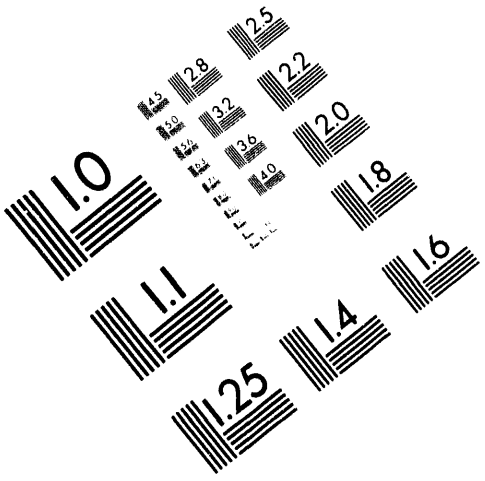

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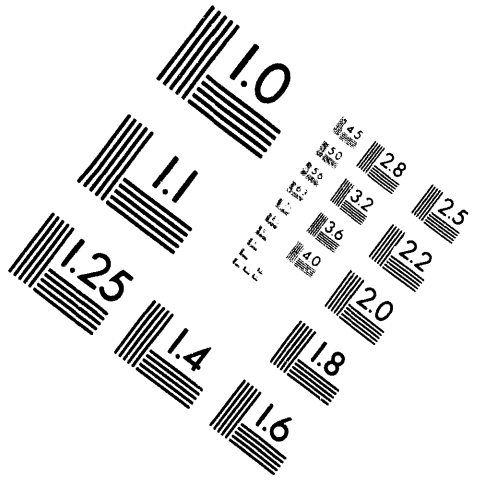

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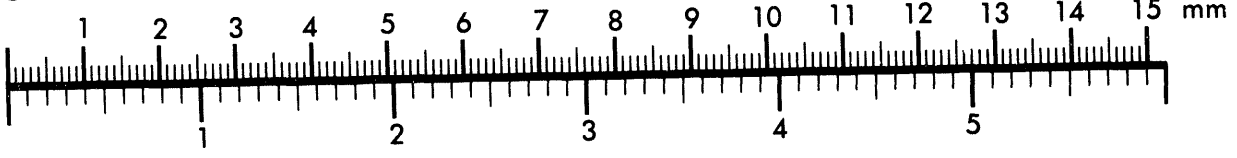

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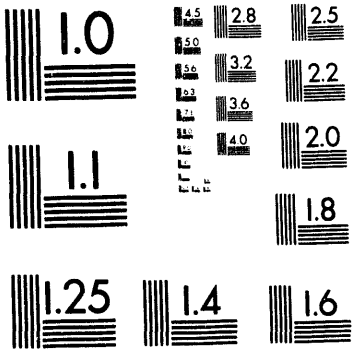

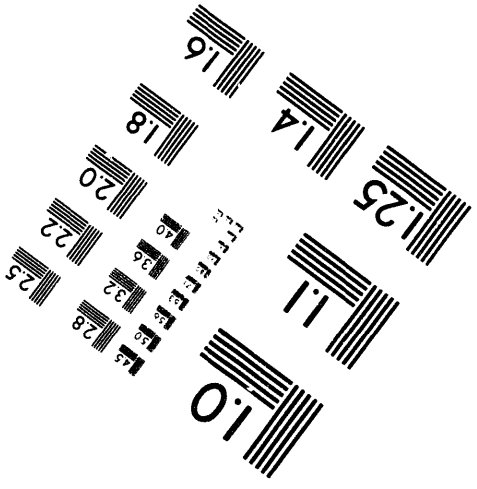

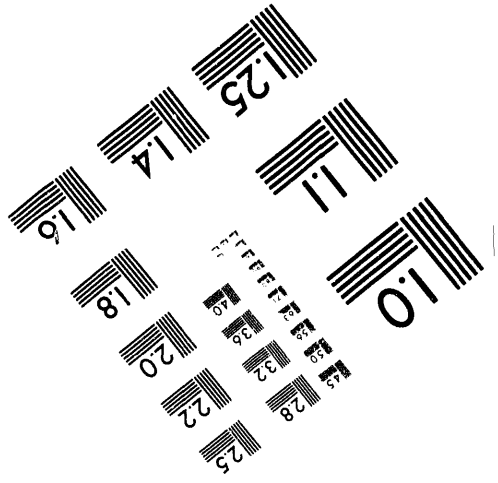

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NEW WASHINGTON STATE
WATER QUALITY STANDARDS

By

J. P. Corley and J. M. Selby

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NEW WASHINGTON STATE WATER QUALITY STANDARDS

By

J. P. Corley and J. M. Selby

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Environmental Studies Section
ENVIRONMENTAL HEALTH DEPARTMENT

December 18, 1967

PACIFIC NORTHWEST LABORATORY
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NEW WASHINGTON STATE WATER QUALITY STANDARDS

In compliance with the Federal Water Pollution Control Act (PL 84-660, as amended), water quality standards for interstate and coastal waters of the state of Washington were adopted by the state Water Pollution Control Commission in June, 1967. After much discussion and additional public testimony, revised standards[1] were finally adopted on December 4, 1967. The new regulation (as did the original) provides for four classes of state waters (AA, A, B, and C), with seven quality standards modified as appropriate for each class of water. Standards are given for; Total Coliform Organisms; Dissolved Oxygen; Temperature; pH; Turbidity; Toxic, Radioactive or Deleterious Material Concentrations; and Aesthetic Values. The Columbia River from the Mouth to Grand Coulee Dam is classified as Class A - Excellent, but with a special rule for temperature applied from the Mouth to Priest Rapids Dam.

A previous document[2] reviewed in some detail proposed revisions (11/67) to the June standards for comparison with plant experience in this reach of the Columbia River. The ADDENDUM paid particular attention to alternate proposals for temperature standards. The purpose of this document is to provide an analysis of the newly adopted standards and determine potential problem areas.

Major changes in the new regulation (as compared with the November draft) are a less restrictive formula for permissible temperature increments between the Washington-Oregon border and Priest Rapids Dam and the deletion of a proposed separate standard for radioactivity.

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

(2) Corley, J. P. and Selby, J. M., "Impact of Proposed Washington State Water Quality Standards on Hanford", BNWL-CC-1411, November 3, 1967, and ADDENDUM, dated November 17, 1967.

