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REPORT ON ADDITIONAL PRODUCTION CAPACITY OF HANFORD WORKS

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FACTORS INVOLVED IN CASE II AND CASE III

On August 7, 1951, an informal meeting of members of the Pile Technology Unit was held to discuss the factors involved in Case III of the Expansion Report. The meeting was attended by W. K. Alexander, M. W. Carbon, R. M. Fryar, G. E. McCullough, W. R. Lewis, P. H. Reinker, and W. K. Woods.

A previous meeting was held to fix the water requirements for Case II and Case III. Conclusions of this meeting reported by P. F. Gast in HW-21761, dated July 26, 1951, consisted of a preliminary report of the water requirements necessitated by the revisions and process modifications which are outlined in this report. This preliminary information on water requirements is included to make an integrated report on items 3a and 3b as outlined in document HDC-2261.

Case II - Item 3b - 1 and 2

Basics

1. Enriched material will be used for radial flattening only - no front to rear flattening is considered under Case II.
2. No increase will be considered in the present maximum power per tube in the present piles.
3. No relaxation of the present graphite temperature limit will be considered.
4. No change in the present boiling consideration limit in the present piles.
5. No change in the present header pressures for the old piles, and the use of designed header pressures for the C Pile plus the New Pile.

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These bases are conservative in the sense that no current technical limit to the power levels to the present piles is exceeded. In the case of the C Pile and the one New Pile, it is assumed that higher than current central slug temperatures will be tolerable. Because of the experience gained with the H-10 loading, the use of enriched material for full radial flattening is believed to be on a relatively firm basis. The use of enrichment for front to rear flattening introduces additional problems because of the boiling consideration limits, and would require higher header pressures. On these bases, full radial flattening and large orifices on all tubes will be necessary. This leads to the water flow rate requirements, outlined in Table I, which will be required to obtain the desired additional 650 MW average increase in output. Seasonal variations in power cannot be avoided; the pile or the water plant must be over designed. Figures quoted below are average figures.

TABLE I

<u>B, D, and F</u>	<u>DR and H</u>	<u>C Pile and New Pile</u>
40,000 gpm	50,000 gpm	62,000 gpm
500 MW	625 MW	750 MW
400 psig Riser	400 psig Riser	400 psig Riser

Development Work

Because of the conservative nature of the bases, and the experience already available on various aspects on the enrichment problem, no extensive development work should be necessary to insure the technical feasibility of obtaining the above production levels. The timing for Case II should depend only on the availability of the required water flow rates, availability of enriched slugs, and the implementation of the changes in physical plant or operational procedures which may be necessary.

Development Work Affecting Timing

Plans have been formulated in connection with the Water Quality Studies Program to determine the effects of substituting alum and activated silica for the present Ferrifloc coagulation in the process water treatment. A full pile production test is proposed to determine the film formation and the effluent activity effects of the substitution of alum during the months of October and November, 1951. If this alteration and treatment proves satisfactory from a pile standpoint, it is recommended that a full scale conversion to the alum - activated silica treatment be employed at one pile area during the winter months, along with tests to determine the maximum filter capacities of the present water plants. It is anticipated that significantly higher filter rates can be obtained, possibly by as much as 20 per cent, which would enable the present water plants to provide the required water amounts as listed in Table I. The suitability of this treatment from a quality standpoint should be known by January 1, 1952. The maximum filter capacity should be determined by March 1, 1952.

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Pumping Requirements

The use of normal standby equipment on the line, and the operation of the primary pumps at higher than rated speeds in case of emergency, may allow the use of the estimated required water capacities without major additions to the pumping system.

Case III - Item 3a - 1 and 2

MODIFICATIONS TO EXISTING PILES TO ATTAIN THE MAXIMUM PRODUCTION POSSIBLE AND FEASIBLE

Details of most of the information outlined in this report have been recorded in rough draft document EW-20425, R. M. Fryar and M. W. Carbon, July 10, 1951. This document will be recalled and issued in final form at an early date.

Limits

It has been concluded that a 525 psig secondary pump outlet pressure, with a resulting 500 psig riser pressure, is the highest practical pressure which can be obtained without a complete redesign involving major modifications to the present pumping system. With this header pressure and the enlarged outlet fittings, the maximum power output per tube in the existing piles will be set at about 600 KW. In the case of the C Pile, the limit is believed to arise from the axial temperature of the metal slugs which would limit the maximum power per tube to about 700 KW.

Water Requirements

Water Requirements based on the above limits, and with full radial flattening, are given in Table II.

