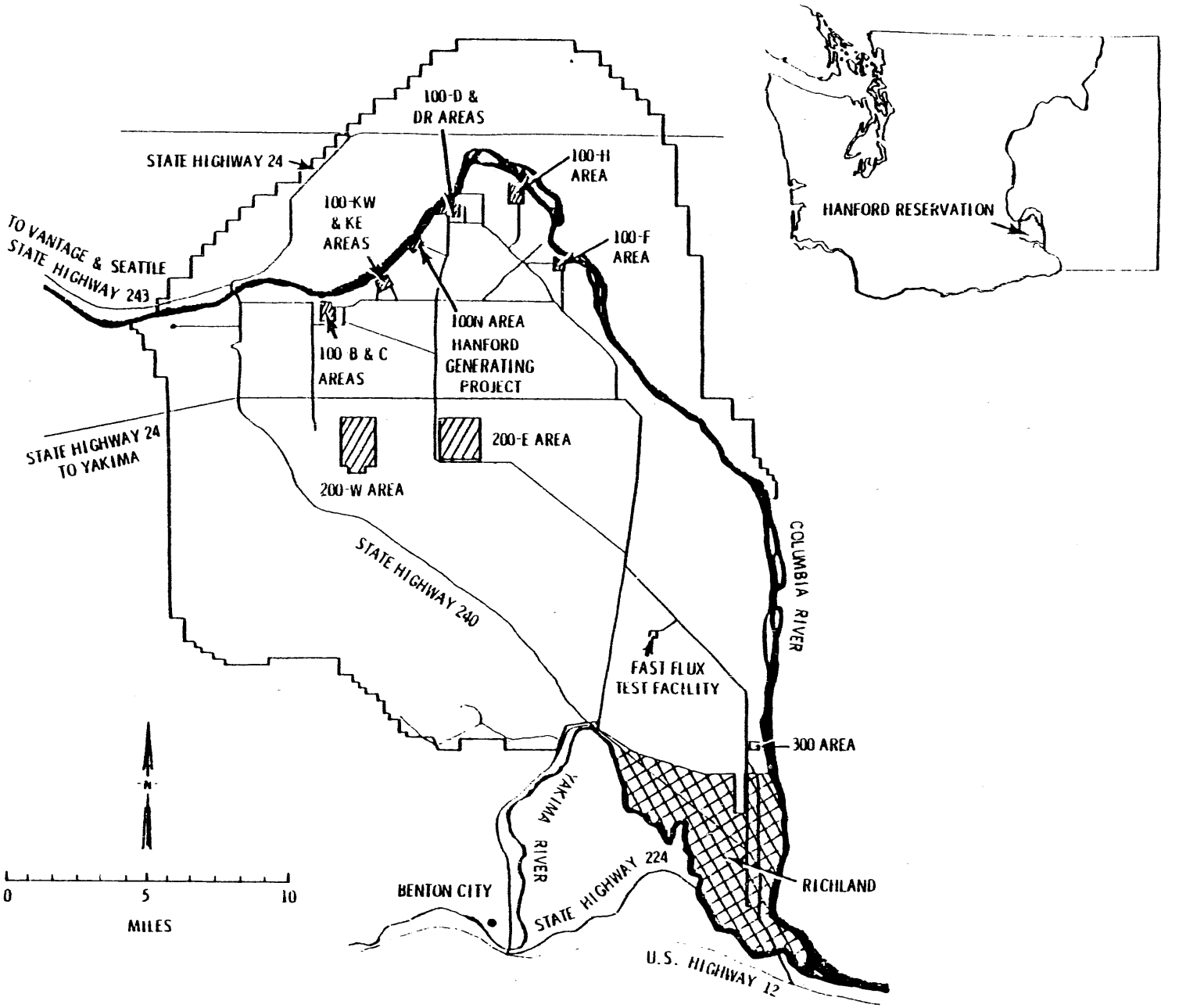

FIGURE 1. Hanford Reservation

The purpose of this report is to document and detail the thermal releases from the Hanford nuclear production reactors during the period 1951 through 1971, and to put these releases in historical perspective with respect to changing Columbia River flows and temperatures. This information can also be used as a foundation for further ecological evaluations.

When examining Hanford production reactor thermal releases to the Columbia River all related factors affecting the releases and the characteristics of the river should be considered. The major considerations in the present study were the characteristics of the releases themselves (primarily coolant flow rate, temperatures, discharge facilities, period of operation, and level of operation) and the characteristics of the river in that reach (primarily flow rate, temperature and mixing characteristics; the effects of dam construction were also taken into account. In addition, this study addressed ecological effects of thermal releases on aquatic species. Accordingly, this report includes discussion of the reactor cooling systems, historical heat releases, thermal mixing and transport studies, hydroelectric power development, and ecologic effects of Hanford production reactor heat releases on salmon and trout. Appendix A contains reactor operating statistics, and Appendix B provides computations of heat added to the Columbia River between Priest Rapids Dam and Richland, Washington.

DESCRIPTION OF THE REACTOR COOLING SYSTEMS

The cooling system used was direct once-through cooling with river water flowing directly through the reactors. The primary circulating system is shown in Figures 2 and 3. Figure 2 is an illustration of a typical dual production reactor area. Areas having ~~dual~~ two production reactors were 100 B and C, 100 KW and KE, and 100 D and DR. Areas having single reactor facilities were 100 H and 100 F. The typical cooling system for the eight reactors is shown schematically in Figure 3 (the facilities at N Reactor are discussed later). Figure 3 also shows the buildings (designated by numbers) that were used for different facets of cooling treatment.

Columbia River water was obtained through pump houses which enclosed 5 to 14 vertical deepwell pumps; the bottoms of the pump bowls were approximately 11 ft below normal flow water elevations.(a) The intake channels from the pump houses into the river were dredged and lined with rock and concrete. River water entered the pump house deepwell through traveling screens which prevented entrance of fish and debris. Combinations of 30-in., 36-in., 42-in., and 48-in. lines passed circulating water from the river pump houses (181 Bldg.) to reservoirs(b) in the 182 Building and chemical treatment and filtering facilities in the 183 Building.

Although the Columbia River water is exceptionally pure it was necessary to filter and chemically treat it at the 183 Building to prevent filming in the reactor process tubes. Each reactor had a separate treatment plant consisting of a head house, raw water flume, mixing chambers, distribution

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(a) Much of the information concerning details of the circulating water systems comes from References 1 and 2 which do not discuss 100-KE and 100-KW reactor areas.

(b) Prior to plant modification in 1956-1957 under project CG-558 the reservoirs were used as the principal water supply source for the filter plants and ultimately the reactors. Under project CG-558 flow modifications were made to various plant facilities to permit significantly higher coolant flow rates and thereby increase production of nuclear materials. After CG-558 the reservoirs were used primarily for "export water" used as a source for emergency cooling. Export water was water supplied to off-plant areas such as the 200 Area and to other reactor areas as needed.

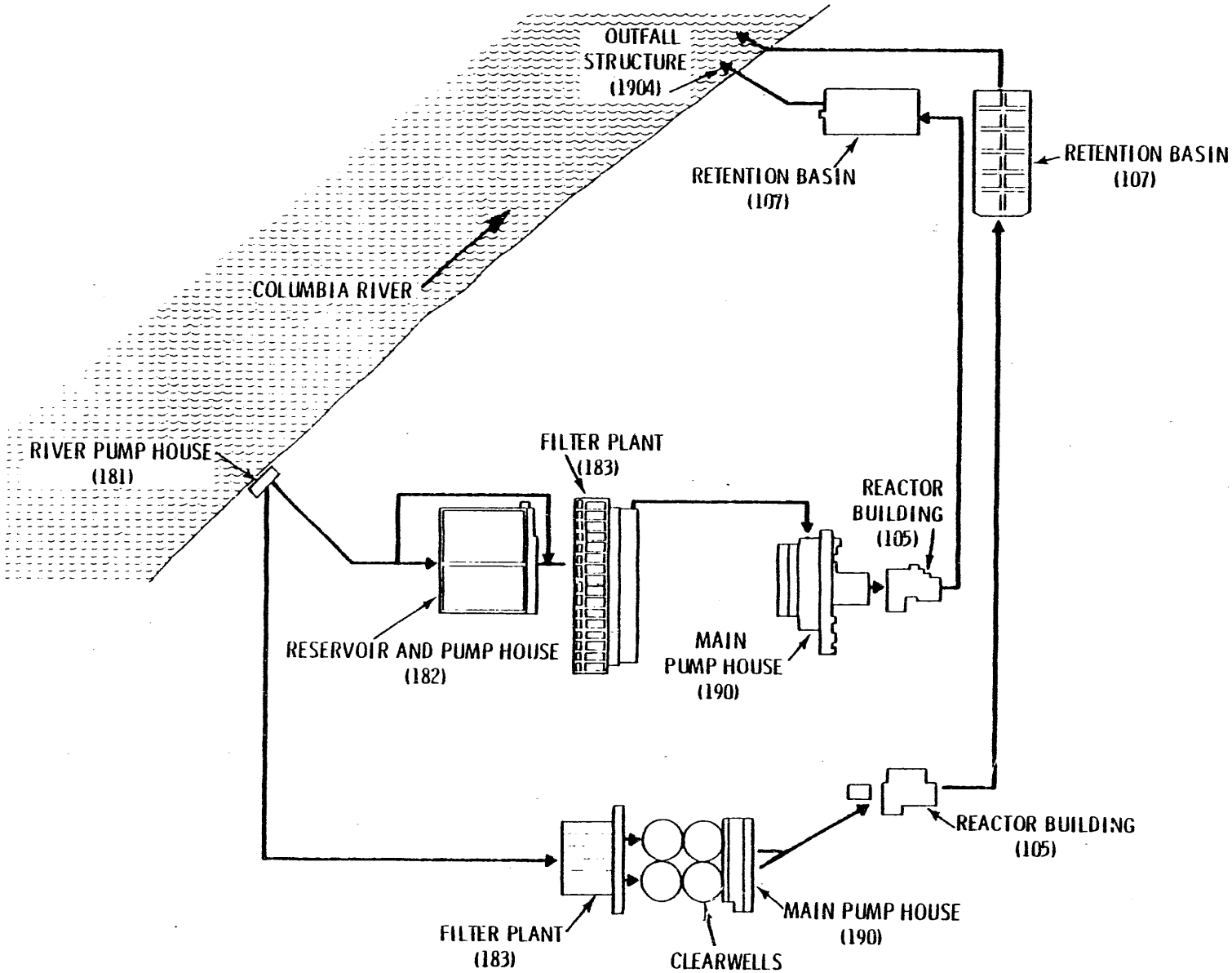

FIGURE 2. Typical Limited Area for Dual Production Reactor Plants (Figure Modified from Reference 4)

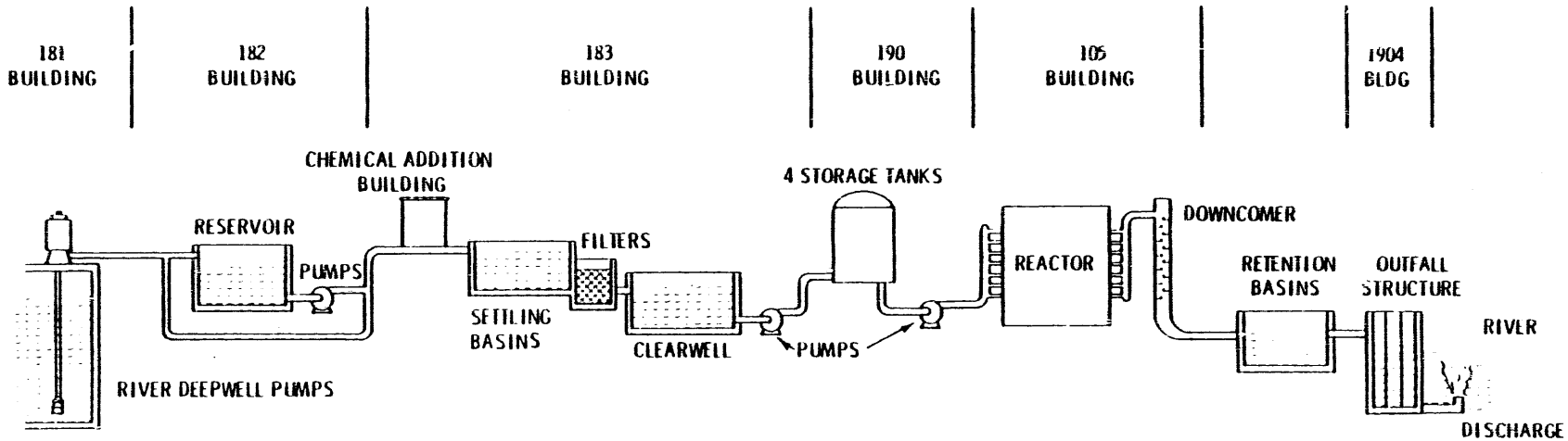

FIGURE 3. Water Flow for a Typical Production Reactor Plant (Figure Modified from Reference 4)

flume, flocculators, settling basins, collecting flume, influent flume, filters, effluent and backwash piping, effluent flumes, and clearwells.

In the head house, alum (used as a flocculating agent), sulphuric acid (to control pH), and chlorine (used as an algacide for control of algae in the settling basins) were metered into the raw river water. The combination was mixed in the mixing chambers and conducted to paddle-wheel flocculators and settling basins via the distribution flume. After particulates settled out, the circulating water entered gravity flow filter beds consisting of layers of crushed gravel, sand, and crushed anthracite coal. An organic polyelectrolyte filter aid was added during filtering to increase efficiency. The filters were backwashed with water from the clearwells as necessary to maintain proper operation.

From the filters the cooling water flowed by gravity into the clearwells. The clearwells, which served to collect and store waters from the filters, had storage capacities of approximately 3×10^6 to 10^7 gal. The filtered water was then pumped or gravity drained into four large storage tanks in the 190 Building. The storage tanks provided water to the coolant pumps that supplied cooling water to the reactor. Tank storage capacities varied from about 7×10^6 to 21×10^6 gal. For normal operating flow rates there was sufficient storage capacity to operate the reactor at full flow for more than an hour without supply from the clearwells. Intake of 182 Reservoir storage between reactor areas provided additional supplies if required.

The 190 Building also housed the primary coolant pumps that supplied high pressure cooling water to the reactors, and high tanks which could supply 300,000 gal of emergency cooling water if pressure in the piping from the 190 Building to the reactor was lost. Gravity flow of emergency cooling water from the export water system could supply coolant if supplies in the high tanks were exhausted.

Cooling water was supplied to the reactor building (105 Building) at 600 psi. Water flowed into vertical inlet risers which paralleled each side of the front face of the reactor. The coolant flowed from these risers through as many as 46 4-in. crossheaders to inlet nozzles on each process tube.

The coolant then flowed through the process tube and around the fuel element housed within the process tube. During irradiation the coolant was heated by the hot fuel element and adjacent graphite moderator. The coolant left the reactor in a similar manner, passing through outlet nozzles, to crossheaders, to two vertical risers which were interconnected above the reactor to a downcomer. The downcomer served to break the fall of water from the crossover piping to the effluent lines. The downcomer was vented to relieve trapped gases (air) and steam. Reactor outlet piping had a rated working pressure of 150 psi. From the downcomer the effluent moved by gravity from the reactor building through underground piping to large retention basins. The retention basins were designed to permit decay of short-lived radioisotopes. The basins served another purpose by containing high concentrations of radioactive substances released during fuel element failures until they could be removed to adjacent cribs for effective filtering through the ground.

The retention basins varied considerably in size although operation was similar in all of them. Effluent entered one end of the rectangular or round retention basins, flowed through or across the basins and exited from the other side. Several of the basins had baffles to prevent the effluent from channeling in the basins. The nominal dimensions, volumes, and estimated flow-through times for the retention basins are given in Table 2. In actuality, some channeling did occur thereby reducing travel times at certain plants.

The reactor effluents left the retention basins by overflowing a weir at one end of the basin. Effluent flowed into a downpipe to underground piping leading to the outfall structure or, as necessary, to a crib for isolation. The outfall structure consisted of three compartments. The effluent flowed into one compartment, then overflowed into an adjacent chamber which led via one or two effluent pipelines (depending on the plant) center of the river for submerged vertical single port discharge. If flow through the discharge effluent lines was obstructed, or if river water elevation was extremely high, water could overflow the second chamber into a third which led via a spillway to the river shore for shoreline surface

discharge. Submerged discharge in the center of the river was designed to provide rapid dilution with river waters, both thermally and radiologically.

TABLE 2. Retention Basin Statistics

Reactor Basin	Basin Length (Dia.)ft	Basin Width, ft	Basin Depth, ft	Volume 10^3/ft	Travel[a] Time, hr	Flow[b] Rate, gpm
107-B[c]	450	230	16	1656	2.38	87,000
107-CW	(330)		16	1368	1.96	87,000[c]
107-CE	(330)		16	1368	1.78	96,000
107-D	450	230	16	1656	2.33	89,000
107-DR	450	230	16	1656	2.35	88,000
107-F	450	230	16	1656	2.33	89,000
107-H	600	270	15	2430	3.26	93,000
107-KE[d]	(250)		29	4270[d]	2.59	206,000
107-KW[d]	(250)		29	4270[d]	2.57	208,000

(a) Computed from assumed flow rate and calculated basin volume.
(b) Nominal values for reactor flows in 1964.
(c) Because of excessive leakage from the 107-B retention basin effluent from B reactor was routed to 107-CW.
(d) Three basins of the size given. Volume is total of all three basins.