Summary

The temperature standard of the new regulation, although less restrictive than previously proposed, continues to be one with which Hanford may find compliance difficult. The degree of restriction will depend both on natural river conditions and the methods of enforcement. Other specific standards are not apt to be restricting in the near future, but will necessitate further study and probably increased routine surveillance.

One general requirement, which stipulates that "all known, available and reasonable methods of treatment" must be pursued before approval is granted for a dilution zone, may present difficulties. No guidelines are given for "reasonable", yet an adequate dilution zone is mandatory for Hanford reactor effluents to comply with the regulation.

General Considerations

The new regulation under "General Considerations" contains two sections of major importance to Hanford. The first of these permits limited dilution areas for effluents, but with conditions as follows:

"3. The water quality criteria herein established, except for the aesthetics values, shall not apply within immediate dilution areas of very limited size adjacent to or surrounding a wastewater discharge. In determining the size of an immediate dilution area, consideration will be given to the quality of the effluent or wastewater discharged and the nature and condition of the receiving waters. No such areas will be established for a waste discharge unless authorized under a permanent permit:

a. The wastewater discharge has been provided with all known, available and reasonable methods of treatment,

b. The wastewater treatment facilities are operated and maintained to the satisfaction of the Commission and,

c. The treated wastewater is provided with initial diffusion at the point of discharge into the receiving water to the satisfaction of the Commission."

The extent of a "limited dilution area" is not defined. One cannot escape the conclusion that the requirement for "all known, available and reasonable methods of treatment" is apt to be imposed on Hanford, especially for temperature and radioactivity. This conclusion is even more probable if enforcement, as would seem to be likely, devolves on the regional Federal Water Pollution Control Agency office.

The second area of concern results from a change from previous drafts. The pertinent section reads:

"4. The criteria established in Section IIA for any of the various classifications of this regulation may be modified by the Director for limited periods when receiving waters fall below their natural water quality condition due to natural causes which are unusual and not reasonably foreseeable if in the opinion of the Director the protection of the overall public interest and welfare requires such modification."

Previous drafts have contained language implying the lifting of restrictions in the event natural conditions exceed stated limits. The impact of the new language, presumably changed for clarity, seems to be that more restrictive limits may be imposed as a result of changes in natural conditions. The potential for shutting down operations "for limited periods" must in the future be considered as the river approaches naturally the limits given in the several standards.

Both the sections quoted above as well as several specific standards permit considerable flexibility in interpretation by the regulatory agency. Good relations and communications between appropriate Hanford offices and other agencies will presumably be of greater importance than ever before, but to what effect cannot be answered at this time.

It is assumed that Federal installations will not be required to obtain industrial waste discharge permits as indicated in the Implementation and Enforcement Plan. Whether routine effluent monitoring and inspections as specified in the regulation would be conducted by state personnel is not known. In any case, full compliance with Executive Order 11258[3] on water pollution would require that "pollution control standards are met on a continuing basis."

(3) Federal Register, Vol. 30, No. 224, "Executive Order 11258, Prevention, Control and Abatement of Water Pollution by Federal Activities", November 17, 1965.

Temperature

Despite a change in the temperature standard, this remains the one of greatest potential impact on Hanford operations. The new regulation reads as follows for the Columbia River from the Washington-Oregon border to Priest Rapids Dam:

"No measurable increases shall be permitted within the waters designated which result in water temperatures exceeding 68°F nor shall the cumulative total of all such increases arising from non-natural causes be permitted in excess of $t = \frac{110}{T-15}$; for purposes hereof "t" represents the permissive increase and "T" represents the resulting water temperature."

Major questions of interpretation and enforcement exist for this standard. First, where and how are river temperatures to be measured? At present, river temperatures are measured continuously at the Priest Rapids Gauge station (downstream of the dam) and at the Richland water plant pump house. These measurements are made with AEC-owned instruments and reported weekly to the USGS Current Records Center in Portland, where it is published with other regional river temperature data. A review of the USGS reports for the past summer shows an extended period when the Richland temperature exceeded 68°F. Similar measurements at Pasco show an average temperature about 0.5°F higher at the time. Much of the Columbia River below the mouth of the Snake River would show temperatures in excess of 68°F for some period each year even if the Hanford plant were not operating. The second question therefore is, if temperatures in the McNary pool and further downstream exceed 68°F because of warm water from the Snake, other industrial sources, or solar heating, will Hanford be permitted to operate? The authors cannot answer these questions.

In any case, an adequate dilution area is vital in applying the temperature standard to Hanford effluents. Mixing of all reactor effluents is, generally, nearly complete below White Bluffs but not at D area.

To provide a proper perspective, we can calculate a permissible thermal loading on the river at Priest Rapids if Hanford is permitted to use the total temperature increment available. Several possible river conditions have been considered which, if not completely realistic for any given year, should bracket the probable range. The flow rate and temperature characteristic curves used are shown in Figures 1 and 2. The average flow rate and average minimum temperatures are based on 15-day moving averages for 5 years of record at Priest Rapids (1960-1965). Maximum and minimum temperatures were obtained by drawing smooth curves through the daily average maxima and minima of record. The estimated average flow rate for 1970, after the Arrow-Lakes project is completed in Canada, is based on an assumed minimum flow rate of 80,000 cfs and no change in average total flow.

The projected low mean flow rate for 1985 was prepared by the Corps of Engineers as part of their optimization studies. The shifted temperature curve was prepared by assuming that the Canadian projects will shift the temperature peak by at least 30 days. The low flow-rate curve was produced by shifting the average flow-rate curve downward uniformly to meet a minimum flow-rate of 36,000 cfs. The latter figure will be approached at least one day a week for several months each year until Canadian dam storage is available.

Figure 3 shows the permissible temperature increment for a given natural river temperature as calculated by the formula in the new regulation $t = \frac{110}{T-15}$. In this report, the symbol ΔT is substituted for t and T_f for T in the formula for clarity. T_n is the upstream river temperature. Figure 5 shows the limiting mixed river temperature, using the new standard formula, for the average river flow-rate and both average and maximum river temperature curves as shown in Figure 1. The average upstream temperature is shown for comparison.