TABLE II

<u>BDF</u>	<u>DR, E</u>	<u>C</u>
900 MW	900 MW	1000 MW
70,000 g/m	70,000 g/m	80,000 g/m
500 psig riser	500 psig riser	525 psig riser

Economics

Rough cost estimates have been made on all of the technical changes which have been proposed to obtain the higher power levels. These have been used to justify technical feasibility only. Recommendations have been made regarding the timing of the proposed changes insofar as costs are concerned.

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Timing

Insofar as it is possible to predict changes which depend on the satisfactory solution of technical problems, Table III gives the best possible estimate of the rate at which new power levels may be achieved, and indicates the necessary equipment modifications and the problems which must be considered. Numerous other problems which are mentioned later will need attention on a continuing basis but these are relatively minor and should be amenable of solution by proven methods. The power levels quoted in Table III are not uniform but reasonable. The estimates take no account of reasonable variations, which are unavoidable; the figures are given for the winter operating levels.

TABLE III

	<u>B, D, F</u>	<u>DR, H</u>	<u>C</u>	<u>Equipment Modifications</u>	<u>Problems Requiring Solution</u>
Jan. 1952	450 MW	550 MW	-	DR-H Modified Pumps and Fittings. Water Plant Revisions	Slug Erosion
Jan. 1953	450	600*	400	B, D, F, Modified Pumps and Fittings. Water Plant Revisions	B, D, F, DR-H Pile Gas Modification B Shield Distortion Axial Slug Temperature and Slug Design
Jan. 1954	600	650*	600*	B, D, F Pile Gas Modification	
Jan. 1955	650*	700*	700*	New Pile Atmosphere or Major Modifications to Old Atmosphere for all Piles	
Jan. 1956	750*	750*	850*		

*Add 15-20 per cent to these levels for full radial flattening by enrichment.

DEVELOPMENT WORK AFFECTING TIMING

Front Face Risers and Cross Headers

The pile inlet risers are the weakest part of the cooling water system. These should be replaced with risers of higher pressure rating at each area. In addition, the front face cross header should be replaced with headers containing check valves. These alterations are proposed as a desirable feature regardless of other changes. These changes should be made concurrently with the installation of the Ball 3-X, which is scheduled to start at the DR or B Pile in March 1952 or later, with other piles at one month intervals or longer.

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Modified Pumps and Rear Face Outlet Fittings

Modified secondary pump and rear face outlet fittings should be installed at the DR and H Piles at the earliest possible time, with effort to coordinate the work with the Ball 3-X installation. Modified secondary pumps should be installed at the B, D, and F Areas at some later date because this can be done without loss of operating time. The desirability of altering the outlet fittings at the B, D, and F Piles depends on the relation of the current graphite temperature limit. Installation concurrent with the Ball 3-X system will save later outage time.

Pile Gas Modification

It is anticipated that power levels above 450 MW at the B, D, and F Piles and above 600 MW at the DR and H Piles (after discharge of the H-10 load) will require some modifications to the pile gas. The development program in progress on these studies should allow a partial solution in 1953, and a possible new pile gas or completely altered pile gas, which presents no pile temperature limit, by 1955. Additional gains at the B, D, and F Piles above 450 MW are anticipated as the result of continued nuclear annealing of the graphite in 1953. Some modifications to the pile gas may be necessary to achieve the 600 MW level by January 1954.

Axial Slug Temperature

It is assumed that axial slug temperatures higher than those currently encountered in the piles will be suitable. Results from continued studies on slug design may be necessary to allow these higher temperatures.

Biological Shield Distortion

The possibility that excessive biological shield distortions may occur above the 500 MW level is difficult to predict. This must be followed by actual measurement as the levels are raised.

Flattening

Results on the effectiveness and technical aspects of the radial flattening should be known by the time the major water plant changes must be started.

Water

As mentioned in Case II, an extensive study of water quality is in progress. This may allow relaxation of the current technical limits on water quality and permit the present plants to operate at higher efficiencies. A large portion of the results from this program are expected by January of 1953, which will allow time for modification of the water treatment procedures for any new water plant facilities.

Slug Erosion

Serious slug erosion problems may occur at flow rates higher than the present. Information on this effect is being obtained and it is believed that this difficulty can be overcome.

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Primary Pump Drive Modifications

It is believed that appreciable financial savings can be made through modifications to the primary pump drives. This change consists of converting the drive of the primary pumps to a dual electric - steam drive similar in nature to the proposed C Pile pump drive.

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