N REACTOR COOLING SYSTEM

N Reactor has a different cooling system because its main reactor coolant loop produces steam. A schematic of the cooling systems for N Reactor and Hanford Generating Plant (HGP) is shown in Figure 4. There are essentially three circulating circuits. The primary system coolant picks up heat in the reactor and transfers it to the secondary system coolant in a steam generator. N Reactor is a pressurized water reactor using ultrapure water as the primary coolant, operating at approximately 1200-1500 psig.[2] In the steam generator energy from the primary coolant is transferred via a heat exchanger to the secondary coolant which boils to steam. Pressure in the secondary coolant in the steam generator is about 140 psig.[3] This low pressure steam is generally routed to the HGP where it is used to drive

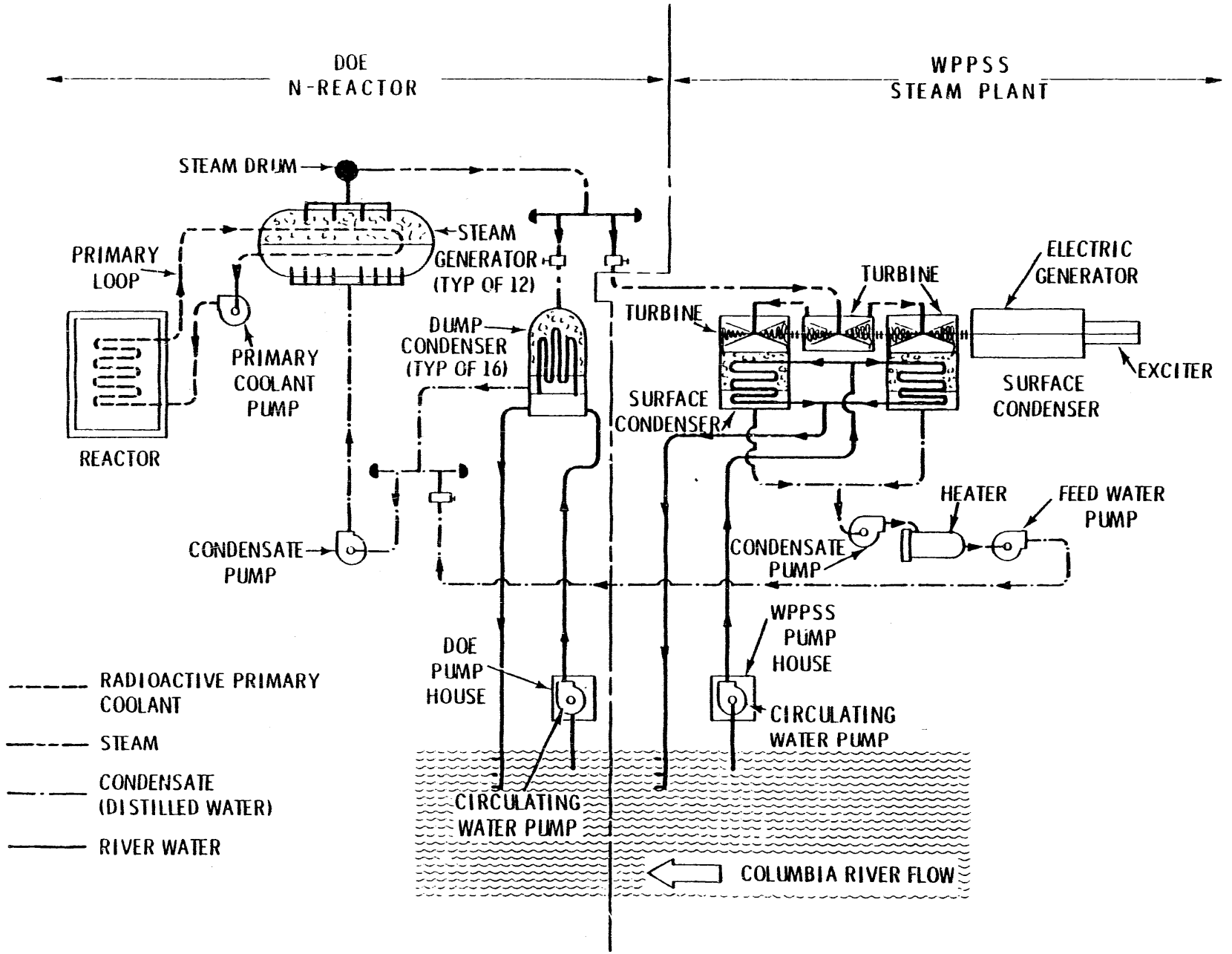

FIGURE 4. Schematic of Cooling Systems for N Reactor and Hanford Generating Plant

turbines, then condensed to liquid, and pumped back to the steam generator. During periods when HGP is not operating it is routed to "dump" condensers in the 100 N Area for condensation and return to the steam generator. In the condensers, thermal energy is transferred from the condensing steam to circulating water from the river. Water is pumped from the river through the condenser heat exchanger back to the river. This is true of both the dump condensers and the HGP condensers. The major difference is that if steam is routed to the HGP, a portion (slightly less than 25%) of the energy in the steam can be transformed into electrical energy rather than dumped into the river.

The intakes for N Reactor and HGP are very similar to the eight other production reactors; however, the discharges are somewhat different. N Reactor has a single port vertical outfall as do the other reactors but with a velocity cap to provide more rapid mixing. HGP employs an outfall having four vertical ports positioned 50-ft apart on a diffuser line across the central portion of the river providing even greater mixing than the single ports.

HISTORICAL HEAT RELEASES

The Hanford production reactors represent a unique collection of historical industrial facilities in regard to thermal energy releases to the environment. Several features of these facilities are not likely to be duplicated at any other industrially developed site. For example:

- No other facilities of any significant size discharged waste heat into the Columbia River for a considerable distance upstream and downstream of the reactor locations during the operating period of the reactors.
- The magnitude of the releases dwarf those of many comparable industrial facilities.
- Because of the nature of the plants and their discharges, excellent records exist providing reactor operating statistics.
- Reasonably coherent and consistent environmental analyses were performed throughout the plant operating period.
- The plant facilities were very similar and were operated in very similar manners.
- The sites are in a relatively compact arrangement.
- With the exception of the effects of dam construction and operation there was very little change in water quality entering the Hanford Reservation during the operating period.

For these reasons the Hanford reactor heat releases are a valuable reference point for future development in the Columbia Basin and at other sites around the nation.

ENERGY OUTPUT

When the production reactors were designed and constructed (primarily in the 1940's and early 1950's) the main concern was production of weapons-grade nuclear materials. The early designs permitted small production rates for nuclear materials and waste heat. The reactor designs were made with little operational experience and very limited knowledge of optimal values for production parameters. Their output was intially small until the

design and operational characteristics were expanded to achieve greater production. The plants generally operated in two possible modes. Either the plant output was limited by the power level or the plant output was limited by the temperature of the effluent in the downcomer. During 1951-1955 power levels in the six older reactors rarely exceeded 6000 MW. However, in 1956 and 1957 these reactors underwent flow modifications under project CG-558. These modifications more than doubled the potential reactor sustained power levels. During the following years, as more experience was gained and minor modifications performed, the power level limits and downcomer temperatures limits were successively raised; in the middle 1960's all of the reactors operated at near peak power levels. Eight of the nine production reactors were operating in 1955 (N Reactor began in 1964); however, total maximum average heat release at that time was only 6000 to 9000 MW. In March 1964, the total maximum average heat release for these same reactors was nearly 21,000 MW.

Figures 5 through 8 illustrate the monthly energy released by the production reactors in the period 1951-1971. In these figures the total maximum average heat release is the sum of the monthly average power levels during reactor operation for all of the reactors operated that month. This total represents a reasonable estimate of the peak combined heat release during the month since there would likely have been only a small portion of the time that all reactors operated during the month. Also shown in the figures is the integrated power released by the reactors in gigawatt days (GWD). This number was obtained by multiplying the average power level during reactor operation by the time during the month that the reactor operated for each reactor and summing for all the reactors. The integrated power thus represents the total energy released to the environment during the month. The third curve shown in these figures is the mean energy release to the river during the month and is computed as the integrated power divided by the number of days in the month.

The development of production capacity at Hanford can readily be seen. The maximum heat release was in December 1964 when all the reactors were operating and river temperatures were low. The total maximum heat discharge

could have reached 23,501 MW during the month. Integrated power was 604.1 GWD and the mean monthly heat release computed to nearly 20,000 MT_t, 19,490 MW_t.

Six 1250 MW_e nuclear generated stations today would generate 7500 MW_e total maximum power, and at 33% thermodynamic efficiency, 15,000 MT_t total maximum heat release. Using an annual plant factor of 0.7 including a 1-month refueling outage, these six plants would yield 352.2 GWD integrated heat release monthly and a mean monthly (30 days) heat release rate of 11,730 MW_t. The Hanford production reactors exceeded 15,000 MW_t in total maximum heat release rate for 8 years between August 1959 and August 1967. Monthly integrated power exceeded 353 GWD for over 8 years during the period from December 1958 to August 1967.

Total maximum heat release rate exceeded 20,000 MW_t for 13 of 15 months between December 1963 and April 1965, and 10,000 MW_t for more than 13 years between November 1956 and January 1970. Monthly integrated power exceeded 470 GWD in 19 months between March 1963 and April 1967; 235 GWD was exceeded for 13 years between June 1956 and June 1969. Data for the average power level during operation and the time operating efficiency (percent of month reactor operated) are given for each reactor by month in Appendix A for the period 1951-1971. Also given in Appendix A are the cooling water temperatures into and out of the reactor, and the nominal coolant flow rate for each reactor as recorded during the "last equilibrium operation."

The last equilibrium operation is the latest time (within the month) that the reactor operated stably at operational limits. These temperatures and flow rates should not be taken as maximum operating values, nor should they necessarily be considered as an average operating value for that parameter. Rather, they should be interpreted as typical operating values when reactor operation was stable. Computation of the power levels of the reactor using the flow rates and temperatures across the reactor will result in values not necessarily the same as those given in Appendix A. The average power levels during operation and the time operating efficiencies are considered accurate.

Table A-1 shows the total maximum average power level (or heat release) for that month (AVG. MW) and the integrated power (heat release) for the month for the combined reactors in GWD. When both N reactor and HGP were operating, the difference between the energy released by N reactor and the electrical production of HGP[a] is computed as N^* and represents the thermal energy release rate to the environment when both plants are operating. Examination of the table shows that after 1966 N Reactor rarely operated when HGP could not, making N^* a reasonable estimate of the N Reactor heat release to the environment. The total maximum average heat release is the sum of the average power levels during operation for all the reactors except when HGP was operating, for which N^* replaced the N Reactor contribution. The integrated heat release includes the N Reactor thermal contribution at its related time operating efficiency as well as subtracting HGP electrical generation at its related time operating efficiency. The integrated heat release represents the total energy released to the environment for the month. The mean monthly heat release rate to the environment may easily be computed as the integrated power, GWD, divided by the number of days in the month.

ENERGY TRANSFER

The energy produced by the reactors did not all reach the Columbia River There were several mechanisms for energy transfer to the atmosphere and the ground before entering the river. For example, a certain amount of heat transfer occurred between the piping and the soil. No data exist to determine the magnitude of that heat transfer; however, it is expected to be relatively small due to the relative insulating value of soil. A far more signficant heat transfer mechanism for the eight reactors was the heat transfer to the atmosphere and ground from the retention basins.[b] During operation the hot effluent (occasionally greater than 90°C) passing through the retention basins transferred great quantities of heat and mass to the atmosphere in the form of vapor plumes. These plumes rose 1000 or 2000 ft

(a) All energy rates in the Appendices are given as thermal except for HGP energy rates which are electrical.
(b) N Reactor did not empty retention basins and experienced no known leakage between the dump condensers and the river shoreline.

in the air under certain conditions. When evaporative heat loss dominated heat transfer to the atmosphere. Many of the retention basins leaked large quantities of effluent to the ground waters which eventually flowed to the Columbia River near the plant sites.

While ground-water flow speeds into the Columbia River from the retention basins in the zones bordering the river were between 10 and 30 ft/day, normal ground-water influxes to the Columbia are estimated to contribute over four times the thermal energy leaked from reactor retention basins.[4] The piping between the 105 Reactor Buildings and the retention basins was also observed to leak. The water table was observed to rise in the regions of the retention basins and effluent lines. Large portions of these locally raised water tables were at elevated temperatures. The six older reactor areas had ground-water temperatures in excess of 70°C in extensive zones underneath the retention basins. Leakage from the retention basins is estimated to have been from 1 to 5% of the effluent flow from the reactor based on available information.[4]

Based on temperature measurements of effluents in the downcomer and leaving the retention basins, an estimated 3 to 8% heat loss occurred as a result of heat transfer to the atmosphere. There was also considerable leakage from piping leading from the retention basins to the discharge in the center of the river, as evidenced by thermal plume surveys with infrared imagery.[5] It is therefore very difficult to estimate the true heat releases from the Hanford production reactors to the Columbia River. A reasonable estimate is that probably 3 to 10% of the reactor thermal energy generated was dissipated to the atmosphere before effluents entered the river, leaving 90 to 97% to enter the river.

FATE OF EFFLUENTS

Numerous studies have been performed to determine the fate of effluents that entered the river from the production reactors. Mixing near the discharges was observed to be rapid vertically so that even the highly buoyant discharges from the production reactors were completely mixed vertically within a few hundred yards of the outfall. Mixing laterally was observed to proceed much slower than vertically. Narrow ribbons of effluent plume were

often observed downstream until major river features (such as islands and bends in the river) enhanced lateral mixing. Lateral temperature profiles at Richland, Washington, demonstrated that complete lateral mixing was not obtained even to that point. Lateral mixing coefficients were observed to vary from about 0.5 ft^2/sec to 12.6 ft^2/sec depending on the river location and the buoyancy (lateral mixing increased for buoyant cases).[6] Generally acceptable values for lateral eddy diffusivities upstream of Locke Island are near 2 ft^2/sec.[6] Dilution of effluents near the discharge have been measured.[7] Dilution factors varied significantly for varying flow conditions and reactor discharges. The dilutions to the points where the plumes were first observed to strike the surface (about 50 ft downstream) were estimated to be from 2 to 7 for a river flow of 36,000 cfs.[a] For the same river flow dilution factors were estimated to be from 7 to 17 at 100 yd downstream from where the plume surfaced, and from 17 to 37 at 400 yd downstream.[a] As a general rule the dilution increased directly with river flow rate such that at a river flow of 360,000 cfs dilutions would be an order of magnitude larger than those estimated at 36,000 cfs. As would be expected, the data supporting those analyses display considerable scatter evidencing highly varying turbulent characteristics.

(a) Dilutions were computed based on maximum plume measured temperatures and efficiency and effluent temperatures recorded at the reactor downcomer.

THERMAL CHANGES

Because of the magnitude of energy released to the Columbia River by the production reactors, the importance of the river for commercial fishery on the Pacific Coast, and the emerging concern with thermal discharges as "pollution," numerous studies have been performed relating Hanford heat releases to 1) power development on the Columbia and 2) environmental effects of large heat releases. The emerging interest in the environment and resulting environmental regulation brought about an extensive effort by Hanford researchers to characterize and model the extent and persistence of the Hanford thermal discharges. Additional monitoring was performed on special studies and analyzed.[8-11] A temperature monitoring system already in existence on the Columbia was refined in 1964 to provided added data and remove biases that may have existed in prior monitoring programs. Analysis of data from this network and other studies with special computer routines and the development of various river reservoirs computer models for heat transfer and heat budget simulation led to several interesting observations ranging from the effects of the dams on the hydrothermal character of the Columbia River to the persistence of Hanford heat additions downstream of the Hanford Reservation.

The Columbia River flows generally east across the northern portion of the Hanford Reservation, then turns south forming the eastern boundary. The Columbia is the second largest river in the United States with a discharge at its mouth slightly larger than the Ohio River.[12] Because of the large discharge, low suspended sediment load, and steep side slopes characterizing the river, significant hydroelectric power development has occurred. At present the only nontidal free flowing reach of the river is the 49-mile length from the head of McNary Reservoir (behind McNary Dam) to Priest Rapids Dam [river mile (RM) 397]. Except for about 9.5 miles immediately below Priest Rapids Dam, this reach lies completely within or is bounded by the Hanford Reservation.

The period of major construction and operation of the Hanford production reactors (1951-1971) was also the period of major dam construction on the

Columbia. Table 3 shows the river mile, the total storage, and the completion date for all U.S. dams on the mainstem of the Columbia River. In addition to these dams other major dams on the Snake River (Ice Harbor, Lower Monumental, Little Goose, Lower Granite, and others) contribute to power development, navigation and flood control. However, since the Snake River enters the Columbia below the Reservation (about RM 325) flow control on the Snake has no effect on the Columbia River flow past the Hanford Reservation. Additional dam construction on the upper Columbia or its tributaries in Canada and the U.S. (Mica, Duncan, Hungry Horse, Libby, and Arrow) will increase storage volumes fivefold over that of U.S. dams on the mainstem of the Columbia and aid significantly in flow control.

TABLE 3. Selected Dam Statistics

Dam	River Mile	Reservoir Length mi	Storage Capacity 1000 acre-ft	Completion Year
Bonneville	146	48	87	1938
The Dalles	192	24	53	1957
John Day	216	75	535	1968
McNary	292	59	185	1953
Priest Rapids	397	56	44.8	1959
Wanapum	415	18	160.8	1965
Rock Island	453	20	8.6	1933
Rocky Reach	474	42	36	1961
Wells	516	28	125	1970
Chief Joseph	545	51	115	1955
Grand Coulee	597	151	5232	1941

Dam construction has had a major influence on Columbia River flows and temperature, thereby affecting both Hanford reactor operations and analyses of environmental effects of those operations. The impoundment of waters in the Snake and Upper Columbia Rivers has substantially reduced high water discharge. This is the intended effect of the 1971 Columbia Treaty between the United States and Canada, which provided for flood control on the Columbia

and its tributaries. The effective storage of spring and summer runoff waters has signficantly aided in meeting large power demands during the winter through hydroelectric generation. At the same time, storage has created a temporal shift in the river temperature cycle. For example, the construction of Grand Coulee Dam produced a permanent delay of about 30 days in arrival of peak temperatures at locations downstream. Similarly, waters with peak temperatures arrive at Priest Rapids about 7 to 10 days later than they reach Rock Island.[13] Previously, peak temperatures were simultaneous at these locations. The shifts are generally attributed to increased flow times through reservoirs behind the dams.

Another temperature effect observed as a result of dam construction on the Upper Columbia is the lowering of peak and average temperatures. It has been predicted that the average August-September temperatures at Priest Rapids Dam after completion of the Canadian Dams will be nearly 2°C lower than the average 1961-1967 temperatures.[13] Construction of the Canadian Dams is predicted to lower temperatures of water emerging from Grand Coulee Dam by as much as as 4°C as compared to average peak temperatures for the period 1929 through 1957.[13] Lower Columbia River temperatures and cycle shifting are most pronounced upstream from the mouth of the Snake River. The Columbia seems to equilibrate considerably between McNary Dam and Bonneville Dam. The bulk of this is due to climatological and hydrodynamic conditions characteristic of that reach. The Snake River raises temperatures in the Columbia particularly in late summer.

Additional findings concerning thermal characteristics of the Columbia River are as follows:[15]

- Dam impoundments respond much more slowly to thermal additions than free flowing river reaches evidencing larger heat transfer coefficients for free flowing rivers.
- Columbia River temperatures appear to be closely related to river management practices (hydroelectric and storage operations).
- Temperatures in the free flowing reach between Priest Rapids and Richland gain from 0.5 to 0.90°C in August and September due to natural heating in the absence of thermal discharges.

- The majority of thermal energy released by the production reactors in 1969 was dissipated to the atmosphere before effluents reached the confluence with the Snake. At the Oregon-Washington border between 60 and 95% of the thermal additions of the production reactors had been dissipated, with the average dissipation being 65%. At Bonneville only about 20% of the production reactor heat release (1969) remained in the river.
- An annual thermal addition of 4000 MW_t is attributable to the Snake River. During August and early September the addition is nearly twice the annual average. With the completion of the Canadian Treaty Dams this summer addition may rise to over 15,000 MW_t.
- Thermal additions in winter persist further downstream than those same discharges in summer.
- Studies concerning the thermal capacity of the Columbia indicate that there is a potential for addition of from 20 to 25 GW_t in the zone between Grand Coulee and Pasco, Washington, within state water quality criteria.[16]

The data in Appendix B illustrate the magnitude of thermal changes in the Hanford reach of the Columbia. Specifically, these data include the monthly average Priest Rapids temperature, Richland temperature, Columbia River discharge; the computed heat additions between Priest Rapids and Richland (based on their temperatures and the flow of the Columbia); the monthly mean heat additions by the Hanford production reactors (which lie between these sampling points); and the difference between the computed means and the reactor heat additions for the period of June 1964 through December 1971. The values given in Appendix B demonstrate that flow management tends to have a large influence on the natural heat gain. During high flow periods computed natural monthly mean heat gains often exceeding 20,000 MW_t were observed. During low flow periods the Hanford production reactor contributions formed a large part of the gross thermal gain of the river.