Figure 4 may be used to calculate available thermal loading for a given ΔT and river flow rate (Q_r), using the formula:

$$\text{Thermal Loading (in megawatts)} = 0.1185 \times \Delta T(^{\circ}C) \times Q_r(\text{cfs})$$

Figures 6, 7, and 8 show available thermal loadings for several upstream temperature and flow-rate combinations. In Figure 6, the average flow-rate was used, with average, maximum, and minimum temperature data. Figure 7 was based on the postulated minimum flow-rate curve. Figure 8 shows available thermal loadings with the postulated temperature and flow-rate effects of Canadian Dam construction. In all the cases based on historical data the minimum occurs in the fall of the year, with extreme dips in August and September for the low flow-rate and high temperature cases. The expected benefits of the Canadian dams are obvious. For comparison, Table I shows the approximate percentage of the time that a given level of thermal loading would be available for the several sets of river conditions considered. Translation of these calculations to effects on plant operations must be done by others.

TABLE I

PERCENTAGE OF TIME-AVAILABLE THERMAL LOADING

River Flow-Rate	River Temp.	Thermal Loading			
		5,000MW	10,000MW	15,000MW	20,000MW
Average	Average	100	90	60	40
Average	High	90	80	60	30
Average	Low	100	90	70	50
Low	Average	100	50	30	30
Low	High	90	30	20	20
Average(1970)	Average	100	100	70	50
Low (1985)	Average	100	100	80	50

Total Coliform Organisms

The proposed standard applicable to the plant reach is:

> "Total coliform organisms shall not exceed median values of 240 (per 100 ml) with less than 20% of samples exceeding 1000 when associated with any fecal source."

Monthly sample data is available above and below the reactors only since May, 1967. The maximum coliform count on downstream samples (at North Richland) during this period was 550 per 100 ml. in November. Samples above the reactors (at Vernita) have been as high as 830 per 100 ml. and at Hanford as high as 2030 per 100 ml. The reason for the consistently higher results is unknown and is under study. At present, the standard may represent no problem for the plant if median values are determined over an extended time period and if lack of a plant source can be demonstrated. However, since all warm-blooded animals may be a source of coliform bacteria, poor performance of liquid waste leaching trenches from Biology facilities and the 300 Area leach trench may change this situation. Additional sampling points have been added to better define the problem.

Dissolved Oxygen

The applicable standard is that dissolved oxygen shall exceed 8.0 mg/l. Biweekly samples at Vernita and Hanford over the past three years show only four results (8.3 minimum) less than 9 mg/l. A limited amount of unpublished data in effluent plumes shows no significant effect on dissolved oxygen. This standard should have no effect on plant operations.

pH

The standard provides that pH shall be in the range of 6.5 to 8.5 with an induced variation of less than 0.25 units. A review of river pH values reported monthly by each of the D-UN reactor water plants shows occasional values slightly in excess of 8.5, but an induced variation probably not exceeding 0.2 units. The effect of reactor effluents should be to reduce the river pH slightly; the data indicates an opposite trend which may only reflect the range of variability with plant instruments. No real problem to Hanford operations is believed to exist. With the shutdown of D area, a new monitoring location for this parameter is being sought.

Turbidity

The applicable standard is that turbidity shall not exceed 5 Jackson Turbidity Units (JTU) over natural conditions. Monthly data from the D-UN reactor water plants shows no consistent differences between upstream (B-C) and downstream (K,D) reactor plant data. No problem is expected meeting this standard. However, no data is available in the effluent plumes.

Turbidity (Continued)

At times of filter backwashing, local turbidity variations may exceed the permissible differential of 5 JTU. In this case, the provision for a dilution area even of limited size might be required. A new monitoring site for this parameter is also needed.

Toxic, Radioactive or Deleterious Material Concentrations

The standard states:

"Toxic, Radioactive or Deleterious Material Concentrations shall be below those of public health significance, or which may cause acute or chronic toxic conditions to the aquatic biota, or which may adversely affect any water use."

The language of this paragraph is so non-specific as to make interpretation difficult, especially as regards radioactivity. The phrase "of public health significance" requires a judgment value which may well be different for different agencies. For example, the regional office of the FWPCA has recommended that Hanford reduce its releases of ^{65}Zn; we do not believe the probable radiation doses resulting from this isotope at the present concentration to be of significance to health. The sum of radioactivity in river water may approach a limit recommended in 10CFR20 for short periods of the year as far downstream as Hanford. We do not consider this at present to be of significance to public health, but a regulatory agency might. Complete release of the river, with potential public access to the reactor effluent plumes, would almost certainly bring this question to the fore.

The two toxic materials which are used in significant quantities by the Hanford plant and which reach the river are hexavalent chromium (added to reactor cooling water as sodium dichromate) and nitrate ion (added to underground water via separations areas waste disposal sites). Hexavalent chromium and nitrate ion have been measured routinely at the Richland Water Plant and Vernita for several years. Analytical results for both are well below Public Health Service Drinking Water Standards (1962) recommendations, i.e. 0.05 ppm for hexavalent chromium and 45 ppm for nitrate ion. The hexavalent chromium currently averages less than half the concentration of 0.02 ppm established by our own Biology Department to prevent deleterious effects on salmonoid fish species. No problem in meeting this standard beyond effluent dilution areas is foreseen.

Occasional discharges of decontaminating solutions must be properly controlled to prevent local temporary concentrations in excess of those approved for fish exposure. In addition, careful evaluation of any non-routine chemical discharge is mandatory.

Aesthetic Values

No routine discharge of plant origin is known that would affect aesthetic values. Sewage is discharged only to tile fields and no color or taste inducing additives are discharged to the river in significant quantities. Occasional fuel oil spillage or leakage would be an exception, but to date has not been observed below Hanford.

ACKNOWLEDGMENTS

We greatly appreciate the temperature and flow projections for the effects of the Canadian Dams furnished by R. T. Jaske, Water and Land Resources Section, without which this report would not have been complete. The average flow rate and average temperature data are from curves prepared by D. E. Jenne of the Atmospheric Physics Section. Much of the detailed calculation and plotting for this report was provided by R. J. Eby of the Environmental Studies Section.

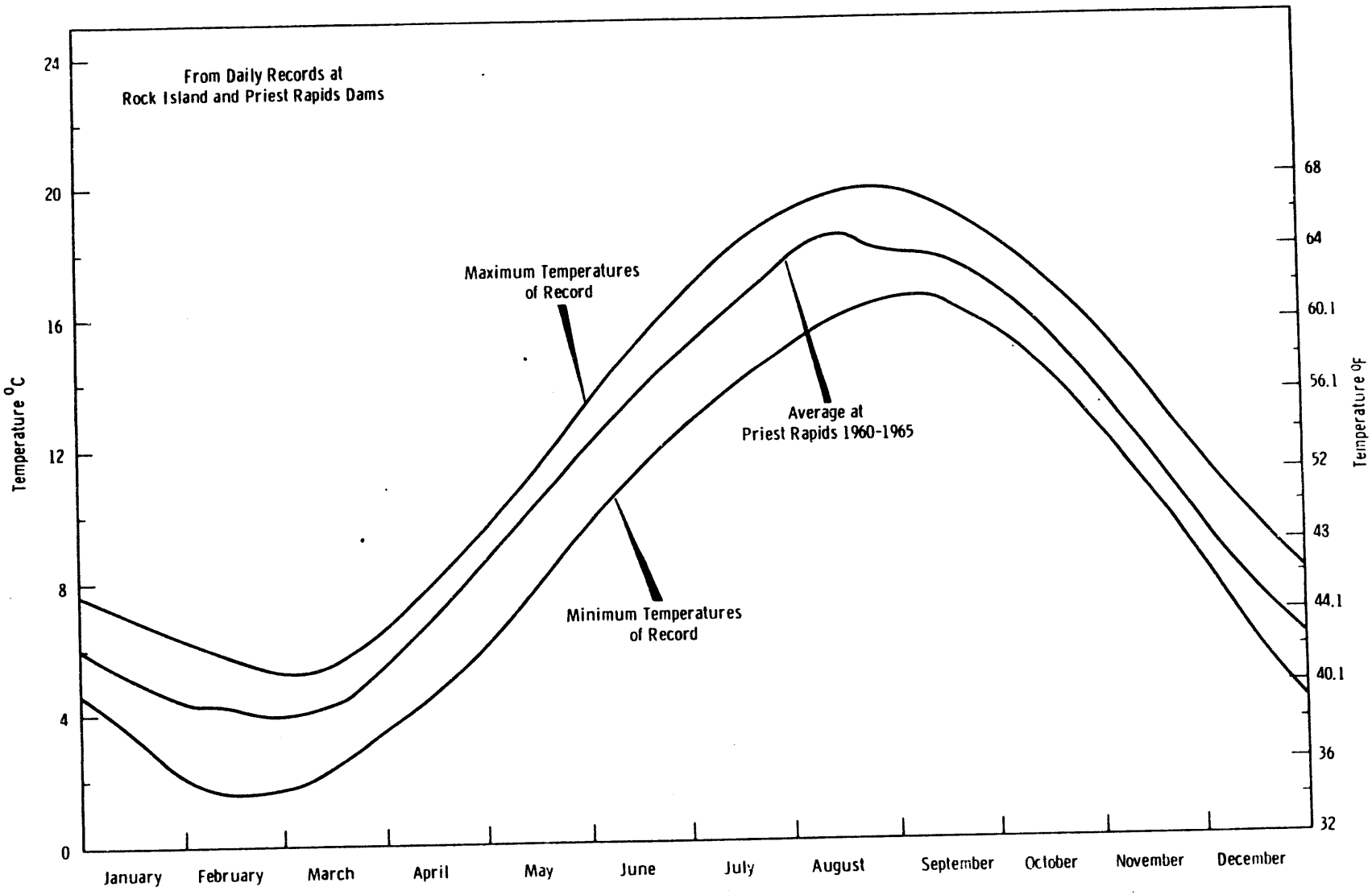

FIGURE 1

Columbia River Temperatures of Record Above Hanford 1947-1967

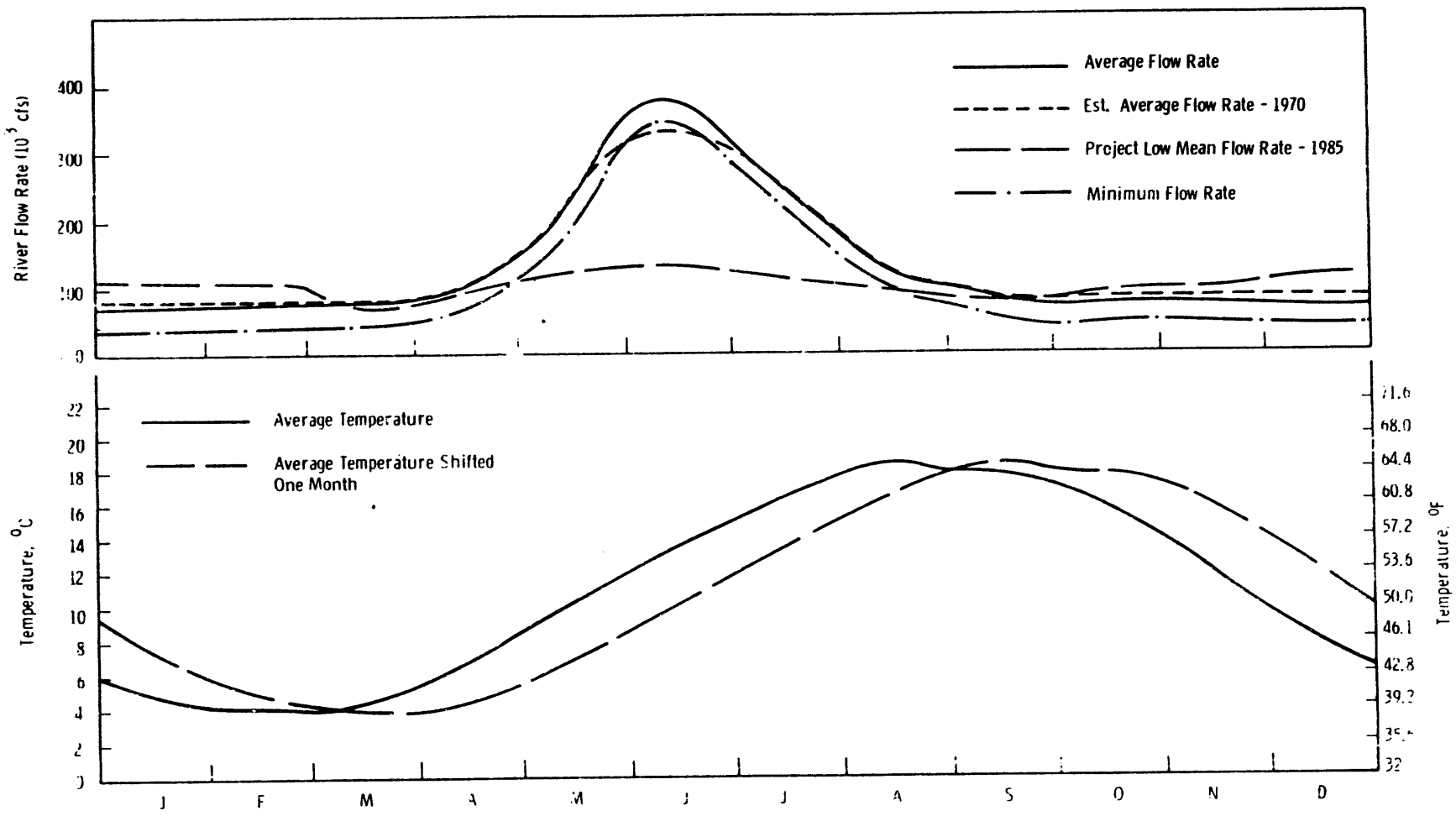

FIGURE 2
Temperature and Flow Rate Cycles of the Columbia River at Priest Rapids Dam