ECOLOGICAL EFFECTS OF THE HANFORD DISCHARGES

As early as 1945 ecologists were studying the effects of the Hanford production reactor discharges on the flora and fauna of the Columbia River in the Hanford reach. Generally, these studies have endeavored to determine the effect of Hanford production reactor operations on economically important species, primarily salmon and trout.

Effects considered include thermal shock, thermal tolerance, upper thermal lethal limits, and, to a limited extent, temperature in regard to infectious diseases and gas bubble disease. Additional studies have been performed on migrating fish past the discharges, on the number of fish spawning in the Hanford reach, and on the effects of temperature on annual fish and insect cycles. These studies have demonstrated the following results:[17]

- "Cold water" fish such as salmon have a much narrower tolerant temperature band than other fish; duration of exposure plays a critical part in loss of equilibria and mortality.
- Field studies from March through September 1968 and 1969 were conducted to determine mortality of juvenile salmonids drifted through effluent plumes in liveboxes. Drifts through shoreline areas near seepage from retention basins resulted in significant mortalities among only a few test groups. Drifts through midriver effluent plumes resulted in losses only during unfavorable late summer conditions.
- "Columnaris" disease (a myxo-bacterial infection) associated with the Columbia River in warmer months has not been linked to the Hanford discharges. Mortality of fish subjected to large doses of Columnaris organisms was higher in warmer waters than cooler. Fish ladders appear to have much higher concentrations of the organism than other river locations.
- The problem of nitrogen supersaturation, which causes gas-bubble disease, may be enhanced in warmer water temperatures. Nitrogen supersaturation is linked primarily to entrainment and compression of air in dam spillways. Gas-bubble disease was not an obvious problem in the Hanford

reach; however, heat releases at Hanford may have contributed in a very minor way to occurrence at downstream dams.

- Rainbow trout and chinook salmon were selectively preyed upon by larger fish after being subjected at sub-lethal exposures to water at lethal temperatures (i.e., thermally shocked) in the laboratory. Significant increases in predation rates were found when chinook salmon and rainbow trout received thermal doses that were 10 and 20% of doses causing equilibrium loss.
- Juvenile fish appeared to be more resistant to warm temperature effects than adults.
- Migrating fish appear to prefer shoreline areas particularly the area across from shoreline seepages of reactor effluents. Definite rheotaxis (thermal avoidance) was exhibited by migrating fish in the region of the shoreline effluent seepages near the reactor retention basins.
- Changes in the timing of emergence of caddisflies (Trichoptera) have been related to river temperatures. Caddisfly emergence occurred a few weeks earlier in waters immediately downstream of the effluent discharges, slightly later in well mixed waters further downstream, and latest upstream of the reactors. It is felt this would have little effect on annual biologic cycles of juvenile fish of which 96% of their diet is adult and larval insects (the bulk of which are midges).
- The annual census of spawning fall chinook salmon in the Hanford reach, begun in 1947, has failed to illustrate any deleterious effects of the Hanford discharges. Dam construction has displaced many spawning fish such that rearing nests in the Hanford reach have generally increased. This indicates that spawning in the Hanford reach has not been despoiled, and that Hanford heat releases have not resulted in a catastrophic fisheries disaster.
- Tests on manually spawned fertilized salmon eggs taken from fish captured below Priest Rapids and reared at temperatures elevated above those in the river showed normal mortality (for hatchery operations) and increased body weight (factor of 1.4 for each 2°F rise above

ambient to 12°F) for the eggs and young. The question exists whether or not warmer winter and spring waters might not increase body weight of migrants thereby improving survivorship until seaward migration. (Size of young at release from hatcheries is known to influence the number of adults returning.)

A general conclusion is that the Hanford production reactor thermal discharges have had no detectable harmful influence on the Hanford reach aquatic environment including salmon and trout.

Dam development on the Columbia and its tributaries has had a major effect on migrating salmon and trout. Although steps have been taken to mitigate the influence of dam construction on these anadromous fish (fish ladders, restocking, etc.), there is little doubt that dams have contributed to reducing or eliminating return of spawning fish to certain portions of the Columbia and its tributaries, increased mortality of spawning fish through mechanical stresses, increased incidence of infectious disease and gas bubble disease, and caused relocation of major spawning grounds.

The influences of dam construction and operation and other factors (e.g., irrigation return) on the Columbia River fisheries and the Hanford aquatic ecology tend to mask the effects of the Hanford production reactors, and consequently, a definitive link between changes in the aquatic ecology and fisheries and the operations at Hanford is difficult to establish. Without segregating the effects of dams, irrigation and Hanford operations, it is unlikely that any discernible deleterious environmental effect can be attributable to Hanford production reactor operations.

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APPENDIX A

HISTORICAL HANFORD PRODUCTION REACTOR OPERATING STATISTICS

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C	395		370	461	325	485						2036	
2/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	388		361	448	359	469						2025	
3/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	397 90.9		376 91.9	494 97.3	391 96.1	493 94.2						2151	62.8
4/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	412 96.7		402 96.1	469 88.4	394 84.0	490 82.5						2167	58.1
5/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	398 94.0		401 87.5	422 85.2	372 87.9	491 78.7						2084	55.7
6/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	432 100		431 96.3	441 86.3	422 92.4	489 85.4						2215	61.1

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C	392 88.2		403 84.9	499 87.7	386 59.3	514 86.9						2194	55.8
8/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	398 78.2		439 82.5	528 95.6	477 93.1	512 79.0						2354	62.8
9/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	450 96.1 36.5		434 74.2 37.4	528 96.0 41.3	436 84.8 37.7	538 75.6 41.4						2386	61.1
10/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	430 81.8 36.9		440 87.4 36.6	521 91.0 40.8	405 74.4 37.9	513 95.6 41.6						2309	62.1
11/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	445 87.1 36.7		456 81.9 36.7	466 85.8 40.1	418 99.8 37.7	529 96.0 42.5						2314	62.6
12/51	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	431 86.7 36.4		477 93.8 38.1	489 85.8 40.7	394 53.6 37.4	545 92.3 42.5						2336	60.6

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C	440 85.0 36.4		462 90.2 37.5	361 85.5 40.2	451 83.4 36.7	559 96.7 42.6						2273	62.5
2/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	490 92.1 36.1		478 92.1 38.1	380 78.1 40.7	512 78.8 37.5	558 91.7 41.1						2418	61.0
3/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	524 94.1 35.0		448 91.1 38.1	536 94.4 41.1	496 51.4 36.8	559 88.6 42.4						2563	66.9
4/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	452 85.2 36.3		513 94.6 38.7	532 90.1 40.8	496 84.6 36.5	582 93.8 42.9						2555	68.9
5/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	467 89.5 36.5		532 93.2 39.0	548 97.0 41.6	509 99.8 37.0	506 76.7 43.4						2562	72.6
6/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	524 89.9 36.4		551 94.5 39.7	546 96.3 42.0	461 78.7 36.8	532 90.0 43.4						2614	70.8

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C	494 92.8 37.8		540 88.9 39.4	560 100.0 41.9	486 75.1 37.2	554 90.6 49.3						2634	73.3
8/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	482 78.5 38.3		509 74.0 39.7	561 93.4 42.1	440 71.8 37.5	583 93.5 45.7						2575	66.3
9/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	521 91.0 38.8		565 91.0 40.0	539 92.9 42.2	488 85.0 38.1	591 93.3 45.8						2704	73.7
10/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	532 88.8 39.0		550 89.0 39.0	566 94.2 43.0	494 88.2 37.7	604 94.9 45.8						2746	77.6
11/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	496 86.7 38.1	400 39.3 65.1	558 99.6 38.9	559 91.1 42.7	519 50.6 37.5	597 89.0 46.0						3129	73.4
12/52	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	553 91.6 37.8	686 92.7 64.8	561 91.9 38.6	572 92.9 42.7	342 8.9 ---	624 92.6 47.3						3338	86.7

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C	466 18.2 37.8	697 99.7 64.1	540 74.6 38.5	563 92.6 42.6	448 59.2 38.3	617 92.6 47.7						3331	78.8
2/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	494 82.3 38.3	733 93.9 64.0	384 14.0 44.5	558 91.5 42.5	543 91.7 38.4	655 94.6 47.8						3367	77.8
3/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	526 91.1 38.1	764 91.3 71.2	543 84.3 44.9	485 1.7 ---	548 87.1 38.7	641 96.4 47.3						3507	84.5
4/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	533 78.8 38.3	852 88.2 72.0	548 92.7 44.7	500 77.2 42.6	562 91.1 39.0	660 15.5 ---						3655	80.4
5/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C	539 93.4 38.5	876 81.1 73.9	594 90.1 46.7	415 80.4 42.9	595 92.8 39.3	586 65.8 49.7						3605	93.6
6/53	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	559 88.9 38.6	871 87.7 75.1	653 89.2 47.2	369 94.5 43.3	576 54.9 39.2	634 87.6 51.0						3662	91.9

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/53	AVG. OP. MW	519	866	605	530	584	762						3866	110.7
	T.O.E. - %	91.8	99.9	82.4	91.3	90.1	94.8							
	FLOW - KGPM	38.5	74.5	47.5	43.6	38.9	52.6							
	TEMP. IN- °C													
	TEMP. OUT - °C													
8/53	AVG. OP. MW	557	939	598	334	562	732						3722	105.3
	T.O.E. - %	93	89.2	87.5	99.9	92.3	90.8							
	FLOW - KGPM	39.0	74.1	47.3	43.4	38.5	52.5							
	TEMP. IN - °C	19.2	18.4	20.0	19.3	19.6	19.6							
	TEMP. OUT - °C	75.2	70.6	70.6	67.4	76.7	74.4							
9/53	AVG. OP. MW	521	978	640	351	581	638						3709	91.9
	T.O.E. - %	78.8	80.4	92.6	99.9	87.4	65.0							
	FLOW - KGPM	38.9	73.7	47.4	43.2	39.2	52.5							
	TEMP. IN -°C	18.0	16.8	17.8	17.9	17.8	18.0							
	TEMP. OUT - °C	72.1	71.3	71.6	66.3	78.9	69.5							
10/53	AVG. OP. MW	541	945	663	531	631	707						4018	105.8
	T.O.E. - %	81.3	71.4	93.4	91.8	95.6	83.0							
	FLOW - KGPM	39.3	72.7	47.1	42.9	39.2	52.7							
	TEMP. IN - °C	15.5	15.3	16.0	15.6	15.7	15.9							
	TEMP. OUT - °C	71.8	69.1	70.1	62.6	75.8	70.1							
11/53	AVG. OP. MW	625	1000	649	512	633	795						4214	112.4
	T.O.E. - %	91.3	92.0	82.9	87.9	86.9	90.3							
	FLOW - KGPM	39.1	72.2	46.5	42.5	40.0	52.2							
	TEMP. IN -°C	11.4	10.8	12.4	12.1	12.1	11.9							
	TEMP. OUT - °C	76.1	65.5	68.3	59.1	75.3	76.0							
12/53	AVG. OP. MW	664	976	739	544	658	869						4450	117.7
	T.O.E. - %	68.7	68.6	81.9	99.8	87.8	93.4							
	FLOW - KGPM	39.5	82.5	46.7	42.8	39.3	52.7							
	TEMP. IN - °C	8.1	7.7	9.4	8.6	8.9	8.6							
	TEMP. OUT - °C	77.3	56.4	76.7	56.7	77.7	75.4							

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/54	AVG. OP. MW	707	1074	814	593	704	754						4646	123.8
	T.O.E. - %	90.3	82.8	99.8	95.9	77.3	71.7							
	FLOW - KGPM	40.0	81.7	47.9	42.5	38.8	52.8							
	TEMP. IN- °C	5.6	4.8	6.2	5.8	4.9	5.8							
	TEMP. OUT - °C	75.8	63.0	72.7	64.9	68.8	56.6							
2/54	AVG. OP. MW	673	1096	796	388	628	889						4470	98.5
	T.O.E. - %	67.8	69.4	87.8	94.1	70.0	89.6							
	FLOW - KGPM	40.0	81.5	47.8	42.7	45.2	52.5							
	TEMP. IN - °C	6.3	5.6	6.8	6.4	6.4	6.4							
	TEMP. OUT - °C	75.3	63.6	71.7	64.8	74.0	73.6							
3/54	AVG. OP. MW	628	1191	787	566	713	877						4762	114.1
	T.O.E. - %	46.6	82.3	89.7	75.7	78.7	81.1							
	FLOW - KGPM	45.5	81.7	47.7	43.1	45.5	52.5							
	TEMP. IN -°C	6.3	5.3	6.5	6.3	6.9	6.5							
	TEMP. OUT - °C	71.6	65.3	74.5	66.8	76.3	74.3							
4/54	AVG. OP. MW	708	1172	741	642	737	891						4891	114.8
	T.O.E. - %	74.7	70.9	77.8	83.0	82.3	84.1							
	FLOW - KGPM	48.4	82.0	46.8	43.0	45.6	52.4							
	TEMP. IN - °C	9.7	8.6	9.6	9.4	9.6	9.7							
	TEMP. OUT - °C	73.0	64.5	73.9	73.8	78.2	79.3							
5/54	AVG. OP. MW	731	1199	770	652	701	797						4850	119.5
	T.O.E. - %	89.8	75.4	86.2	94.9	68.6	66.7							
	FLOW - KGPM	48.5	88.7	47.7	43.1	45.0	52.3							
	TEMP. IN -°C	13.0	11.6	12.7	12.7	12.6	12.3							
	TEMP. OUT - °C	74.8	69.6	74.8	68.7	78.0	77.8							
6/54	AVG. OP. MW	821	1227	760	620	718	899						5045	130.1
	T.O.E. - %	87.8	73.6	96.2	77.8	89.0	95.6							
	FLOW - KGPM	48.7	89.2	47.5	42.8	45.9	52.6							
	TEMP. IN - °C	14.4	13.4	14.2	14.0	14.3	14.1							
	TEMP. OUT - °C	84.9	67.6	73.7	70.7	80.3	82.6							

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/54	AVG. OP. MW	817	1182	739	610	781	908						5037	134.3
	T.O.E. - %	78.8	75.7	92.2	89.6	96.1	89.9							
	FLOW - KGPM	47.4	88.8	48.3	42.8	45.5	52.5							
	TEMP. IN - °C	17.4	16.1	17.7	16.5	17.5	17.3							
	TEMP. OUT - °C	83.2	67.3	76.1	76.3	82.0	83.1							
8/54	AVG. OP. MW	829	1201	755	662	755	857						5059	135.6
	T.O.E. - %	75.1	81.0	91.9	99.8	89.0	87.7							
	FLOW - KGPM	48.7	89.9	48.3	43.0	46.3	52.5							
	TEMP. IN - °C	18.5	17.7	18.5	18.5	18.6	18.0							
	TEMP. OUT - °C	85.7	72.6	80.0	85.8	84.2	82.2							
9/54	AVG. OP. MW	809	1276	735	639	760	851						5070	137.0
	T.O.E. - %	88.7	78.6	99.9	100.0	87.8	94.7							
	FLOW - KGPM	48.1	90.6	48.8	42.7	46.3	52.1							
	TEMP. IN - °C	17.2	16.5	17.4	17.4	18.5	17.7							
	TEMP. OUT - °C	84.2	71.8	74.8	73.8	84.4	80.3							
10/54	AVG. OP. MW	851	1247	766	599	816	703						4982	127.0
	T.O.E. - %	82.9	8.12*	87.4	86.9	95.9	57.6							
	FLOW - KGPM	47.7	87.2	48.5	42.7	46.4	52.0							
	TEMP. IN - °C	13.6	13.2	14.2	14.2	14.1	14.1							
	TEMP. OUT - °C	85.7	71.1	78.0	71.8	88.5	75.9							
11/54	AVG. OP. MW	897	1268	766	654	757	863						5205	124.8
	T.O.E. - %	88.6	67.5	75.2	89.7	70.2	94.5							
	FLOW - KGPM	47.7	85.4	50.8	41.7	46.2	51.9							
	TEMP. IN - °C	11.5	11.2	10.8	11.2	12.6	10.9							
	TEMP. OUT - °C	85.7	72.7	72.3	74.2	86.1	76.2							
12/54	AVG. OP. MW	961	1307	910	689	897	925						5689	141.5
	T.O.E. - %	87.3	65.0	71.9	90.6	81.8	93.3							
	FLOW - KGPM	47.8	84.3	51.7	42.2	46.6	51.5							
	TEMP. IN - °C	7.4	6.9	8.5	7.9	8.3	7.5							
	TEMP. OUT - °C	89.2	76.4	84.0	71.7	86.0	78.7							

* Data source lists suspected value of 8.12%. Value 81.2% was used in computation of GWD.

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/55	AVG. OP. MW	918	1234	996	734	933	952						5767	144.8
	T.O.E. - %	75.5	71.7	86.5	96.2	86.9	75.0							
	FLOW - KGPM	48.1	82.3	52.7	42.0	46.5	52.5							
	TEMP. IN - °C	6.2	5.5	6.6	6.4	6.6	6.0							
	TEMP. OUT - °C	85.6	76.7	85.7	75.8	85.9	76.8							
2/55	AVG. OP. MW	841	1358	888	680	952	944						5663	111.3
	T.O.E. - %	67.6	65.7	75.8	83.0	13.7	80.6							
	FLOW - KGPM	48.2	82.8	58.8	41.5	---	52.2							
	TEMP. IN - °C	5.2	4.3	4.7	4.7	---	4.7							
	TEMP. OUT - °C	84.1	74.8	77.3	71.3	---	80.0							
3/55	AVG. OP. MW	867	1350	951	735	864	959		861				6587	168.7
	T.O.E. - %	84.6	69.5	73.9	93.0	95.6	78.5		93.4					
	FLOW - KGPM	48.8	81.8	53.2	41.1	45.9	52.6		124.0					
	TEMP. IN -°C	5.9	5.1	5.5	6.0	6.3	5.5		4.5					
	TEMP. OUT - °C	81.8	74.8	84.2	75.1	78.5	80.0		37.7					
4/55	AVG. OP. MW	794	907	708	350	566	920	168	734				5327	120.2
	T.O.E. - %	87.3	66.3	79.5	50.1	64.5	91.9	63.9	77.3					
	FLOW - KGPM	48.7	82.7	52.9	41.0	52.9	126.3*	124.3*	---*					
	TEMP. IN - °C	8.1	7.1	8.0	7.2	8.4	8.0	7.4	6.7					
	TEMP. OUT - °C	83.7	77.4	78.2	74.7	89.2	81.3	37.3	37.1					
5/55	AVG. OP. MW	819	838	641	593	627	724	903	914				6059	149.9
	T.O.E. - %	89.5	63.7	78.3	77.8	67.7	77.8	89.7	88.3					
	FLOW - KGPM	48.8	83.0	52.4	49.8	47.6	52.9	128.2	127.1					
	TEMP. IN -°C	12.1	11.2	12.7	12.0	12.6	12.5	11.6	10.9					
	TEMP. OUT - °C	84.4	78.2	84.9	82.3	89.6	83.7	43.4	45.5					
6/55	AVG. OP. MW	773	933	481	799	446	715	999	970				6116	147.4
	T.O.E. - %	85.5	69.5	60.5	93.0	50.6	77.2	93.9	88.1					
	FLOW - KGPM	48.5	83.4	52.4	49.8	46.8	53.0	129.3	127.3					
	TEMP. IN - °C	15.4	14.0	14.8	14.8	15.3	15.3	14.6	13.6					
	TEMP. OUT - °C	87.8	80.2	83.4	78.9	86.4	84.7	46.8	45.7					

*Data source is suspect for these values, they should probably be offset one column to the right.