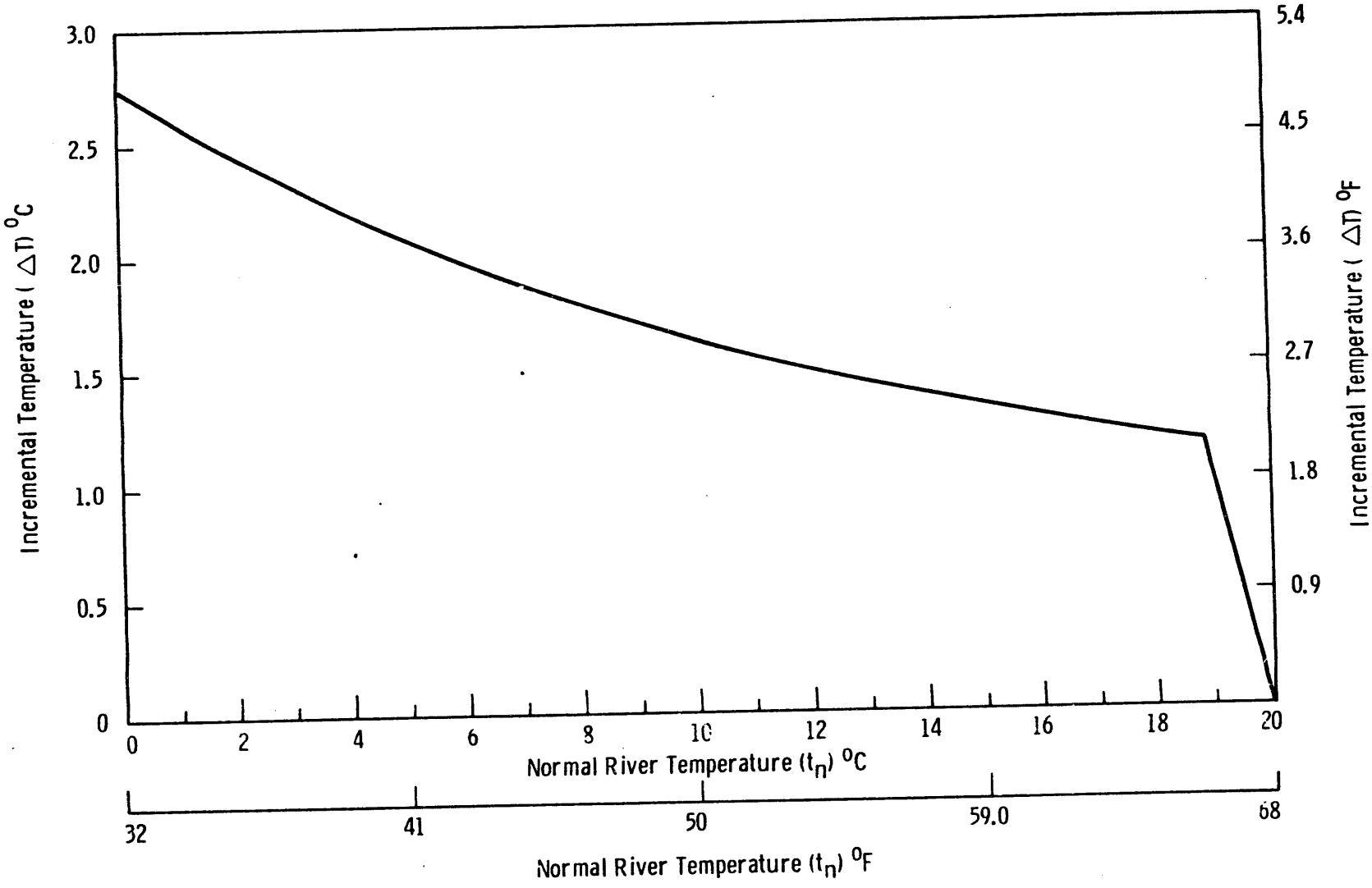

FIGURE 3

Proposed Incremental Temperature $\Delta T = \frac{110}{T_f - 15}$ °F

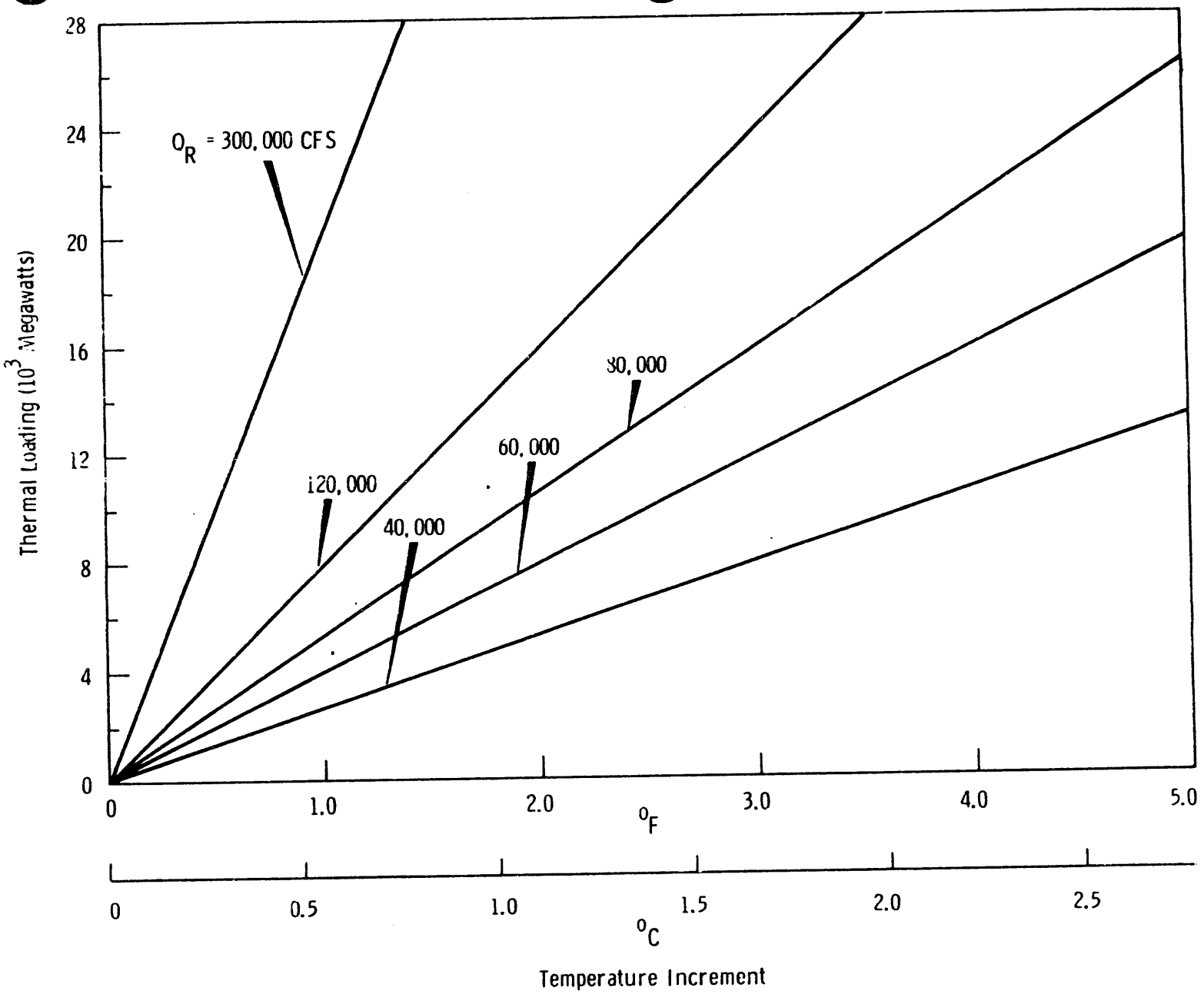

FIGURE 4