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/55	AVG. OP. MW	922	1365	866	885	836	931	1086	1055				7946	177.2
	T.O.E. - %	25.6	74.2	41.6	82.7	67.1	92.2	99.6	83.0					
	FLOW - KGPM	48.4	84.1	52.8	50.1	47.3	53.5	128.6	128.7					
	TEMP. IN- °C	15.3	16.2	17.5	17.0	17.4	16.8	16.7	15.8					
	TEMP. OUT - °C	87.5	82.3	86.4	85.4	89.3	85.0	49.4	50.0					
8/55	AVG. OP. MW	938	1351	863	872	801	937	1006	1036				7804	183.2
	T.O.E. - %	86.3	79.6	73.4	88.8	61.9	55.3	83.1	73.9					
	FLOW - KGPM	48.4	83.0	53.2	50.8	47.2	57.1	128.5	130.0					
	TEMP. IN - °C	19.3	17.8	19.8	19.5	19.9	19.5	18.5	18.4					
	TEMP. OUT - °C	89.4	82.7	88.5	86.9	88.9	92.0	52.2	50.7					
9/55	AVG. OP. MW	861	1278	900	641	747	965	1068	1099				7559	153.4
	T.O.E. - %	91.1	56.2	60.4	80.4	38.8	70.2	89.8	56.8					
	FLOW - KGPM	48.2	83.1	53.1	51.0	46.9	57.1	126.4	128.8					
	TEMP. IN -°C	17.5	16.2	18.0	17.5	18.0	17.7	16.7	16.6					
	TEMP. OUT - °C	90.0	77.5	90.0	83.9	88.8	80.4	51.5	49.2					
10/55	AVG. OP. MW	912	1358	853	948	820	1020	1240	1386				8537	181.8
	T.O.E. - %	96.4	72.9	42.7	74.4	45.8	63.5	63.8	80.2					
	FLOW - KGPM	47.8	83.0	53.2	51.0	47.3	56.9	136.7	127.4					
	TEMP. IN - °C	14.0	13.1	16.4	13.6	14.4	14.4	13.4	12.7					
	TEMP. OUT - °C	84.5	81.8	82.3	92.3	85.4	87.4	63.5	64.0					
11/55	AVG. OP. MW	875	1313	878	1033	784	1071	1537	1592				9083	196.7
	T.O.E. - %	63.8	57.6	48.3	94.5	47.4	85.1	85.9	77.7					
	FLOW - KGPM	47.5	82.1	52.1	50.5	45.9	56.7	125.3	127.9					
	TEMP. IN -°C	10.1	9.0	9.3	9.2	10.3	9.8	8.3	8.9					
	TEMP. OUT - °C	83.6	71.8	82.3	89.8	85.0	85.1	62.3	62.9					
12/55	AVG. OP. MW	895	1413	843	862	867	915	1846	1763				9404	218.5
	T.O.E. - %	90.9	68.3	19.6	74.9	69.6	64.9	90.6	90.1					
	FLOW - KGPM	46.6	83.8	52.0	49.6	47.0	56.1	125.5	125.0					
	TEMP. IN - °C	5.5	5.5	6.3	5.9	6.7	6.3	4.9	4.4					
	TEMP. OUT - °C	81.3	78.2	80.3	85.4	84.9	80.5	64.9	61.8					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/56	AVG. OP. MW	784	1432	885	833	829	1042	1882	1814				9501	192.6
	T.O.E. - %	57.8	56.4	58.6	73.4	36.2	64.0	75.0	79.5					
	FLOW - KGPM	47.1	84.0	51.1	50.0	45.9	55.7	124.0	122.5					
	TEMP. IN- °C	1.8	1.4	2.6	5.4	3.2	5.9	4.1	2.1					
	TEMP. OUT - °C	75.2	76.8	54.6	85.6	82.5	82.5	65.5	63.4					
2/56	AVG. OP. MW	826	1461	633	828	888	957	1766	1849				9208	194.9
	T.O.E. - %	60.0	73.7	41.8	72.3	45.3	69.5	86.5	91.5					
	FLOW - KGPM	46.1	83.8	49.9	49.8	47.0	55.4	139.0	136.0					
	TEMP. IN - °C	4.2	3.6	3.4	4.8	5.4	5.0	3.4	3.0					
	TEMP. OUT - °C	80.8	78.5	77.9	80.9	81.5	84.0	58.3	64.0					
3/56	AVG. OP. MW	841	1504	886	898	781	1052	1930	1963				9855	231.8
	T.O.E. - %	60.4	74.3	62.7	73.7	48.5	77.6	90.0	86.7					
	FLOW - KGPM	46.1	83.2	49.9	50.3	46.9	55.6	140.0	134.0					
	TEMP. IN -°C	6.5	5.0	6.5	5.9	6.4	6.0	4.8	4.2					
	TEMP. OUT - °C	84.0	79.5	82.5	77.8	70.8	82.0	59.8	63.5					
4/56	AVG. OP. MW	897	1532	922	924	834	1119	1979	1823				10030	234.3
	T.O.E. - %	87.0	79.6	68.3	85.1	39.5	70.1	88.1	84.3					
	FLOW - KGPM	45.8	83.9	49.8	50.2	47.0	56.4	140.0	138.0					
	TEMP. IN - °C	10.0	9.4	9.6	10.1	9.0	8.5	8.9	8.0					
	TEMP. OUT - °C	84.2	81.8	84.7	80.2	82.2	86.0	68.5	62.2					
5/56	AVG. OP. MW	842	1400	831	901	834	1015	1887	1789				9499	225.9
	T.O.E. - %	83.3	74.6	55.3	79.5	57.9	63.0	92.0	84.2					
	FLOW - KGPM	46.0	83.0	49.9	51.2	46.7	11.0	138.0	140.0					
	TEMP. IN -°C	14.3	12.8	9.8	13.0	14.7	12.6	12.1	12.6					
	TEMP. OUT - °C	84.3	81.0	84.8	84.3	87.4	86.6	68.1	66.0					
6/56	AVG. OP. MW	834	1492	853	933	858	942	2038	1875				9825	235.7
	T.O.E. - %	80.5	84.4	73.5	95.1	43.8	61.2	88.2	88.6					
	FLOW - KGPM	45.8	84.4	50.1	51.0	7.6	16.8	141.0	136.0					
	TEMP. IN - °C	15.0	13.9	14.0	15.0	14.3	14.3	14.2	14.0					
	TEMP. OUT - °C	85.0	84.0	85.0	84.8	84.6	86.2	72.8	70.9					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/56	AVG. OP. MW	815	1447	764	901	772	955	2146	1894				9694	235.0
	T.O.E. - %	95.3	77.0	51.9	88.8	52.4	61.3	83.3	90.5					
	FLOW - KGPM	46.4	85.8	51.2	51.7	47.6	57.2	143.0	146.0					
	TEMP. IN- °C	18.3	17.0	17.7	18.3	18.8	18.9	17.8	17.2					
	TEMP. OUT - °C	84.9	86.3	83.1	84.3	84.8	87.6	79.6	73.1					
8/56	AVG. OP. MW	772	1418	847	886	790	1010	1986	2069				9778	243.6
	T.O.E. - %	77.8	73.9	78.2	92.7	77.1	71.4	80.6	86.7					
	FLOW - KGPM	46.5	85.0	51.0	51.8	47.4	56.7	145.5	147.0					
	TEMP. IN - °C	19.8	18.4	20.4	19.4	20.4	21.1	20.2	19.0					
	TEMP. OUT - °C	84.8	85.5	84.5	86.5	83.0	91.0	78.0	77.5					
9/56	AVG. OP. MW	784	1299	841	902	793	982	1811	2202				9614	225.2
	T.O.E. - %	68.8	76.3	87.1	90.9	72.3	75.6	71.4	82.4					
	FLOW - KGPM	46.2	86.0	50.3	51.5	47.0	56.4	149.0	147.0					
	TEMP. IN -°C	19.8	18.4	19.9	19.1	19.0	18.4	17.0	18.0					
	TEMP. OUT - °C	86.4	82.2	87.4	87.4	85.5	87.8	76.8	72.1					
10/56	AVG. OP. MW	---	1276	879	904	805	1034	2261	2337				9496	256.8
	T.O.E. - %	0	92.9	91.2	86.0	75.2	91.0	85.3	87.5					
	FLOW - KGPM	0	84.2	49.5	51.5	48.0	56.5	149.0	149.0					
	TEMP. IN - °C	14.0	13.0	15.6	16.5	14.9	14.8	13.0	13.0					
	TEMP. OUT - °C	---	72.7	85.8	84.9	86.5	87.5	79.2	80.5					
11/56	AVG. OP. MW	---	1308	932	938	875	1079	2464	2448				10044	249.6
	T.O.E. - %	0	75.0	68.8	86.4	86.6	86.8	86.2	83.8					
	FLOW - KGPM	---	84.0	51.0	52.0	48.0	56.3	149.5	148.5					
	TEMP. IN -°C	---	9.5	10.4	10.1	11.0	10.5	9.0	8.9					
	TEMP. OUT - °C	---	75.3	86.8	86.3	86.7	87.7	76.0	77.9					
12/56	AVG. OP. MW	938	1411	963	1077	914	1045	2294	2573				11215	266.8
	T.O.E. - %	61.2	78.9	84.9	100.0	73.2	73.1	57.6	88.2					
	FLOW - KGPM	69.0	84.0	51.3	51.8	47.7	56.0	147.0	148.0					
	TEMP. IN - °C	7.0	7.3	9.6	8.4	8.1	9.6	6.0	6.6					
	TEMP. OUT - °C	69.8	73.5	87.3	88.2	80.4	82.7	73.0	77.6					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/57	AVG. OP. MW	979	1326	1031	1106	972	1112	2586	2513				11625	266.7
	T.O.E. - %	89.2	83.1	84.6	7.0	68.0	82.1	80.5	80.5					
	FLOW - KGPM	71.0	81.2	51.1		47.8	56.1	146.0	147.0					
	TEMP. IN- °C	3.0	2.9	3.2		4.8	5.0	1.8	1.0					
	TEMP. OUT - °C	62.3	68.8	86.2		87.8	83.1	72.1	71.9					
2/57	AVG. OP. MW	1030	1265	1029	1042	1008	1161	2686	2529				11750	237.2
	T.O.E. - %	69.9	64.1	37.8	32.0	83.2	84.8	84.1	84.9					
	FLOW - KGPM	70.2	81.6		71.5	48.2	56.1	148.0	150.0					
	TEMP. IN - °C	3.5	4.4		5.1	5.2	5.8	3.9	2.6					
	TEMP. OUT - °C	66.0	72.0		70.0	90.0	86.0	78.0	77.0					
3/57	AVG. OP. MW	1147	1324	0	1100	1010	1153	2628	2837				10999	256.9
	T.O.E. - %	59.8	69.6	0	78.1	71.8	72.2	72.0	89.9					
	FLOW - KGPM	71.0	82.9	---	68.9	47.4	56.9*	149.5	149.0					
	TEMP. IN -°C	5.5	6.5	---	7.5	6.7	7.8	5.2	5.6					
	TEMP. OUT - °C	72.1	73.2	---	72.6	90.8	88.8	81.7	79.0					
4/57	AVG. OP. MW	1227	1348	1084	1205	0	1140	2678	2824				11506	285.8
	T.O.E. - %	86.4	74.1	80.4	85.7	0	78.8	85.7	83.9					
	FLOW - KGPM	71.0	83.0	67.2	69.1	0	56.1	145.5	150.5					
	TEMP. IN - °C	9.1	8.1	10.0	10.3	0	10.1	7.5	7.8					
	TEMP. OUT - °C	79.9	74.9	80.7	80.7	0	88.8	78.3	84.0					
5/57	AVG. OP. MW	1152	1427	1116	1151	1058	981	2478	2663				12026	270.4
	T.O.E. - %	67.4	94.6	63.8	78.0	40.4	25.3	79.8	87.6					
	FLOW - KGPM	70.5	83.6	71.0	69.2	72.9		150.0	150.5					
	TEMP. IN -°C	14.1	13.3	13.0	13.1	13.6		13.0	12.1					
	TEMP. OUT - °C	83.8	80.6	77.3	82.2	79.5		82.4	84.5					
6/57	AVG. OP. MW	1236	1410	1145	1213	1074	0	2576	2565				11219	272.7
	T.O.E. - %	73.6	86.6	77.1	84.6	75.0	0	80.2	85.0					
	FLOW - KGPM	71.7	85.0	71.0	70.5	73.0		161.0	155.5					
	TEMP. IN - °C	16.2	15.5	16.5	16.3	16.9		15.8	16.4					
	TEMP. OUT - °C	87.8	83.5	84.8	87.0	80.0		82.8	83.9					

* Value given in source is 56.9 gpm

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/57	AVG. OP. MW	1123	1335	1216	1254	1222	1124	2603	2848				12725	296.5
	T.O.E. - %	73.1	50.9	83.4	78.2	90.5	63.7	80.4	75.7					
	FLOW - KGPM	71.0	85.5	70.9	71.8	73.2	69.4	162.0	165.0					
	TEMP. IN- °C	19.1	18.7	19.0	19.0	19.6	20.2	19.1	18.1					
	TEMP. OUT - °C	91.3	84.8	89.0	88.3	87.1	85.4	86.7	89.0					
8/57	AVG. OP. MW	1235	1368	1204	1244	1207	1186	1576	2706				11726	273.3
	T.O.E. - %	72.1	74.3	83.8	88.0	76.4	80.2	45.7	81.7					
	FLOW - KGPM	71.0	85.8	70.5	70.7	72.5	69.0	165.5	165.5					
	TEMP. IN - °C	19.5	19.0	21.1	18.9	20.8	21.4	---	18.2					
	TEMP. OUT - °C	92.3	85.6	92.9	88.0	89.3	89.2	---	87.0					
9/57	AVG. OP. MW	1244	1436	1218	1268	1276	1198	2300	2511				12451	294.7
	T.O.E. - %	71.7	71.7	72.3	82.0	80.0	77.4	85.0	82.8					
	FLOW - KGPM	71.0	87.0	71.0	70.0	71.5	70.3	164.0	162.0					
	TEMP. IN -°C	19.4	19.0	18.9	19.3	19.9	20.1	18.1	18.0					
	TEMP. OUT - °C	93.0	85.8	88.0	90.0	91.9	87.7	82.1	84.8					
10/57	AVG. OP. MW	1324	1352	1269	1241	1060	1201	2639	2739				12825	324.5
	T.O.E. - %	84.8	85.1	92.0	71.5	56.8	78.9	84.9	85.8					
	FLOW - KGPM	71.6	82.0	71.2	70.4	70.2	71.4	153.5	164.0					
	TEMP. IN - °C	16.2	14.8	15.5	15.9	15.3	16.7	15.8	14.8					
	TEMP. OUT - °C	89.2	86.5	87.3	90.2	84.5	87.1	85.9	81.8					
11/57	AVG. OP. MW	1298	1329	1242	1253	1246	1237	2794	2874				13273	321.0
	T.O.E. - %	82.0	76.1	78.8	76.8	82.1	84.3	82.3	80.7					
	FLOW - KGPM	71.5	82.5	71.0	69.8	71.2	69.0	152.0	152.5					
	TEMP. IN -°C	10.6	10.4	13.6	12.0	11.1	12.5	12.7	10.5					
	TEMP. OUT - °C	84.1	78.0	84.6	88.2	83.8	83.2	85.3	87.0					
12/57	AVG. OP. MW	1237	1372	1272	1222	1260	1245	2632	2918				13158	319.1
	T.O.E. - %	83.7	78.7	83.0	58.9	76.6	83.7	76.1	82.0					
	FLOW - KGPM	71.0	71.2	70.4	69.1	71.5	70.3	153.0	155.5					
	TEMP. IN - °C	7.4	7.6	8.7	9.8	9.8	8.8	7.0	6.0					
	TEMP. OUT - °C	79.0	77.4	83.7	88.2	81.2	82.6	81.9	79.9					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/58	AVG. OP. MW	1333	1472	1265	1338	1297	1299	2765	2847				13616	341.1
	T.O.E. - %	74.1	91.7	87.5	90.2	71.4	86.2	74.9	78.9					
	FLOW - KGPM	70.8	84.5	71.0	70.7	71.4	70.3	152.5	154.0					
	TEMP. IN- °C	7.6	7.5	8.3	7.5	9.2	8.5	7.5	7.2					
	TEMP. OUT - °C	82.8	76.0	80.8	84.4	83.2	84.0	81.9	80.4					
2/58	AVG. OP. MW	1286	1356	1291	1331	1329	1335	2877	2018				12823	287.8
	T.O.E. - %	80.8	71.7	88.7	76.4	89.3	84.4	78.7	75.6					
	FLOW - KGPM	70.8	85.2	70.9	70.5	72.4	70.8	153.5	154.5					
	TEMP. IN - °C	8.0	7.8	8.0	7.5	8.0	7.6	7.2	6.8					
	TEMP. OUT - °C	84.1	77.0	83.8	84.5	81.6	84.4	81.0	72.5					
3/58	AVG. OP. MW	1218	1454	1305	1323	1342	1331	2790	2454				13217	305.0
	T.O.E. - %	71.7	80.6	79.5	78.3	76.7	80.7	67.7	70.4					
	FLOW - KGPM	70.6	85.5	71.2	69.6	72.2	71.1	158.0	155.5					
	TEMP. IN -°C	7.9	7.8	9.4	7.8	9.2	7.2	7.5	7.0					
	TEMP. OUT - °C	83.3	77.5	84.2	86.3	82.9	82.3	82.9	83.8					
4/58	AVG. OP. MW	1306	1460	1335	1261	1351	1374	2550	2796				13433	315.1
	T.O.E. - %	84.8	86.2	84.9	64.1	84.2	45.7	73.8	91.1					
	FLOW - KGPM	70.8	90.2	70.2	70.6	72.5	71.5	173.0	157.0					
	TEMP. IN - °C	11.8	11.0	10.3	9.0	11.3	9.7	8.9	9.8					
	TEMP. OUT - °C	86.2	77.8	88.0	85.3	84.3	87.3	74.9	77.5					
5/58	AVG. OP. MW	1330	1425	1275	1256	1348	1386	2462	2589				13071	320.0
	T.O.E. - %	77.8	79.7	82.2	69.2	81.6	86.7	72.7	82.9					
	FLOW - KGPM	71.0	92.3	70.7	73.1	73.0	71.5	157.5	172.5					
	TEMP. IN -°C	15.9	14.2	14.8	14.1	14.5	15.0	14.8	15.0					
	TEMP. OUT - °C	90.6	84.2	90.0	87.2	88.1	92.6	79.8	78.2					
6/58	AVG. OP. MW	1361	1582	1224	1368	1392	1363	2853	2814				13957	366.5
	T.O.E. - %	81.1	88.1	82.5	90.3	86.6	84.0	92.2	88.6					
	FLOW - KGPM	71.0	94.0	71.0	73.4	73.0	74.1	157.0	172.5					
	TEMP. IN - °C	17.2	18.0	17.2	16.2	17.3	17.1	17.4	16.5					
	TEMP. OUT - °C	92.8	86.1	91.5	90.7	91.3	90.8	86.8	84.0					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/58	AVG. OP. MW	1266	1460	1270	1347	1357	1326	2707	2536				13269	338
	T.O.E. - %	82.0	77.1	78.7	66.9	85.9	84.7	93.0	80.6					
	FLOW - KGPM	73.3	94.5	75.2	73.6	73.7	74.5	147.0	173.5					
	TEMP. IN- °C	21.2	20.7	22.0	21.4	21.6	21.7	20.0	20.4					
	TEMP. OUT - °C	91.7	87.5	90.9	93.5	93.5	93.5	83.7	83.0					
8/58	AVG. OP. MW	1273	1482	1242	1278	1321	1280	2711	2573				13160	329.4
	T.O.E. - %	79.4	71.1	87.0	67.2	82.1	88.0	80.1	87.0					
	FLOW - KGPM	72.3	94.0	77.5	73.2	75.5	74.9	174.0	173.0					
	TEMP. IN - °C	21.9	21.8	22.4	21.8	22.6	22.0	21.3	20.1					
	TEMP. OUT - °C	91.6	89.0	89.8	88.9	91.2	92.9	87.6	85.7					
9/58	AVG. OP. MW	1267	1481	1333	1278	1227	1273	2838	2804				13501	324.7
	T.O.E. - %	67.4	74.3	85.0	71.5	78.2	78.6	85.4	87.0					
	FLOW - KGPM	73.9	95.0	78.7	74.2	75.1	76.8	175.5	172.5					
	TEMP. IN -°C	20.0	18.5	20.1	19.1	21.5	20.2	19.0	18.8					
	TEMP. OUT - °C	90.0	87.7	89.1	91.0	89.0	92.5	86.1	85.5					
10/58	AVG. OP. MW	1297	1482	1399	1215	1317	1265	2508	2900				13383	341.6
	T.O.E. - %	77.1	78.5	94.5	57.7	97.4	76.0	76.9	91.7					
	FLOW - KGPM	75.3	93.8	78.7	76.5	75.2	79.3	172.0	172.0					
	TEMP. IN - °C	16.2	15.3	16.9	16.1	17.0	16.8	18.0	17.7					
	TEMP. OUT - °C	87.4	83.1	86.8	86.1	86.9	86.9	83.9	85.8					
11/58	AVG. OP. MW	1354	1284	1399	1245	1252	1365	2757	3090					
	T.O.E. - %	85.9	62.3	92.2	63.1	65.7	93.7	91.6	7.8				13746	267.2
	FLOW - KGPM	76.2	93.5	78.8	76.9	80.5	80.9	172.5	---					
	TEMP. IN -°C	9.3	8.6	10.0	9.3	10.2	9.5	8.5	---					
	TEMP. OUT - °C	77.6	79.1	79.3	79.0	75.7	78.2	71.4	---					
12/58	AVG. OP. MW	1355	1581	1403	1336	1439	1440	2859	2385				13798	370.1
	T.O.E. - %	86.6	83.3	90.2	72.6	100.0	100.0	84.1	80.9					
	FLOW - KGPM	76.8	94.2	80.2	78.9	80.0	80.6	172.5	171.0					
	TEMP. IN - °C	8.1	8.1	9.5	8.7	9.9	9.1	8.1	8.0					
	TEMP. OUT - °C	79.2	77.8	78.1	78.2	78.1	78.2	77.7	71.9					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/59	AVG. OP. MW	1345	1509	1404	1360	1362	1368	2922	2824				14094	344.6
	T.O.E. - %	53.3	69.2	86.5	78.9	76.0	70.6	90.6	85.7					
	FLOW - KGPM	78.2	94.8	79.4	78.4	81.2	81.4	171.5	171.5					
	TEMP. IN- °C	6.1	5.7	6.7	6.1	7.5	6.2	5.1	5.6					
	TEMP. OUT - °C	76.8	76.3	76.3	75.6	74.4	77.3	76.2	74.8					
2/59	AVG. OP. MW	1458	1695	1435	1502	1498	1494	3189	3038				15309	388.6
	T.O.E. - %	87.7	75.5	92.0	99.9	100.0	83.5	92.4	92.4					
	FLOW - KGPM	78.0	94.5	79.9	80.0	81.2	81.2	172.5	171.5					
	TEMP. IN - °C	4.8	4.7	5.4	4.4	5.9	5.0	4.1	3.8					
	TEMP. OUT - °C	78.0	77.8	79.2	79.3	78.2	80.3	77.0	74.6					
3/59	AVG. OP. MW	1468	1760	1437	1466	1415	1599	2775	3119				15039	382.9
	T.O.E. - %	86.3	74.3	78.7	82.9	65.4	100.0	78.5	87.5					
	FLOW - KGPM	79.0	95.3	78.4	80.2	81.4	81.8	171.5	171.0					
	TEMP. IN -°C	7.0	6.0	6.4	6.0	7.4	6.9	5.2	5.2					
	TEMP. OUT - °C	80.8	79.5	82.9	83.8	77.2	81.9	78.6	77.3					
4/59	AVG. OP. MW	1468	1625	1458	1426	1509	1530	2747	3148				14911	340.7
	T.O.E. - %	92.1	70.3	83.8	80.7	86.8	83.4	45.3	84.5					
	FLOW - KGPM	79.9	94.2	78.4	80.2	82.3	82.5	157.5	173.5					
	TEMP. IN - °C	9.5	9.5	10.1	9.0	10.6	9.0	6.7	8.5					
	TEMP. OUT - °C	81.3	86.0	88.0	86.2	80.8	83.4	79.3	81.3					
5/59	AVG. OP. MW	1444	1737	1457	1479	1399	1480	2493	2752				14241	330.8
	T.O.E. - %	73.8	82.2	92.6	89.3	53.4	81.5	53.2	81.0					
	FLOW - KGPM	80.0	95.0	78.6	79.3	82.3	83.0	174.5	176.5					
	TEMP. IN -°C	11.7	12.1	12.6	11.5	12.6	12.0	11.1	12.0					
	TEMP. OUT - °C	86.7	85.2	87.5	86.5	82.8	86.0	78.8	78.4					
6/59	AVG. OP. MW	1471	1693	1412	1471	1356	1428	3040	2882				14753	371.2
	T.O.E. - %	82.9	81.9	73.2	81.4	83.2	80.4	88.8	89.0					
	FLOW - KGPM	83.1	95.2	78.9	79.5	82.2	85.2	175.0	178.0					
	TEMP. IN - °C	14.7	14.3	15.6	14.4	15.0	14.7	13.9	13.9					
	TEMP. OUT - °C	87.7	87.2	90.5	87.6	84.2	85.7	83.8	78.5					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/59	AVG. OP. MW	1477	1715	1429	1399	1483	1593	2739	2939				14774	385.9
	T.O.E. - %	89.1	84.8	90.6	71.8	80.8	100.0	76.0	85.3					
	FLOW - KGPM	83.0	95.3	81.0	82.0	82.2	85.4	175.0	178.5					
	TEMP. IN- °C	18.6	18.2	18.0	17.8	18.1	18.2	17.4	17.6					
	TEMP. OUT - °C	90.9	88.6	92.1	88.5	87.6	90.8	85.4	85.2					
8/59	AVG. OP. MW	1457	1731	1484	1547	1462	1448	3044	3193				15366	406.1
	T.O.E. - %	77.5	83.5	83.0	89.9	87.7	79.6	83.5	91.7					
	FLOW - KGPM	82.8	95.8	81.0	83.4	85.4	85.3	174.5	178.0					
	TEMP. IN - °C	18.8	18.3	18.8	19.3	19.5	18.8	18.6	17.8					
	TEMP. OUT - °C	91.1	89.9	92.8	91.8	88.3	90.3	90.8	88.1					
9/59	AVG. OP. MW	1499	1615	1520	1498	1401	1543	3142	3300				15527	393.3
	T.O.E. - %	83.3	65.4	94.3	94.4	70.5	83.4	88.2	88.0					
	FLOW - KGPM	82.8	96.4	81.1	82.0	83.6	85.8	174.5	178.0					
	TEMP. IN -°C	17.2	16.7	17.7	17.5	17.6	17.9	16.5	16.3					
	TEMP. OUT - °C	88.2	87.0	92.0	90.0	86.3	89.0	89.1	89.3					
10/59	AVG. OP. MW	1454	1760	1548	1497	1460	1581	3153	3302				15755	408.8
	T.O.E. - %	79.6	94.4	89.9	80.8	83.5	84.3	82.8	78.9					
	FLOW - KGPM	80.3	95.2	79.0	80.2	83.4	84.5	175.5	178.5					
	TEMP. IN - °C	13.6	13.7	13.7	14.6	16.4	14.1	12.9	12.7					
	TEMP. OUT - °C	87.2	88.3	92.3	90.3	91.8	91.5	87.1	86.8					
11/59	AVG. OP. MW	1619	1812	1449	1603	1274	1631	3317	3415				16120	424.5
	T.O.E. - %	87.8	77.9	72.1	93.8	93.8	85.2	92.8	90.9					
	FLOW - KGPM	80.0	95.0	78.8	80.0	83.6	83.4	174.0	179.0					
	TEMP. IN -°C	9.9	9.0	11.1	9.3	9.9	10.0	8.5	8.3					
	TEMP. OUT - °C	87.8	84.8	91.9	90.4	87.8	10.0	86.5	85.7					
12/59	AVG. OP. MW	1405	1756	1597	1543	1610	1636	3325	3406				16278	418.3
	T.O.E. - %	75.4	77.0	90.0	75.3	80.7	89.0	80.2	90.1					
	FLOW - KGPM	82.9	96.0	79.0	79.9	83.4	83.2	176.0	179.5					
	TEMP. IN - °C	7.6	7.4	6.5	6.4	8.5	8.6	7.0	5.0					
	TEMP. OUT - °C	80.8	81.5	86.8	84.0	86.1	90.0	86.2	83.6					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/60	AVG. OP. MW	1540	1743	1595	1556	1624	1684	3549	3507				16798	431.7
	T.O.E. - %	81.7	79.9	74.4	88.9	79.1	82.4	85.3	85.7					
	FLOW - KGPM	80.5	94.8	77.7	79.6	83.3	83.5	178.0	179.5					
	TEMP. IN- °C	4.8	4.0	4.2	4.8	4.5	5.2	3.3	3.3					
	TEMP. OUT - °C	84.0	87.1	88.2	87.2	86.6	89.5	81.7	83.4					
2/60	AVG. OP. MW	1594	1781	1639	1533	1699	1708	3372	3598				16924	380.0
	T.O.E. - %	74.8	73.0	86.7	69.2	68.8	79.1	78.3	82.5					
	FLOW - KGPM	80.0	94.5	78.2	80.0	83.5	84.0	180.0	179.5					
	TEMP. IN - °C	4.0	4.2	5.5	4.6	5.2	5.1	4.0	3.5					
	TEMP. OUT - °C	84.9	85.2	91.2	89.3	88.2	89.4	83.5	83.5					
3/60	AVG. OP. MW	1544	1783	1632	1733	1590	1761	3289	3540				16872	335.9
	T.O.E. - %	80.1	81.6	79.2	84.6	74.8	79.2	85.2	82.3					
	FLOW - KGPM	81.0	95.0	78.9	80.0	82.4	84.2	180.5	180.0					
	TEMP. IN -°C	5.6	6.2	6.9	6.5	8.1	6.6	5.3	5.4					
	TEMP. OUT - °C	85.0	86.2	92.0	92.5	89.8	91.8	79.0	83.1					
4/60	AVG. OP. MW	1619	1842	1710	1754	1553	1759	3378	3560				17175	423.1
	T.O.E. - %	71.9	70.5	91.5	89.5	84.3	77.1	80.9	87.3					
	FLOW - KGPM	80.5	95.5	82.0	82.8	83.4	87.5	181.0	179.5					
	TEMP. IN - °C	8.9	10.3	10.9	10.8	9.8	11.5	10.9	9.2					
	TEMP. OUT - °C	90.3	86.8	92.1	93.0	91.0	93.2	83.1	85.9					
5/60	AVG. OP. MW	1635	1851	1601	1580	1604	1765	3574	3327				16937	454.8
	T.O.E. - %	88.6	86.6	81.2	73.1	89.1	79.0	93.3	90.4					
	FLOW - KGPM	81.0	94.5	82.2	82.5	86.1	86.8	182.0	180.0					
	TEMP. IN -°C	13.1	12.7	11.8	12.0	13.2	11.7	12.7	12.2					
	TEMP. OUT - °C	92.2	89.0	91.8	88.8	88.0	93.3	87.5	88.1					
6/60	AVG. OP. MW	1584	1805	1659	1594	1531	1675	3589	3553				16990	435.2
	T.O.E. - %	82.3	78.8	88.8	92.6	83.1	63.4	91.9	94.5					
	FLOW - KGPM	84.0	95.8	83.7	84.1	86.5	86.6	183.5	180.0					
	TEMP. IN - °C	16.3	16.0	15.8	15.9	16.3	15.8	15.8	15.0					
	TEMP. OUT - °C	90.2	90.7	93.2	93.0	89.1	93.1	90.5	91.4					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/60	AVG. OP. MW	1567	1792	1556	1618	1550	1622	3368	3413				16486	409.1
	T.O.E. - %	81.5	78.5	72.8	89.8	69.9	77.3	78.6	86.2					
	FLOW - KGPM	85.3	95.8	84.8	83.9	86.9	87.2	180.5	179.0					
	TEMP. IN- °C	20.0	20.0	19.2	19.7	20.6	20.5	19.5	19.2					
	TEMP. OUT - °C	93.0	92.9	93.2	93.2	91.2	93.4	91.3	91.9					
8/60	AVG. OP. MW	1604	1825	1571	1454	1575	1631	3169	3343				16172	418.7
	T.O.E. - %	79.8	94.2	85.2	85.6	87.4	86.7	73.4	84.0					
	FLOW - KGPM	85.3	96.0	85.0	83.5	87.3	87.2	180.5	182.0					
	TEMP. IN - °C	18.5	18.5	19.5	19.7	20.0	20.2	18.5	17.9					
	TEMP. OUT - °C	91.4	90.7	92.8	92.9	93.2	93.1	91.1	90.6					
9/60	AVG. OP. MW	1508	1809	1577	1569	1613	1596	3515	3493				16680	425.4
	T.O.E. - %	78.6	79.5	67.7	77.7	90.6	87.0	94.5	88.7					
	FLOW - KGPM	85.2	95.8	84.8	84.8	86.1	88.0	180.0	181.5					
	TEMP. IN -°C	18.7	18.4	19.0	19.0	19.8	20.0	18.0	18.0					
	TEMP. OUT - °C	93.1	92.3	93.4	94.2	93.0	93.2	94.2	92.4					
10/60	AVG. OP. MW	1587	1835	1652	1665	1605	1564	3620	3447				16975	420.6
	T.O.E. - %	75.7	80.2	89.5	65.3	67.4	72.5	86.1	86.9					
	FLOW - KGPM	85.7	96.0	84.8	85.0	86.8	87.2	180.5	181.5					
	TEMP. IN - °C	14.6	14.4	15.4	17.6	16.3	17.9	14.2	13.9					
	TEMP. OUT - °C	91.6	91.2	90.9	94.3	91.2	90.8	92.7	91.3					
11/60	AVG. OP. MW	1677	1929	1718	1574	1723	1673	3742	3701				17737	456.3
	T.O.E. - %	86.3	87.7	86.1	82.4	84.6	81.4	83.6	90.4					
	FLOW - KGPM	84.8	95.0	84.9	85.0	86.8	87.1	179.5	182.0					
	TEMP. IN -°C	10.5	10.0	11.0	11.2	11.9	13.0	10.5	9.8					
	TEMP. OUT - °C	90.3	89.5	91.8	90.3	91.5	93.3	91.4	91.3					
12/60	AVG. OP. MW	1719	1922	1773	1715	1760	1834	3497	3872				18092	471.5
	T.O.E. - %	82.2	77.8	92.6	89.4	83.4	92.5	74.9	86.3					
	FLOW - KGPM	85.0	95.3	85.3	84.2	86.7	86.7	180.5	182.0					
	TEMP. IN - °C	6.8	7.7	8.3	9.0	9.8	10.3	6.8	6.0					
	TEMP. OUT - °C	89.3	90.8	89.9	88.9	89.4	93.2	86.0	89.6					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/61	AVG. OP. MW	1758	2011	1750	1746	1775	1709	3802	3900				18451	466.3
	T.O.E. - %	78.1	87.5	75.3	73.6	80.3	65.5	85.2	90.3					
	FLOW - KGPM	84.5	95.5	85.6	83.0	86.7	86.2	181.0	181.5					
	TEMP. IN- °C	6.0	5.8	5.3	6.8	6.9	7.4	5.6	5.8					
	TEMP. OUT - °C	86.8	90.2	86.2	92.8	88.0	90.0	89.6	88.9					
2/61	AVG. OP. MW	1783	2072	1864	1871	1755	1659	3505	3930				18439	433.9
	T.O.E. - %	85.3	81.0	83.9	94.3	72.1	63.4	84.6	93.8					
	FLOW - KGPM	84.8	96.3	86.0	86.1	84.4	86.3	181.0	182.5					
	TEMP. IN - °C	6.0	5.7	6.7	5.7	6.4	6.0	4.9	4.6					
	TEMP. OUT - °C	89.8	91.1	92.0	91.2	89.3	90.3	88.3	89.0					
3/61	AVG. OP. MW	1733	1971	1871	1764	1800	1836	3818	3810				18603	434.7
	T.O.E. - %	72.8	76.0	83.0	77.9	68.5	82.3	72.6	74.0					
	FLOW - KGPM	85.8	96.0	86.3	86.4	88.3	86.4	182.0	182.5					
	TEMP. IN -°C	6.2	8.1	7.9	7.0	7.9	8.0	7.8	6.1					
	TEMP. OUT - °C	88.8	91.3	92.0	89.0	90.3	93.3	90.2	91.4					
4/61	AVG. OP. MW	1787	2006	1799	1628	1860	1752	3793	3867				18492	452.8
	T.O.E. - %	84.3	81.8	78.7	65.6	87.6	83.5	80.7	85.6					
	FLOW - KGPM	86.2	95.5	86.8	87.2	89.1	86.4	183.0	183.5					
	TEMP. IN - °C	11.7	10.9	11.3	9.7	11.8	12.4	10.7	10.4					
	TEMP. OUT - °C	92.5	93.7	93.3	89.0	91.2	91.1	89.2	92.0					
5/61	AVG. OP. MW	1726	1971	1834	1803	1759	1616	3851	3821				18381	453.1
	T.O.E. - %	73.3	80.0	83.6	79.8	70.4	55.6	86.1	87.7					
	FLOW - KGPM	87.5	98.5	87.2	87.8	90.3	86.2	182.5	184.0					
	TEMP. IN -°C	13.2	12.7	12.5	12.3	12.6	13.5	12.2	12.2					
	TEMP. OUT - °C	93.5	93.8	93.4	93.7	90.0	92.0	92.9	92.0					
6/61	AVG. OP. MW	1760	1908	1732	1769	1742	1655	3804	3807				18177	434.7
	T.O.E. - %	78.3	70.6	68.6	82.8	77.5	77.9	86.6	83.5					
	FLOW - KGPM	88.0	99.8	87.5	90.1	89.9	87.8	183.5	184.5					
	TEMP. IN - °C	17.2	15.5	16.1	16.0	15.4	16.5	16.0	15.3					
	TEMP. OUT - °C	93.1	93.9	93.2	92.9	93.7	93.1	94.8	94.6					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/61	AVG. OP. MW	1709	1990	1656	1129	1657	1645	3647	3641				17074	427.2
	T.O.E. - %	79.8	94.9	71.9	42.2	51.6	93.7	87.3	90.1					
	FLOW - KGPM	88.0	100.0	87.9	88.0	89.9	87.1	183.5	185.0					
	TEMP. IN- °C	20.9	20.5	21.3	20.3	20.2	21.7	19.9	20.0					
	TEMP. OUT - °C	93.3	94.6	93.3	65.6	92.6	93.5	94.5	94.8					
8/61	AVG. OP. MW	1596	1863	1607	1369	1401	1554	3558	3506				16454	396.7
	T.O.E. - %	75.8	60.8	70.8	81.4	89.4	73.7	85.0	79.3					
	FLOW - KGPM	88.4	100.2	88.2	88.5	90.0	86.3	184.0	185.5					
	TEMP. IN - °C	21.1	21.2	21.0	20.9	20.9	22.5	20.7	21.4					
	TEMP. OUT - °C	93.5	94.8	93.2	90.1	93.6	93.0	94.7	94.6					
9/61	AVG. OP. MW	1669	1933	1541	1614	1663	1442	3508	3629				16999	382.7
	T.O.E. - %	68.4	85.4	61.7	65.0	67.7	51.5	82.8	87.9					
	FLOW - KGPM	88.6	101.5	88.0	88.7	90.1	86.3	184.5	184.5					
	TEMP. IN -°C	19.0	17.6	19.0	18.7	18.9	20.0	17.4	17.0					
	TEMP. OUT - °C	93.5	94.7	93.3	94.1	93.4	91.9	94.2	94.1					
10/61	AVG. OP. MW	1612	1970	1618	1591	1738	1605	3745	3752				17631	427.4
	T.O.E. - %	70.1	80.1	76.9	59.3	68.5	81.9	81.2	89.2					
	FLOW - KGPM	88.2	100.0	88.0	88.0	90.3	86.0	185.5	185.5*					
	TEMP. IN - °C	14.4	14.1	15.0	14.9	15.9	15.5	14.0	13.7					
	TEMP. OUT - °C	91.7	94.5	92.5	91.8	93.4	93.1	92.9	94.2					
11/61	AVG. OP. MW	1717	2081	1687	1756	1799	1570	3816	3972				18399	432.8
	T.O.E. - %	47.2	84.7	63.5	83.1	71.6	65.3	89.4	90.6					
	FLOW - KGPM	88.0	100.0	88.0	87.8	89.9	86.0	184.5	185.0					
	TEMP. IN -°C	9.3	9.6	12.7	10.8	11.8	13.6	9.6	9.1					
	TEMP. OUT - °C	91.3	94.8	93.2	91.3	93.5	92.2	89.3	94.3					
12/61	AVG. OP. MW	1648	1965	1924	1746	1822	1710	3870	4023				18708	434.2
	T.O.E. - %	65.1	47.6	63.4	80.0	75.3	75.7	78.0	91.9					
	FLOW - KGPM	88.0	97.7	87.8	87.7	90.3	84.9	184.0	184.5					
	TEMP. IN - °C	6.3	7.3	9.0	8.8	9.3	8.8	6.6	6.9					
	TEMP. OUT - °C	85.6	89.2	93.2	90.5	88.6	92.5	92.7	90.7					