Thermal Loading Versus Temperature Increment

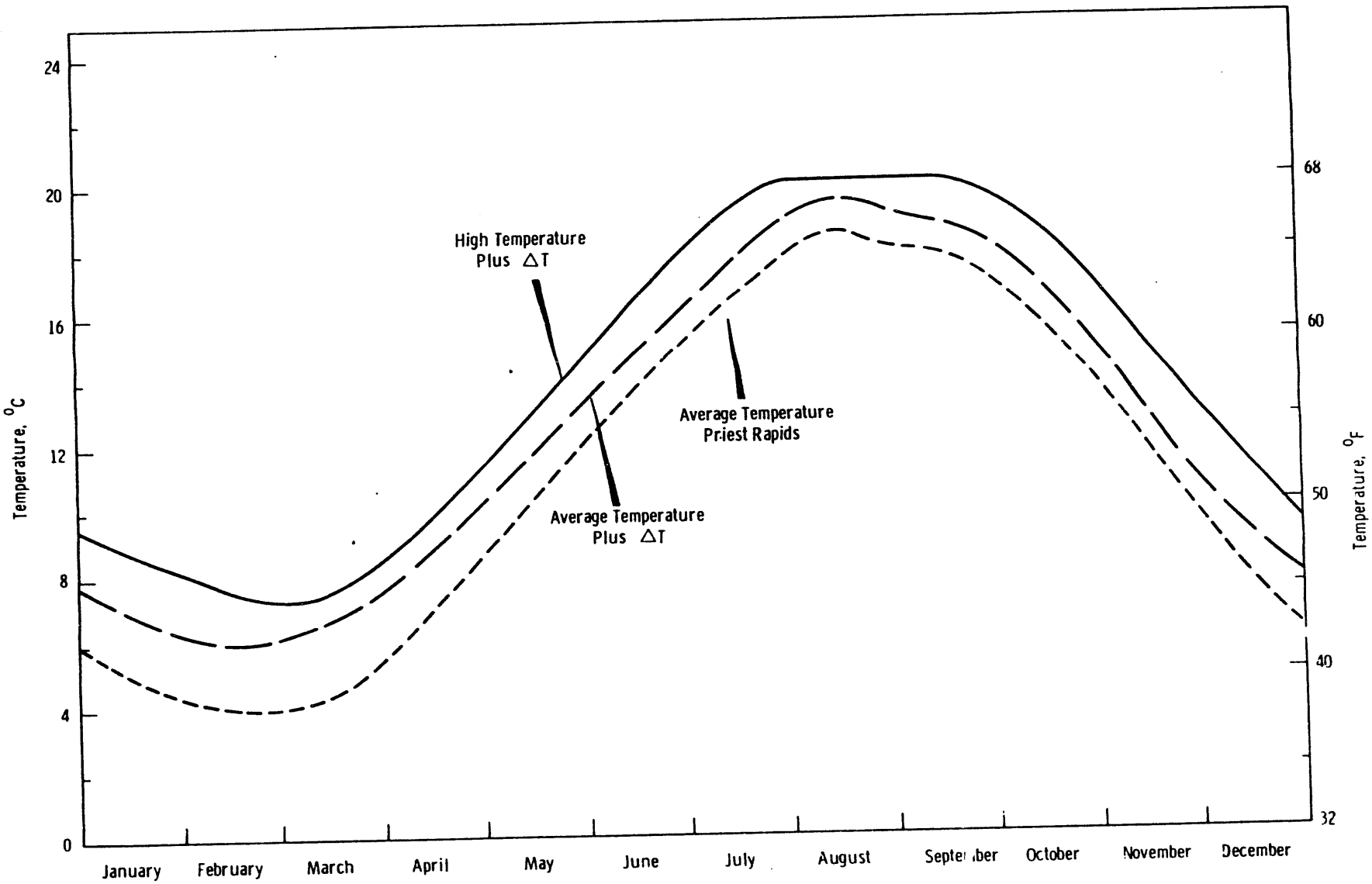

FIGURE 5

Mixed River Temperature at Average Flow Rate $\Delta T = \frac{110}{T_f - 15}$ °F