* Source of data gives suspect value of 18.55 KGPM

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/62	AVG. OP. MW	1631	2082	1610	1734	1756	1613	4248	3977				18651	404.3
	T.O.E. - %	35.2	74.1	65.7	50.6	86.9	54.7	86.2	73.4					
	FLOW - KGPM	88.0	97.7	87.1	87.8	90.8	85.3	188.0	185.0					
	TEMP. IN- °C	5.0	3.0	5.8	6.2	6.2	3.9	4.9	3.6					
	TEMP. OUT - °C	85.0	89.8	81.9	87.8	78.8	83.1	92.0	90.4					
2/62	AVG. OP. MW	1769	2173	1631	1825	1611	1723	4326	3917				18975	408.8
	T.O.E. - %	67.1	69.1	62.3	91.1	36.1	54.7	91.5	82.9					
	FLOW - KGPM	88.0	98.0	87.0	87.7	90.7	86.1	188.8	185.5					
	TEMP. IN - °C	5.2	5.4	6.3	6.7	6.4	6.4	5.0	4.0					
	TEMP. OUT - °C	86.3	91.0	81.3	88.1	78.2	87.1	92.4	93.6					
3/62	AVG. OP. MW	1730	2216	1930	1728	1749	1746	4298	4222				19619	461.1
	T.O.E. - %	82.9	63.9	64.9	35.7	88.1	81.5	78.4	90.5					
	FLOW - KGPM	88.0	101.5	87.0	87.2	88.7	85.7	187.6	186.5					
	TEMP. IN -°C	7.2	6.6	7.1	5.0	8.5	8.3	5.9	6.3					
	TEMP. OUT - °C	91.9	92.2	93.4	85.0	88.0	89.2	93.6	94.6					
4/62	AVG. OP. MW	1684	2140	1762	1648	1790	1698	4155	4085				18962	409.8
	T.O.E. - %	33.3	77.2	70.9	69.2	81.3	48.9	81.9	82.5					
	FLOW - KGPM	88.2	100.5	87.0	88.0	89.5	86.3	188.6	188.0					
	TEMP. IN - °C	8.3	9.0	9.0	8.9	8.5	9.4	8.3	8.4					
	TEMP. OUT - °C	92.2	94.6	93.4	86.4	87.2	91.8	94.6	94.5					
5/62	AVG. OP. MW	1761	2074	1813	1734	1762	1693	3988	4051				18876	435.7
	T.O.E. - %	84.9	52.2	83.7	89.3	50.1	41.1	83.4	86.6					
	FLOW - KGPM	89.0	101.5	87.0	88.0	88.9	86.1	193.7	188.0					
	TEMP. IN -°C	12.5	11.7	12.1	12.1	12.2	11.0	12.0	11.6					
	TEMP. OUT - °C	93.3	94.0	93.4	89.7	92.8	92.9	94.5	94.4					
6/62	AVG. OP. MW	1761	1909	1745	1619	1724	1689	4087	3983				18535	407.6
	T.O.E. - %	80.1	44.6	82.3	38.3	68.1	59.6	86.8	88.6					
	FLOW - KGPM	89.5	100.4	87.0	87.0	89.3	86.1	200.8	188.5					
	TEMP. IN - °C	17.2	16.5	16.2	16.0	15.1	15.5	15.7	15.0					
	TEMP. OUT - °C	93.2	94.2	93.3	93.1	93.4	93.1	94.2	94.0					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/62	AVG. OP. MW	1679	1898	1714	1633	1647	1652	3800	3620				17643	384.3
	T.O.E. - %	76.0	69.7	84.0	73.3	78.9	84.3	63.1	57.2					
	FLOW - KGPM	89.2	100.5	87.5	86.3	89.4	86.3	200.9	198.5					
	TEMP. IN - °C	20.2	19.1	20.0	19.8	20.1	20.5	18.6	19.1					
	TEMP. OUT - °C	93.5	94.1	93.2	93.5	93.5	93.2	94.6	94.5					
8/62	AVG. OP. MW	1673	1766	1646	1654	1656	1573	4007	3934				17909	426.7
	T.O.E. - %	80.3	28.0	75.5	91.6	65.7	75.9	85.1	88.5					
	FLOW - KGPM	88.5	100.0	87.0	86.1	89.1	85.7	201.7	201.5					
	TEMP. IN - °C	18.9	18.5	19.2	18.8	19.8	19.4	18.3	18.3					
	TEMP. OUT - °C	93.5	94.9	93.3	93.5	93.4	93.0	94.4	94.7					
9/62	AVG. OP. MW	1642	1928	1569	1587	1715	1562	3917	3909				17822	391.8
	T.O.E. - %	81.1	71.7	23.8	75.2	92.7	47.5	81.1	83.7					
	FLOW - KGPM	88.2	101.3	87.7	86.2	89.9	85.6	206.0	204.5					
	TEMP. IN - °C	18.6	18.1	21.9	20.4	19.4	19.9	18.1	18.0					
	TEMP. OUT - °C	93.3	94.0	93.2	94.4	93.4	93.4	94.7	94.7					
10/62	AVG. OP. MW	1686	1878	1626	1472	1713	1612	4269	3997				18253	393.9
	T.O.E. - %	67.4	68.2	67.8	41.1	74.8	51.9	94.5	60.8					
	FLOW - KGPM	88.9	101.0	87.3	86.1	89.9	85.6	206.2	204.0					
	TEMP. IN - °C	16.7	15.5	16.0	15.7	16.0	16.7	15.3	14.7					
	TEMP. OUT - °C	93.4	94.6	92.5	92.5	93.0	91.7	94.8	94.1					
11/62	AVG. OP. MW	1609	2003	1721	1726	1695	1692	3867	4297				18610	386.3
	T.O.E. - %	42.1	73.9	72.1	84.7	76.2	74.7	41.5	89.7					
	FLOW - KGPM	89.0	99.8	87.3	85.9	90.7	85.5	206.0	205.0					
	TEMP. IN - °C	12.3	11.2	11.9	11.1	11.7	13.2	11.0	10.1					
	TEMP. OUT - °C	89.5	92.1	92.9	92.6	87.3	93.4	92.2	91.3					
12/62	AVG. OP. MW	1727	1780	1791	1676	1763	1635	4188	4297				18857	440.0
	T.O.E. - %	85.3	10.6	76.1	92.8	86.6	79.4	78.8	81.2					
	FLOW - KGPM	89.0	98.5	87.8	86.0	90.3	85.3	205.0	205.5					
	TEMP. IN - °C	9.1	7.5	9.4	8.0	9.1	12.0	7.8	8.1					
	TEMP. OUT - °C	86.4	87.0	92.1	85.2	86.1	92.3	89.9	89.0					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/63	AVG. OP. MW	1841	2021	1790	1646	1726	1489	4162	4349				19024	436.2
	T.O.E. - %	70.2	82.0	79.4	81.0	50.6	28.0	84.0	82.3					
	FLOW - KGPM	89.3	97.8	87.8	86.1	90.3	---	206.0	205.5					
	TEMP. IN- °C	6.3	3.8	4.8	5.2	5.7	---	4.9	3.5					
	TEMP. OUT - °C	86.9	88.1	89.5	81.4	85.0	---	86.6	84.8					
2/63	AVG. OP. MW	1679	2069	1893	1721	1843	1805	3989	4253				19302	364
	T.O.E. - %	52.5	71.2	76.7	44.0	89.9	96.2	62.2	59.5					
	FLOW - KGPM	89.0	97.8	87.8	85.6	90.1	84.8	205.0	204.0					
	TEMP. IN - °C	6.7	4.7	5.6	5.2	6.1	6.4	4.8	4.9					
	TEMP. OUT - °C	87.7	88.3	92.0	85.3	84.8	93.0	86.5	86.4					
3/63	AVG. OP. MW	1864	2146	1879	1658	1835	1861	4215	4353				19811	494.3
	T.O.E. - %	90.1	62.8	45.1	72.6	83.6	92.9	82.4	94.9					
	FLOW - KGPM	89.0	97.5	87.3	86.3	89.5	84.3	205.0	204.0					
	TEMP. IN -°C	8.2	6.2	7.9	7.6	6.3	7.9	6.0	5.6					
	TEMP. OUT - °C	88.4	88.8	92.5	87.9	86.0	93.3	87.5	87.6					
4/63	AVG. OP. MW	1805	2062	1867	1810	1792	1827	4336	4206				19705	502.6
	T.O.E. - %	78.0	76.5	84.5	87.7	94.2	86.8	93.0	78.4					
	FLOW - KGPM	89.3	97.5	87.7	86.9	89.3	84.2	205.5	206.0					
	TEMP. IN - °C	10.7	9.6	10.4	10.0	9.3	10.1	9.3	8.9					
	TEMP. OUT - °C	88.2	95.0	92.8	87.1	87.2	93.3	90.4	90.2					
5/63	AVG. OP. MW	1785	2181	1823	1749	1791	1687	4399	3804				19219	385.0
	T.O.E. - %	87.3	95.1	94.6	90.3	87.2	70.7	35.7	30.4					
	FLOW - KGPM	89.8	100.0	87.5	87.4	89.9	84.6	205.0	207.0					
	TEMP. IN -°C	15.2	14.5	14.4	14.0	13.0	14.6	10.7	13.5					
	TEMP. OUT - °C	92.5	94.5	93.3	92.0	90.4	93.4	91.6	91.9					
6/63	AVG. OP. MW	1740	2039	1737	1737	1751	1719	4201	4337				19261	462.9
	T.O.E. - %	54.4	80.5	46.8	86.0	73.9	100.0	75.8	100.0					
	FLOW - KGPM	90.7	100.0	87.3	87.0	90.2	84.5	205.8	206.5					
	TEMP. IN - °C	17.0	16.4	15.9	16.0	15.1	16.5	15.7	14.9					
	TEMP. OUT - °C	94.9	95.0	93.4	93.6	92.6	93.4	94.5	94.4					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/63	AVG. OP. MW	1718	1978	1672	1691	1778	1652	3991	3957				18437	463.4
	T.O.E. - %	79.9	89.7	82.1	82.2	92.9	87.7	76.1	73.3					
	FLOW - KGPM	90.5	100.0	87.8	97.0	89.8	83.7	206.0	206.5					
	TEMP. IN- °C	19.4	18.7	18.5	18.3	17.8	19.4	18.0	17.8					
	TEMP. OUT - °C	94.5	94.6	93.5	93.6	93.5	93.8	94.9	94.5					
8/63	AVG. OP. MW	1698	1915	1674	1657	1727	1573	4023	3555				17822	382.9
	T.O.E. - %	85.4	81.8	99.9	86.7	89.9	88.7	64.4	19.3					
	FLOW - KGPM	90.4	100.2	87.5	87.5	87.5	83.5	206.2	210.0					
	TEMP. IN - °C	20.4	19.7	20.0	19.1	19.3	20.9	18.6	19.3					
	TEMP. OUT - °C	95.0	93.8	93.5	93.5	93.5	94.5	94.8	94.1					
9/63	AVG. OP. MW	1725	1868	1627	1651	1666	1554	3682	4144				17917	405.7
	T.O.E. - %	88.7	61.6	82.3	91.0	72.8	58.3	47.2	100.0					
	FLOW - KGPM	90.0	100.0	87.7	87.1	89.8	84.6	206.0	208.0					
	TEMP. IN -°C	20.2	19.2	20.8	20.4	19.2	21.7	18.9	18.7					
	TEMP. OUT - °C	94.3	94.8	93.0	93.8	94.1	94.6	94.6	94.6					
10/63	AVG. OP. MW	1748	2020	1675	1707	1755	1663	4111	3957				18636	413.3
	T.O.E. - %	86.3	93.0	75.8	83.1	87.7	93.5	23.6	80.7					
	FLOW - KGPM	90.4	97.5	87.8	87.6	89.7	84.7	205.0	208.0					
	TEMP. IN - °C	15.3	14.7	14.2	14.6	14.4	15.4	18.0	14.6					
	TEMP. OUT - °C	94.3	94.5	94.0	94.4	94.0	95.0	94.3	94.2					
11/63	AVG. OP. MW	1895	2018	1821	1781	1778	1782	4304	3870				19249	440.3
	T.O.E. - %	92.6	77.6	95.0	83.5	76.3	100.0	92.0	26.9					
	FLOW - KGPM	89.5	96.0	87.8	86.3	89.5	84.9	205.5	208.0					
	TEMP. IN -°C	10.7	10.1	11.4	11.9	11.6	12.9	10.0	10.0					
	TEMP. OUT - °C	93.3	94.6	94.1	94.0	93.8	94.7	91.4	89.8					
12/63	AVG. OP. MW	1894	2134	1914	1813	1805	1771	4148	4194				19673	492.0
	T.O.E. - %	84.7	75.1	90.7	77.8	77.0	85.4	76.0	82.6					
	FLOW - KGPM	89.9	99.5	88.0	87.1	89.3	84.5	206.0	208.0					
	TEMP. IN - °C	8.6	8.0	8.2	8.2	7.8	9.4	7.3	7.6					
	TEMP. OUT - °C	90.8	94.2	94.6	93.4	91.0	93.6	88.5	87.7					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/64	AVG. OP. MW	1853	2201	1949	1873	1906	1840	4351	4393				20366	478.3
	T.O.E. - %	83.1	77.0	79.9	88.9	51.9	34.0	68.1	100.0					
	FLOW - KGPM	86.5	96.2	88.8	87.6	89.1	93.3	205.5	207.5					
	TEMP. IN- °C	6.2	5.6	6.6	6.7	6.8	8.2	5.8	5.3					
	TEMP. OUT - °C	91.8	94.1	93.4	91.5	90.1	88.4	87.1	85.8					
2/64	AVG. OP. MW	1895	2262	1999	1928	1900	1967	4102	4396				20449	387.7
	T.O.E. - %	81.5	79.5	87.3	86.9	86.7	93.8	43.1	41.5					
	FLOW - KGPM	89.3	97.8	78.8	87.6	88.8	93.3	207.5	207.5					
	TEMP. IN - °C	6.0	5.7	5.4	5.8	6.5	7.0	4.7	4.9					
	TEMP. OUT - °C	94.5	94.2	93.6	94.2	90.8	92.5	85.5	85.5					
3/64	AVG. OP. MW	2030	2237	1996	1943	1954	2042	4402	4314				20918	519.0
	T.O.E. - %	51.7	85.7	91.5	66.9	66.3	93.1	100.0	70.7					
	FLOW - KGPM	89.2	96.2	88.0	87.5	89.1	93.3	206.0	208.0					
	TEMP. IN -°C	6.3	6.4	7.5	7.7	7.6	8.5	6.1	6.3					
	TEMP. OUT - °C	94.8	95.0	94.4	93.7	94.0	93.5	87.0	86.0					
4/64	AVG. OP. MW	1853	2178	1823	1880	1749	1709	4189	4362				19744	419.5
	T.O.E. - %	77.1	83.6	38.5	68.4	71.5	43.4	68.4	89.1					
	FLOW - KGPM	89.5	96.0	88.8	87.2	89.6	93.3	207.0	209.5					
	TEMP. IN - °C	9.9	9.4	9.6	10.2	9.6	10.5	9.9	8.4					
	TEMP. OUT - °C	94.3	94.7	94.2	93.4	94.3	91.6	90.5	88.3					
5/64	AVG. OP. MW	1808	2101	1892	1835	1843	1949	4330	4369				20127	542.2
	T.O.E. - %	75.6	80.8	89.0	85.2	80.8	96.5	94.8	84.8					
	FLOW - KGPM	89.9	99.6	88.8	87.2	89.0	93.3	207.0	209.5					
	TEMP. IN -°C	12.8	13.9	13.3	13.4	14.4	13.0	13.4	12.8					
	TEMP. OUT - °C	94.9	93.5	94.6	94.5	93.8	93.6	93.9	92.8					
6/64	AVG. OP. MW	1855	2035	1860	1807	1841	1864	4305	4329				19886	500.8
	T.O.E. - %	91.9	80.9	83.6	88.1	86.6	96.1	75.9	81.8					
	FLOW - KGPM	90.0	99.9	89.0	87.2	89.0	93.2	208.5	209.5					
	TEMP. IN - °C	15.9	15.0	14.5	14.3	15.4	15.3	14.8	14.4					
	TEMP. OUT - °C	95.0	94.0	94.0	94.2	94.2	93.6	94.9	93.9					