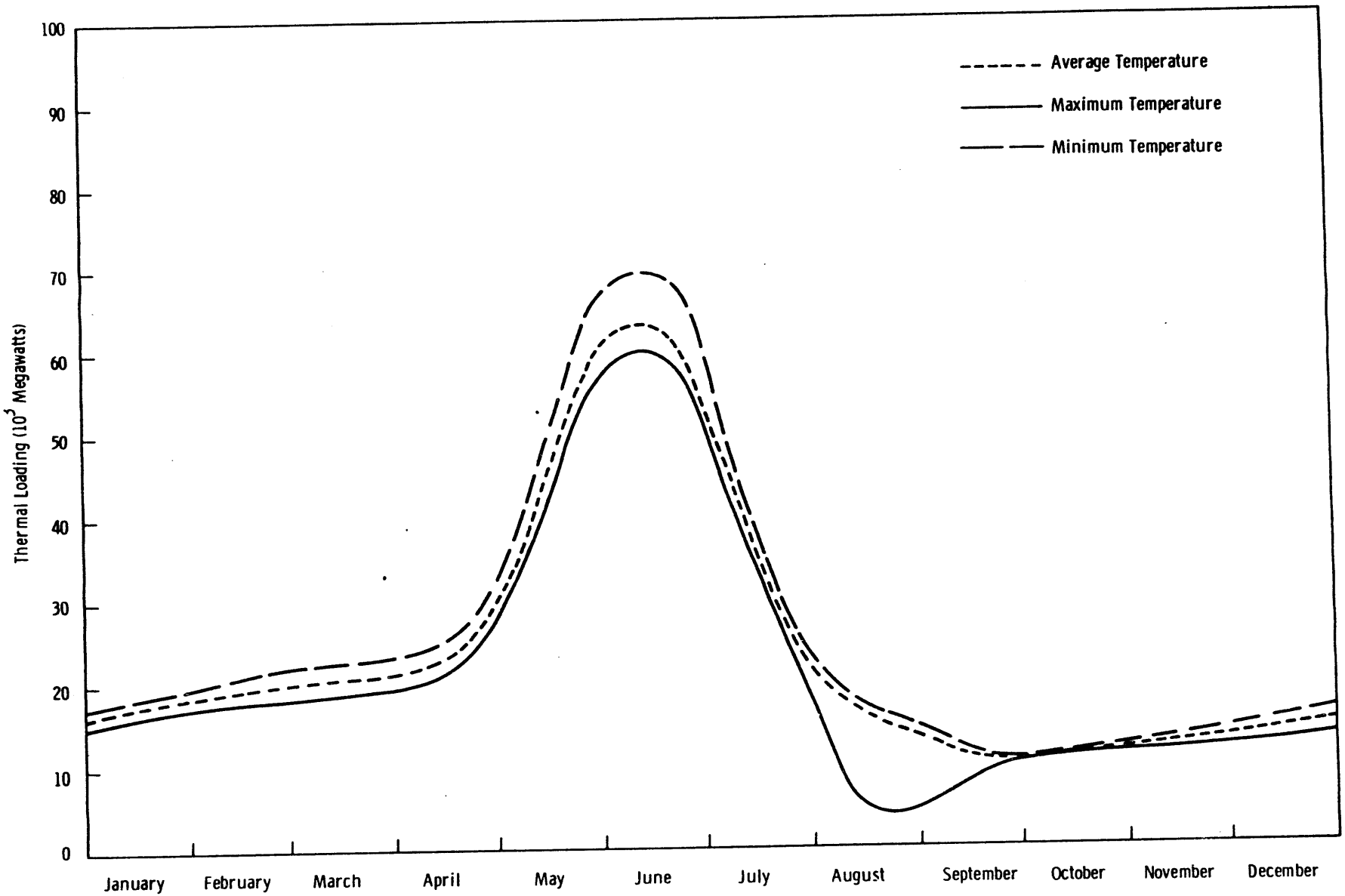

FIGURE 6

Available Thermal Loading at Average Flow Rate $\Delta T = \frac{110}{T_f - 15}\ ^oF$