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/64	AVG. OP. MW	1786	2041	1800	1762	1741	1851	4277	4250	1140			20648	501.0
	T.O.E. - %	65.3	39.1	94.8	88.6	88.8	75.6	89.8	82.2	56.9				
	FLOW - KGPM	89.2	99.5	89.2	87.8	89.3	93.3	209.0	209.5	164.0				
	TEMP. IN- °C	19.0	18.3	18.1	18.0	19.6	19.1	17.8	17.5	18.1				
	TEMP. OUT - °C	91.2	94.0	94.5	94.5	94.4	93.6	94.9	94.5	59.4				
8/64	AVG. OP. MW	1651	1976	1748	1706	1732	1832	4235	4127	1560			20567	488.2
	T.O.E. - %	83.1	86.0	91.0	78.1	91.5	100.0	59.7	81.9	27.4				
	FLOW - KGPM	89.0	100.0	89.0	87.8	89.9	92.8	209.0	208.5	375.0				
	TEMP. IN - °C	18.2	17.6	17.6	17.1	19.2	18.3	17.8	18.1	20.0				
	TEMP. OUT - °C	91.0	93.7	94.3	93.8	93.9	93.8	94.9	94.3	71.1				
9/64	AVG. OP. MW	1636	1985	1743	1696	1681	1756	4102	4270	2660			21529	495.3
	T.O.E. - %	79.3	80.0	87.1	84.8	86.4	76.1	62.5	95.3	46.8				
	FLOW - KGPM	88.2	101.3	89.0	88.0	89.9	92.6	210.0	210.0	~300.0				
	TEMP. IN -°C	16.8	16.3	16.5	16.5	18.0	19.8	16.3	16.7	21.1				
	TEMP. OUT - °C	92.8	93.0	94.0	93.1	93.0	93.9	94.9	94.4	56.1				
10/64	AVG. OP. MW	1687	1980	1660	1627	1768	1802	4265	3963	2456			21208	406.0
	T.O.E. - %	69.3	68.7	45.6	71.9	87.0	88.2	85.3	32.9	23.3				
	FLOW - KGPM	88.9	99.2	88.4	88.0	89.9	93.9	209.0	210.0	~300.0				
	TEMP. IN - °C	15.3	15.4	16.0	15.2	16.5	16.4	14.0	13.8	15.6				
	TEMP. OUT - °C	93.5	94.9	94.6	93.2	93.7	94.2	94.1	92.2	52.8				
11/64	AVG. OP. MW	1676	2092	1713	1807	1812	1794	4347	4320	2932			22493	536.7
	T.O.E. - %	76.0	70.6	70.2	95.0	82.0	86.1	85.0	84.4	63.0				
	FLOW - KGPM	89.1	99.5	89.3	87.5	89.8	93.2	210.0	209.0	300.0				
	TEMP. IN -°C	10.6	10.2	11.2	10.0	11.7	12.5	9.9	9.6	14.4				
	TEMP. OUT - °C	88.3	94.1	93.1	93.1	92.0	89.9	89.6	89.3	56.7				
12/64	AVG. OP. MW	1754	2204	1901	1837	1895	1934	4331	4169	3476			23501	604.2
	T.O.E. - %	83.1	73.6	85.5	91.7	82.2	85.4	85.7	84.0	77.0				
	FLOW - KGPM	87.5	100.1	89.0	87.1	87.1	93.3	209.0	206.5	325.0				
	TEMP. IN - °C	6.9	5.0	5.3	6.0	8.8	6.5	4.3	4.0	8.3				
	TEMP. OUT - °C	88.0	91.0	92.1	85.3	87.0	93.3	84.5	84.5	55.6				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGF	N*	AVG. MW	GWD
1/65	AVG. OP. MW	1888	2157	1812		1987	2033	4332	3936	3025			21170	521.4
	T.O.E. - %	81.3	84.8	80.9		100.0	90.6	74.0	66.4	77.4				
	FLOW - KGPM	87.5	99.8	89.0		88.7	92.9	208.2	204.0	325.0				
	TEMP. IN- °C	6.9	7.6	11.0		10.0	9.3	6.2	5.5	6.1				
	TEMP. OUT - °C	92.5	93.0	91.7		94.4	92.5	86.2	86.8	53.3				
2/65	AVG. OP. MW	1947	2167	1757		1872	1927	4351	4357	3060			21438	475.8
	T.O.E. - %	79.9	80.9	65.8		73.4	77.2	88.1	80.4	76.1				
	FLOW - KGPM	88.5	99.5	89.0		89.5	92.4	208.0	203.0	325.0				
	TEMP. IN - °C	4.8	5.6	4.0		6.4	6.0	5.0	3.6	4.4				
	TEMP. OUT - °C	91.9	93.5	83.8		93.0	89.2	84.7	85.3	51.7				
3/65	AVG. OP. MW	1855	2175	1811		1973	1893	4365	4192	0			18264	477.8
	T.O.E. - %	82.2	75.4	91.4		84.3	89.7	85.8	83.2	0				
	FLOW - KGPM	89.1	99.8	86.0		90.2	93.1	207.0	205.0	0				
	TEMP. IN -°C	6.6	6.7	6.2		7.7	7.4	5.8	4.6	0				
	TEMP. OUT - °C	89.9	94.8	89.2		93.7	88.8	86.0	85.8	0				
4/65	AVG. OP. MW	1950	2176	1774		1877	1719	4219	4221	2855			20791	492.9
	T.O.E. - %	87.2	87.9	82.1		87.3	87.3	68.0	76.3	74.5				
	FLOW - KGPM	89.2	100.6	86.1		90.1	93.2	207.0	206.5	--				
	TEMP. IN - °C	10.4	10.2	10.0		11.0	10.0	9.2	8.8	--				
	TEMP. OUT - °C	94.2	94.0	89.3		93.6	79.0	89.8	89.6	--				
5/65	AVG. OP. MW	1799	2052	1711		1817		4325	4336	3472			19512	473.6
	T.O.E. - %	77.6	67.7	55.3		88.8		73.8	86.8	85.7				
	FLOW - KGPM	90.0	100.8	86.3		89.8		207.5	206.5	---				
	TEMP. IN - °C	14.5	13.6	12.2		14.0		13.0	12.5	---				
	TEMP. OUT - °C	90.8	94.6	90.2		93.7		92.3	93.5	---				
6/65	AVG. OP. MW	1818	2060	1889		1737		4370	4174	2883			18931	436.3
	T.O.E. - %	91.7	81.0	95.7		86.2		82.1	77.1	38.0				
	FLOW - KGPM	89.5	101.2	90.0		89.8		208.0	208.0	--				
	TEMP. IN -°C	17.3	16.7	15.8		15.5		15.1	15.0	--				
	TEMP. OUT - °C	94.6	94.9	94.8		91.8		94.9	94.7	--				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/65	AVG. OP. MW	1710	1832	1761				4314	4148	2800			16565	382.0
	T.O.E. - %	82.7	66.6	80.9				94.9	62.3	56.0				
	FLOW - KGPM	89.5	101.2	89.9				208.5	209.8	--				
	TEMP. IN - °C	20.6	19.3	20.3				18.8	18.9	--				
	TEMP. OUT - °C	95.0	94.8	94.9				94.7	94.8	--				
8/65	AVG. OP. MW	1712	1925	1673				4098	4028	3337			16773	391.3
	T.O.E. - %	84.2	86.5	75.6				75.8	76.3	62.1				
	FLOW - KGPM	89.5	102.4	90.2				209.5	209.0	---				
	TEMP. IN- °C	19.6	19.4	20.5				18.8	18.1	---				
	TEMP. OUT - °C	94.5	94.8	93.8				94.7	94.7	---				
9/65	AVG. OP. MW	1740	1922	1711				4223	4165	3306			17067	392.7
	T.O.E. - %	83.8	74.1	90.4				75.6	73.9	72.3				
	FLOW - KGPM	89.0	102.0	90.0				211.5	208.5	---				
	TEMP. IN - °C	18.3	18.8	19.0				17.7	17.8	---				
	TEMP. OUT - °C	94.1	94.8	93.0				94.8	94.6	---				
10/65	AVG. OP. MW	1745	1987	1722				4274	4296	3314			17338	398.1
	T.O.E. - %	85.4	45.0	80.6				81.9	92.2	48.5				
	FLOW - KGPM	89.1	102.2	90.4				210.0	211.0	---				
	TEMP. IN -°C	15.5	18.9	19.4				15.5	14.9	---				
	TEMP. OUT - °C	93.7	94.7	94.9				94.1	94.2	---				
11/65	AVG. OP. MW	1836	2166	1875				4251	4096	3374			17598	373.4
	T.O.E. - %	79.0	87.6	39.6				81.6	60.9	70.9				
	FLOW - KGPM	88.7	108.8	92.2				210.0	209.5	---				
	TEMP. IN - °C	10.6	13.9	14.2				10.0	9.8	---				
	TEMP. OUT - °C	94.2	94.7	94.0				88.6	89.6	---				
12/65	AVG. OP. MW	1974	2151	2004				4371	4358	3200			18058	426.6
	T.O.E. - %	86.4	63.9	93.9				82.4	74.5	61.0				
	FLOW - KGPM	88.9	107.7	92.2				208.0	209.5	---				
	TEMP. IN -°C	7.0	9.2	8.0				6.5	6.0	---				
	TEMP. OUT - °C	93.9	93.2	94.0				86.6	86.0	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/66	AVG. OP. MW	1961	2348	2051				4284	4225	3331			18200	420.0
	T.O.E. - %	82.2	91.7	74.6				76.8	71.7	58.1				
	FLOW - KGPM	89.4	105.9	93.0				208.0	209.5	---				
	TEMP. IN- °C	5.5	6.0	6.4				5.9	4.8	---				
	TEMP. OUT - °C	93.8	94.1	92.8				85.7	84.7	---				
2/66	AVG. OP. MW	1969	2358	2103				4263	4349	3900			18942	411.1
	T.O.E. - %	77.6	73.0	91.3				67.3	69.3	93.1				
	FLOW - KGPM	89.2	106.7	92.7				213.0	214.0	---				
	TEMP. IN - °C	5.3	5.4	6.1				5.0	4.5	---				
	TEMP. OUT - °C	93.2	94.1	94.4				82.7	82.6	---				
3/66	AVG. OP. MW	2010	2387	2102				4380	4383	3850			19112	508.9
	T.O.E. - %	85.8	84.0	73.6				95.7	89.3	78.8				
	FLOW - KGPM	90.3	107.3	92.4				213.5	214.0	---				
	TEMP. IN -°C	9.1	9.1	14.2				9.5	8.8	---				
	TEMP. OUT - °C	94.5	94.9	94.8				87.2	87.0	---				
4/66	AVG. OP. MW	1975	2366	2003				4352	4287	3542	142	3400	18383	424.9
	T.O.E. - %	89.6	82.0	94.8				83.4	42.2	89.2	29.7			
	FLOW - KGPM	87.6	107.5	92.6				213.5	214.0	---				
	TEMP. IN - °C	10.1	10.1	12.3				10.9	8.3	---				
	TEMP. OUT - °C	94.1	94.8	94.9				88.5	86.6	---				
5/66	AVG. OP. MW	1938	2286	1977				4362	4240	3770	168	3602	18409	381.3
	T.O.E. - %	100.0	86.4	71.4				78.4	81.9	2.2	2.0			
	FLOW - KGPM	89.8	107.8	92.5				214.0	214.5					
	TEMP. IN -°C	14.2	13.8	13.8				13.2	12.8	*				
	TEMP. OUT - °C	94.4	94.9	94.4				90.2	90.7	*				
6/66	AVG. OP. MW	1745	2208	1953				4373	4194	2862	328	2534	17007	367.4
	T.O.E. - %	61.7	65.9	86.6				89.8	63.9	52.3	24.2			
	FLOW - KGPM	90.5	108.4	94.2				213.0	215.3	---				
	TEMP. IN - °C	14.8	15.8	15.4				14.9	14.4	---				
	TEMP. OUT - °C	93.8	94.6	94.9				92.7	92.0	---				

* N Reactor was in shutdown status essentially all month.