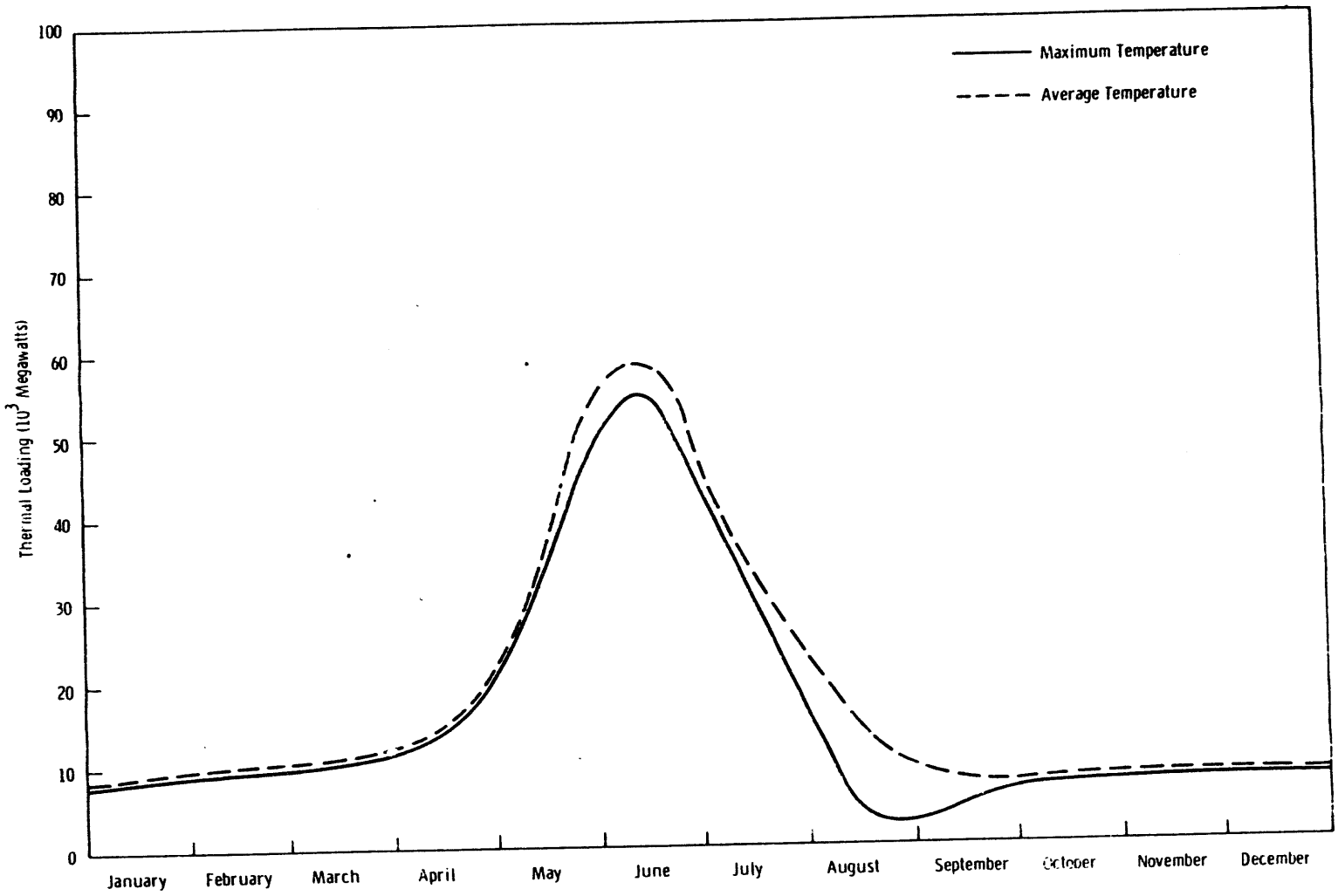

FIGURE 7

Available Thermal Loading at Minimum Flow Rate $\Delta T = \frac{110}{T_f - 15}\ ^{o}F$

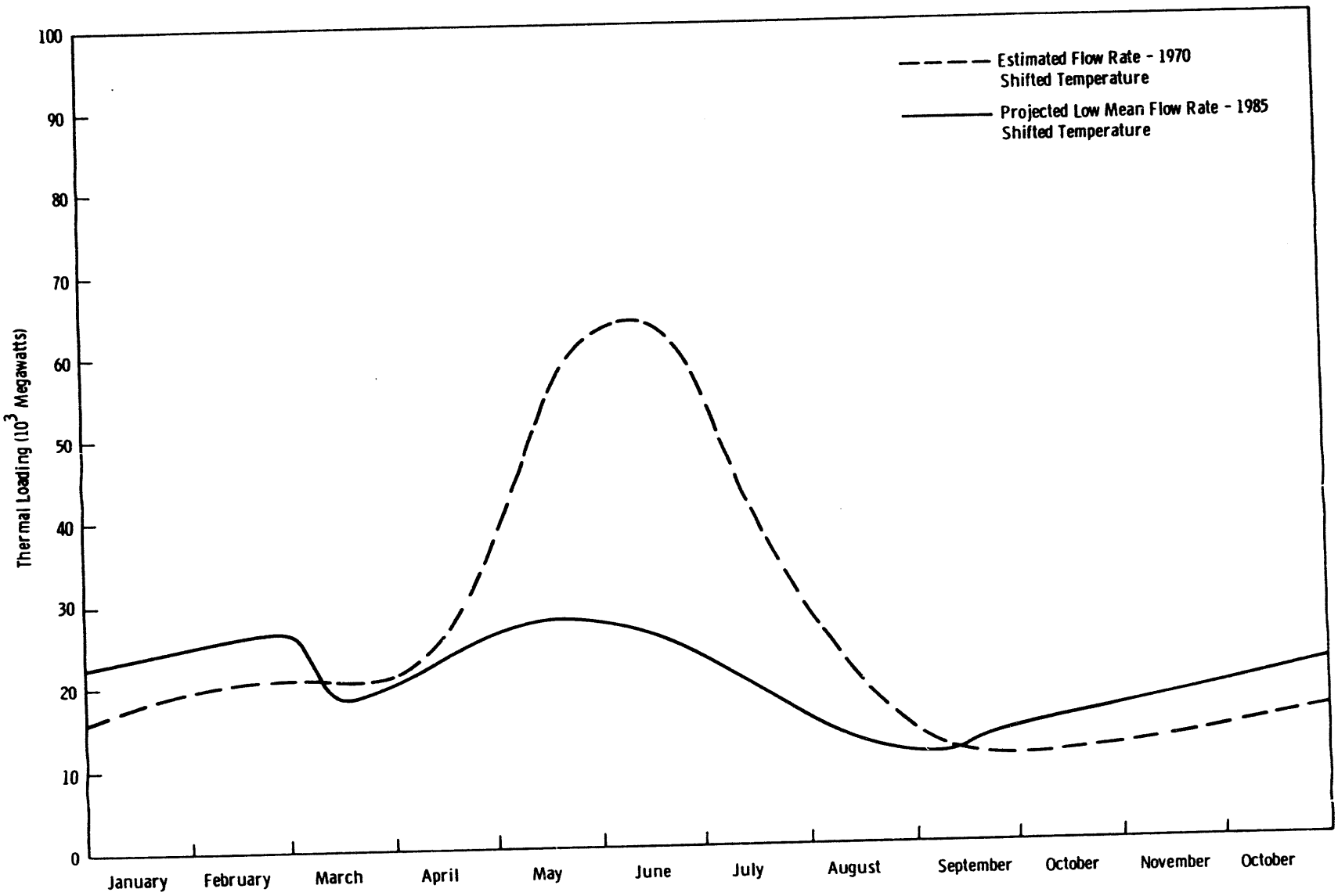

FIGURE 8

Future Available Thermal Loading after Canadian Dam Construction $\Delta T = \frac{110}{T_f - 15}\ ^oF$

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