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/66	AVG. OP. MW	1765	2159	1730				4395	4394	3160	374	2786	17229	109.1
	T.O.E. - %	23.6	15.0	16.2				20.4	24.8	18.1	16.1			
	FLOW - KGPM	90.6	108.1	93.5				213.0	215.0	---				
	TEMP. IN- °C	17.3	15.6	17.0				15.2	15.3					
	TEMP. OUT - °C	95.0	94.7	94.2				92.8	93.2	---				
8/66	AVG. OP. MW	1663	2065	1804				3757	4213	2874	380	2494	15996	98.5
	T.O.E. - %	20.1	21.0	26.8				14.7	23.5	14.7	10.6			
	FLOW - KGPM	90.6	108.5	93.9				213.5	215.0	---				
	TEMP. IN - °C	19.4	18.9	19.9				18.9	18.0	---				
	TEMP. OUT - °C	94.0	94.8	94.8				93.6	94.8	---				
9/66	AVG. OP. MW	1758	2133	1759				4188	4307	3797	405	3392	17537	434.2
	T.O.E. - %	76.9	93.4	62.1				93.0	71.8	89.7	88.1			
	FLOW - KGPM	90.5	108.9	94.0				213.0	216.0	---				
	TEMP. IN -°C	20.1	19.3	20.8				18.5	18.1	---				
	TEMP. OUT - °C	95.0	94.8	94.2				95.0	94.8	---				
10/66	AVG. OP. MW	1805	2204	1877				4322	4211	2626	367	2259	16678	355.1
	T.O.E. - %	90.5	77.9	100.0				44.5	80.8	39.0	33.5			
	FLOW - KGPM	89.9	108.3	94.0				212.0	198.0	---				
	TEMP. IN - °C	15.0	15.0	16.3				14.5	14.5	---				
	TEMP. OUT - °C	94.5	94.8	94.0				94.0	93.0	---				
11/66	AVG. OP. MW	1855	2217	1896				4373	4365	3515	428	3087	17793	415.0
	T.O.E. - %	28.7	79.9	71.3				85.1	85.3	87.5	80.1			
	FLOW - KGPM	93.6	104.9	94.0				212.0	215.5	---				
	TEMP. IN -°C	11.6	12.0	13.7				11.7	10.8	---				
	TEMP. OUT - °C	94.0	94.1	94.3				89.9	88.2	---				
12/66	AVG. OP. MW	1982	2335	2050				4360	4302	3355	443	2912	17941	466.6
	T.O.E. - %	89.6	84.6	100.0				85.1	70.3	85.1	76.4			
	FLOW - KGPM	94.4	107.4	94.3				212.5	215.5	---				
	TEMP. IN - °C	7.7	8.4	9.4				7.9	8.4	---				
	TEMP. OUT - °C	94.7	94.5	93.9				86.2	85.7	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/67	AVG. OP. MW	2056	2417	2027				4354	4387	3516	462	3054	18295	468.6
	T.O.E. - %	75.9	80.9	75.9				78.4	99.7	73.4	66.2			
	FLOW - KGPM	95.0	107.2	93.7				212.0	215.0	---				
	TEMP. IN- °C	6.9	7.6	8.7				6.4	6.0	---				
	TEMP. OUT - °C	93.3	94.8	94.3				84.3	83.7	---				
2/67	AVG. OP. MW	2187	2410	2043				4380	4305	3775	640	3135	18460	423
	T.O.E. - %	100.0	84.0	86.2				78.1	79.9	72.3	69.9			
	FLOW - KGPM	94.3	107.6	93.8				213.5	216.5	---				
	TEMP. IN - °C	6.7	6.1	8.0				6.0	5.5	---				
	TEMP. OUT - °C	94.7	94.9	94.2				83.5	82.7	---				
3/67	AVG. OP. MW	1982	2455	2081				4303	4295	3706	641	3065	18181	417.8
	T.O.E. - %	64.4	74.6	74.0				80.3	79.9	62.4	57.9			
	FLOW - KGPM	95.0	107.3	94.4				197.5	216.5	---				
	TEMP. IN -°C	7.6	6.8	9.6				5.9	6.0	---				
	TEMP. OUT - °C	87.0	94.8	94.0				90.0	82.8	---				
4/67	AVG. OP. MW	2125	2317	2001				4394	4363	3697	650	3047	18247	477.7
	T.O.E. - %	100.0	84.6	81.6				100.0	83.1	70.8	66.3			
	FLOW - KGPM	94.9	104.6	89.8				197.5	216.5	---				
	TEMP. IN - °C	10.1	9.9	9.5				9.8	8.2	---				
	TEMP. OUT - °C	95.0	94.6	94.5				93.7	85.2	---				
5/67	AVG. OP. MW	1985	2262	1937				4278	4188	3572	702	2870	17520	394.7
	T.O.E. - %	77.4	100.0	79.8				65.6	63.1	62.4	41.2			
	FLOW - KGPM	95.2	104.4	93.0				214.5	217.0	---				
	TEMP. IN -°C	13.7	13.3	12.7				12.3	12.1	---				
	TEMP. OUT - °C	94.9	95.0	93.7				89.7	88.7	---				
6/67	AVG. OP. MW	1994	2078	1924				4369	4373	4123	0	4123	18861	435.9
	T.O.E. - %	100.0	58.9	98.1				87.1	87.1	43.9	0			
	FLOW - KGPM	94.4	103.7	92.8				213.0	216.5	---				
	TEMP. IN - °C	16.0	15.2	15.2				15.5	15.8	---				
	TEMP. OUT - °C	94.9	94.6	94.9				93.4	92.4	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/67	AVG. OP. MW	1870	2074					4262	4310	3659	775	2884	15400	391.8
	T.O.E. - %	84.6	94.0					79.5	86.0	65.6	50.1			
	FLOW - KGPM	95.5	103.5					212.5	216.5	---				
	TEMP. IN - °C	19.4	19.3					17.9	18.7	---				
	TEMP. OUT - °C	94.8	94.9					94.9	94.5	---				
8/67	AVG. OP. MW	1626	2017					4239	4211	3904	774	3130	15223	413.2
	T.O.E. - %	83.5	100.0					100.0	78.2	77.0	75.6			
	FLOW - KGPM	94.8	103.3					214.0	216.5	---				
	TEMP. IN - °C	20.3	20.1					20.0	19.3	---				
	TEMP. OUT - °C	92.0	94.7					94.4	93.8	---				
9/67	AVG. OP. MW	1774	1958					4145	4207	0	0	0	12084	273.2
	T.O.E. - %	68.2	60.1					77.2	83.7	0	0	0		
	FLOW - KGPM	95.8	103.4					214.0	216.5	---				
	TEMP. IN - °C	19.4	19.2					19.0	18.3	---				
	TEMP. OUT - °C	93.1	94.7					94.2	94.5	---				
10/67	AVG. OP. MW	1727	2081					4223	4301	0	0	0	12322	288
	T.O.E. - %	78.5	85.8					72.1	72.2	0	0			
	FLOW - KGPM	95.4	101.7					214.5	215.5	---				
	TEMP. IN - °C	16.9	15.5					15.0	14.2	---				
	TEMP. OUT - °C	93.4	94.2					92.8	91.6	---				
11/67	AVG. OP. MW	1855	2110					4311	4400	0	0	0	12676	326
	T.O.E. - %	74.5	65.0					86.3	100	0	0	0		
	FLOW - KGPM	95.8	102.2					198.0	215.0	---				
	TEMP. IN - °C	10.6	10.7					11.0	10.0	---				
	TEMP. OUT - °C	94.3	93.9					93.8	87.7	---				
12/67	AVG. OP. MW	2071	2279					4355	4349	42	383	-	12713	327.7
	T.O.E. - %	94.7	74.2					84.2	74.8	6.0	0.66			
	FLOW - KGPM	94.7	105.1					194.5	215.5	---				
	TEMP. IN - °C	8.1	8.0					7.5	6.5	---				
	TEMP. OUT - °C	95.0	94.4					93.3	84.1	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/68	AVG. OP. MW	1613	2331					4299	4152	2789	564	2225	14620	328.3
	T.O.E. - %	68.9	59.5					68.3	75.5	88.5	79.4			
	FLOW - KGPM	93.6	105.9					196.0	194.5	---				
	TEMP. IN- °C	5.1	6.5					4.4	3.9	---				
	TEMP. OUT - °C	79.4	93.9					89.4	85.9	---				
2/68	AVG. OP. MW	1674	2236					4340	4256	2953	607	2346	14852	348.4
	T.O.E. - %	93.7	54.3					86.5	90.7	67.9	63.9			
	FLOW - KGPM	93.2	106.3					193.0	192.5	---				
	TEMP. IN - °C	5.4	7.9					5.5	4.6	---				
	TEMP. OUT - °C	79.6	94.8					92.1	89.0	---				
3/68	AVG. OP. MW		2418					4316	4385	3159	672	2487	13606	336.5
	T.O.E. - %		93.6					73.3	82.0	72.4	67.6			
	FLOW - KGPM		106.2					196.0	193.5					
	TEMP. IN -°C		8.0					6.8	5.0					
	TEMP. OUT - °C		94.9					92.1	91.1					
4/68	AVG. OP. MW		2286					4355	4172	3345	702	2643	13456	328.1
	T.O.E. - %		74.5					93.9	75.3	75.0	72.0			
	FLOW - KGPM		107.7					194.5	195.0	---				
	TEMP. IN - °C		11.6					10.9	9.9	---				
	TEMP. OUT - °C		94.8					94.6	94.6	---				
5/68	AVG. OP. MW		2258					4250	4135	3275	682	2593	13236	323.1
	T.O.E. - %		87.4					77.9	78.1	72.8	69.5			
	FLOW - KGPM		107.7					195.0	212.0	---				
	TEMP. IN -°C		14.4					12.9	12.3	---				
	TEMP. OUT - °C		95.0					94.8	91.4	---				
6/68	AVG. OP. MW		2176					4346	4259	3265	664	2601	13382	257.8
	T.O.E. - %		81.8					87.7	23.7	75.3	70.3			
	FLOW - KGPM		107.3					207.5	212.0	---				
	TEMP. IN - °C		16.0					15.2	13.0	---				
	TEMP. OUT - °C		94.8					94.8	92.0	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/68	AVG. OP. MW		2076					4183	3486	3670	656	3014	12759	213.3
	T.O.E. - %		79.6					80.5	9.3	50.6	48.8			
	FLOW - KGPM		106.2					207.5		---				
	TEMP. IN- °C		20.3					19.2		---				
	TEMP. OUT - °C		95.0					94.3		---				
8/68	AVG. OP. MW		1940					3933	4070	3417	740	2677	12620	274.7
	T.O.E. - %		79.6					58.8	89.1	50.1	45.0			
	FLOW - KGPM		106.2					207.5	210.5	---				
	TEMP. IN - °C		19.3					18.6	18.0	---				
	TEMP. OUT - °C		95.0					92.6	94.8	---				
9/68	AVG. OP. MW		1935					3717	3942	3750	776	2974	12568	297.6
	T.O.E. - %		32.6					81.4	100	77.3	74.2			
	FLOW - KGPM		106.6					194.5	196.5	---				
	TEMP IN -°C		19.4					17.8	17.3	---				
	TEMP. OUT - °C		94.6					94.7	94.2	---				
10/68	AVG. OP. MW		2117					4039	3857	3679	774	2905	12918	326.1
	T.O.E. - %		88.1					100.0	60.5	77.3	72.6			
	FLOW - KGPM		105.7					193.0	194.5	---				
	TEMP. IN - °C		13.8					13.8	14.0	---				
	TEMP. OUT - °C		94.1					93.7	90.0	---				
11/68	AVG. OP. MW		2173					3963	3845	3801	789	3012	12993	310.6
	T.O.E. - %		69.6					84.9	89.2	67.2	64.4			
	FLOW - KGPM		105.4					192.0	193.5	---				
	TEMP. IN -°C		10.5					10.3	10.6	---				
	TEMP. OUT - °C		94.0					89.6	89.0	---				
12/68	AVG. OP. MW		2225					3935	3934	3716	777	2939	13033	305.4
	T.O.E. - %		84.2					80.2	83.4	51.8	49.2			
	FLOW - KGPM		105.0					190.5	193.5	---				
	TEMP. IN - °C		3.9					4.0	6.1	---				
	TEMP. OUT - °C		88.1					83.2	85.5	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/69	AVG. OP. MW		2196					3908	3818	3609	769	2840	12762	281.5
	T.O.E. - %		51.8					74.8	84.7	61.5	56.2			
	FLOW - KGPM		100.8					190.0	192.0	---				
	TEMP. IN - °C		2.4					1.0	0.5	---				
	TEMP. OUT - °C		93.9					80.3	80.0	---				
2/69	AVG. OP. MW		2311					3879	3738	3868	732	3136	13064	268.2
	T.O.E. - %		65.7					82.7	70.5	70.3	68.6			
	FLOW - KGPM		98.9					188.0	191.5	---				
	TEMP. IN - °C		2.8					2.7	2.0	---				
	TEMP. OUT - °C		94.2					75.5	81.0	---				
3/69	AVG. OP. MW		2183					3792	3652	3735	769	2966	12593	287.2
	T.O.E. - %		75.6					84.7	74.5	56.1	53.8			
	FLOW - KGPM		99.7					188.0	191.0	---				
	TEMP. IN - °C		7.3					6.0	5.9	---				
	TEMP. OUT - °C		94.0					83.5	83.5	---				
4/69	AVG. OP. MW		2069					3369	3953	3856	765	3091	12482	277.9
	T.O.E. - %		80.8					26.0	100.0	88.8	86.9			
	FLOW - KGPM		101.4					190.0	191.0	---				
	TEMP. IN - °C		9.4					9.5	8.7	---				
	TEMP. OUT - °C		94.0					87.4	87.6	---				
5/69	AVG. OP. MW							3851	3757	3678	754	2924	10532	194.6
	T.O.E. - %							83.1	51.5	38.6	36.8			
	FLOW - KGPM							190.0	192.0	---				
	TEMP. IN - °C							14.0	11.0	---				
	TEMP. OUT - °C							93.5	90.3	---				
6/69	AVG. OP. MW							3902	3777	3717	775	2942	10621	246.8
	T.O.E. - %							91.1	76.7	59.6	56.9			
	FLOW - KGPM							190.0	193.5	---				
	TEMP. IN - °C							16.6	15.9	---				
	TEMP. OUT - °C							94.6	93.1	---				

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C							3758 43.7 190.0 19.9 94.7	3653 79.7 192.5 19.8 94.6	3524 51.5 --- --- ---	677 42.5	2847	10258	188.5
8/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3512 68.8 191.5 19.3 94.8	3729 86.7 192.5 19.3 94.7	0 0	0 0	0	7241	175.1
9/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3651 82.9 190.5 17.9 94.0	3475 65.6 195.0 17.8 90.5	3079 64.4 --- --- ---	709. 57.2	2370	9496	206.5
10/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3615 57.1 190.5 14.9 92.4	3757 64.3 194.5 15.1 89.4	3841 87.0 --- --- ---	785 85.9	3056	10428	221.6
11/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3442 50.2 190.0 12.7 92.3	3646 77.9 203.5 11.0 80.6	3702 59.5 --- --- ---	789 58.8	2913	10001	189.2
12/69	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3741 72.2 192.5 8.2 86.0	3911 100 203.0 6.1 81.0	3686 67.2 --- --- ---	787 64.8	2899	10551	265.9

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C							3944 89.5 199.5 4.6 80.4	3946 77.4 202.5 4.1 79.0	3602 50.9 --- --- ---	769 47.5	2833	10723	249.6
2/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3920 1.1 199.5 4.6 80.4		3622 80.8 --- --- ---	770 77.4	2852	6772	66.5
3/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3390 22.3 199.5 4.6 80.4		3862 57.6 --- --- ---	749 53.6	3113	6503	79.9
4/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3903 82.9 199.5 8.6 84.2		3709 72.7 --- --- ---	784 70.1	2925	6828	161.5
5/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3778 71.7 200.0 13.5 87.1		3061 45.5 --- --- ---	714 41.4	2347	6125	118.0
6/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3777 71.9 200.0 17.5 91.5		0 0	0 0	0 --- --- ---	3777	81.5

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
7/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C							3454 68.5 200.5 20.1 90.1		0 0 --- --- ---	0 0	0	3454	73.3
8/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3653 43.2 202.5 20.2 89.7		0 0 --- --- ---	0 0	0	3653	48.9
9/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3519 78.6 202.0 17.5 88.4		3017 36.0 --- --- ---	686 31.5	2331	5850	109.1
10/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3700 79.1 202.0 13.2 85.1		3132 23.9 --- --- ---	716 21.4	2416	6116	109.2
11/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C							3819 75.2 201.5 7.8 83.6		3625 90.1 --- --- ---	795 88.2	2830	6649	163.1
12/70	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C							3866 76.4 202.0 6.0 81.6		3516 48.5 --- --- ---	800 45.8	2716	6582	133.1

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
1/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C							3929 64.6 202.0 4.6 80.1		3599 81.2 --- --- ---	801 78.7	2798	6727	149.7
2/71- 6/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C	N Reactor was down from February 1971 to June 1971												
7/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C									729 7.5 --- --- ---		729	729	1.7
8/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C									2495 80.0 --- --- ---	775 51.8	1720	1720	48.0
9/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C									3686 96.2 --- --- ---	843 95.5	2843	2843	82.2
10/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C									3638 69.5 --- --- ---	848 67.7	2790	2790	60.6

DATE	PARAMETER	REACTOR B	C	D	DR	F	H	KE	KW	N	HGP	N*	AVG. MW	GWD
11/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN- °C TEMP. OUT - °C									3583 87.2 --- --- ---	849 82.8	2734	2734	72.6
12/71	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C									3369 55.2 --- --- ---	808 50.7	2561	2561	45
	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C													
	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C													
	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN -°C TEMP. OUT - °C													
	AVG. OP. MW T.O.E. - % FLOW - KGPM TEMP. IN - °C TEMP. OUT - °C													

APPENDIX B

COMPARISONS OF COLUMBIA RIVER HEAT GAIN WITH REACTOR ADDITIONS

PIP TI:=PRINT.RLT

DATE	PRIEST RAPIDS TEMPERATURE (DEG. C)	RICHLAND TEMPERATURE (DEG. C)	TEMP. DIFF. (DEG. C)	RIVER FLOW (KCFS)	COMPUTED HEAT (MW)	REACTOR HEAT (MW)	HEAT DIFF. (MW)
6/64	12.84	13.83	0.99	388.00	45518.	16693.	28825.
7/64	15.30	16.51	1.21	295.81	42348.	16161.	26187.
8/64	17.06	18.89	1.82	131.14	28324.	15748.	12576.
9/64	16.32	18.46	2.14	74.32	18876.	16510.	2366.
10/64	14.55	15.75	1.20	87.11	12354.	13097.	-743.
11/64	10.80	12.24	1.44	70.12	11937.	17890.	-5953.
12/64	6.25	7.82	1.57	68.48	12723.	19490.	-6767.
1/65	4.45	6.10	1.65	77.37	15173.	16819.	-1646.
2/65	3.33	5.36	2.03	99.24	23897.	16993.	6904.
3/65	4.11	6.27	2.15	88.33	22553.	15413.	7140.
4/65	6.65	9.09	2.44	111.61	32270.	16430.	15840.
5/65	10.01	11.03	1.02	235.39	28524.	15277.	13247.
6/65	13.35	14.22	0.87	310.50	32132.	14543.	17589.
7/65	16.05	17.28	1.23	218.42	31727.	12323.	19404.
8/65	18.36	19.83	1.47	127.77	22321.	12623.	9698.
9/65	17.31	18.53	1.23	77.23	11225.	13090.	-1865.
10/65	15.30	16.41	1.11	63.78	8411.	12842.	-4431.
11/65	11.87	12.56	0.69	70.96	5774.	12447.	-6673.
12/65	7.79	8.44	0.65	74.15	5698.	13761.	-8063.
1/66	4.84	5.92	1.08	67.91	8657.	13548.	-4891.
2/66	4.14	6.25	2.11	80.39	20073.	14682.	5391.
3/66	4.45	6.80	2.35	76.70	21315.	16416.	4899.
4/66	7.82	10.31	2.48	75.88	22330.	14163.	8167
5/66	10.59	12.05	1.46	182.58	31547.	12300.	19247.
6/66	12.43	13.47	1.04	276.33	34163.	12247.	21916.
7/66	15.30	16.18	0.88	229.39	23937.	3519.	20418.
8/66	17.55	18.77	1.22	108.65	15740.	3177.	12563.
9/66	17.48	19.36	1.88	72.94	16249.	14473.	1776.
10/66	14.63	15.63	1.00	66.74	7908.	11455.	-3547.
11/66	11.63	12.57	0.94	65.58	7305.	13833.	-6528.
12/66	8.37	9.49	1.12	73.71	9777.	15052.	-5275.

DATE	PRIEST RAPIDS TEMPERATURE (DEG. C)	RICHLAND TEMPERATURE (DEG. C)	TEMP. DIFF. (DEG. C)	RIVER FLOW (KCFS)	COMPUTED HEAT (MW)	REACTOR HEAT (MW)	HEAT DIFF. (MW)
1/67	5.92	7.36	1.44	75.25	12858.	15116.	-2258.
2/67	5.25	6.99	1.74	76.63	15793.	15107.	686.
3/67	4.99	6.64	1.65	90.22	17678.	13477.	4201.
4/67	6.81	8.80	2.00	89.22	21109.	15923.	5186.
5/67	10.05	12.03	1.98	138.60	32478.	12732.	19746.
6/67	13.27	13.88	0.61	430.30	31104.	14530.	16574.
7/67	16.07	17.00	0.93	288.00	31596.	12639.	18957.

8/67	18.55	20.22	1.67	125.00	24703.	13329.	11374.
9/67	18.20	19.39	1.19	80.85	11433.	9107.	2326.
10/67	15.42	16.05	0.63	71.94	5390.	9290.	-3900.
11/67	11.34	11.96	0.62	74.24	5483.	10867.	-5384.
12/67	7.17	7.83	0.66	80.62	6945.	10571.	-3626.
1/68	4.65	5.66	1.02	77.89	9378.	10590.	-1212.
2/68	3.33	5.00	1.67	73.79	14594.	12014.	2580.
3/68	4.63	6.05	1.42	108.39	18189.	11823.	6366.
4/68	7.09	8.83	1.74	100.07	20633.	10937.	9696.
5/68	11.05	12.84	1.78	125.70	26573.	10423.	16150.
6/68	13.44	14.26	0.82	271.30	26256.	8593.	17663.
7/68	16.07	16.99	0.93	226.35	24832.	6881.	17951.
8/68	17.51	18.75	1.24	112.53	16517.	8861.	7656.
9/68	17.16	18.30	1.14	90.88	12242.	9920.	2322.
10/68	14.25	14.95	0.71	76.97	6473.	10519.	-4046.
11/68	10.85	11.40	0.55	78.67	5128.	10353.	-5225.
12/68	6.77	7.36	0.59	91.65	6447.	9852.	-3405.
1/69	2.45	2.71	0.26	104.49	3275.	9081.	-5806.
2/69	1.46	1.90	0.44	118.81	6185.	9248.	-3063.
3/69	3.39	4.34	0.95	105.76	11886.	9265.	2621.
4/69	7.21	7.97	0.76	185.33	16764.	9263.	7501.
5/69	10.80	11.44	0.63	234.71	17586.	6277.	11309.
6/69	14.61	15.32	0.71	239.17	20029.	8227.	11802.

DATE	PRIEST RAPIDS TEMPERATURE (DEG. C)	RICHLAND TEMPERATURE (DEG. C)	TEMP. DIFF. (DEG. C)	RIVER FLOW (KCFS)	COMPUTED HEAT (MW)	REACTOR HEAT (MW)	HEAT DIFF. (MW)
7/69	17.11	17.87	0.76	189.90	17131.	6081.	11050.
8/69	18.20	19.26	1.06	100.95	12658.	5648.	7010.
9/69	17.70	18.60	0.91	75.94	8159.	6883.	1276.
10/69	14.81	15.15	0.34	82.46	3341.	7148.	-3807.
11/69	11.55	11.72	0.17	88.66	1786.	6307.	-4521.
12/69	7.64	8.03	0.38	96.91	4409.	8577.	-4168
1/70	4.27	5.27	1.00	87.21	10334.	8052.	2282.
2/70	4.14	4.86	0.72	77.02	6584.	2293.	4291.
3/70	4.75	5.72	0.96	85.75	9768.	2577.	7191.
4/70	6.85	7.94	1.09	91.91	11908.	5383.	6525.
5/70	10.87	11.72	0.85	131.10	13131.	3806.	9325.
6/70	14.83	15.39	0.56	183.12	12223.	2717.	9506.
7/70	18.04	19.02	0.99	124.60	14574.	2365.	12209.
8/70	19.24	19.94	0.70	100.79	8361.	1577.	6784.
9/70	17.49	17.51	0.02	75.33	208.	3637.	-3429.
10/70	15.17	14.87	-0.31	74.58	-2709.	3523.	-6232.
11/70	10.56	10.56	0.00	74.76	0.	5437.	-5437.
12/70	6.15	5.95	-0.21	78.57	-1952.	4294.	-6246.
1/71	4.01	4.25	0.24	71.38	2019.	4829.	-2810.
2/71	3.55	3.45	-0.10	95.93	-1096.	5162.	-6258.
3/71	3.62	3.77	0.15	131.74	2265.	4829.	-2564.
4/71	6.61	7.05	0.44	120.71	6246.	4990.	1256.
5/71	10.68	11.05	0.37	270.85	12010.	4829.	7181.
6/71	12.62	12.95	0.33	298.86	11570.	4990.	6580.
7/71	15.32	16.44	1.13	213.36	28464.	55.	28409.
8/71	18.42	19.54	1.12	132.34	17502.	1548.	15954.
9/71	17.21	17.84	0.63	74.63	5601.	2740.	2861.
10/71	15.24	14.96	-0.28	71.91	-2364.	1955.	-4319.
11/71	11.30	10.71	-0.59	82.32	-5738.	2420.	-8208.
12/71	6.78	6.18	-0.60	99.93	-7143.	1452.	-8595.

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