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**Pacific Northwest Laboratory
Operated for the U.S. Department of Energy
by Battelle Memorial Institute**

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HDC-1063
APR 6-1949

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FILE ~~111g~~ 700 N

Route List

1. ~~John Doe~~
2. ~~John Doe~~
3. ~~John Doe~~
- 4.
- 5.

DATE 4-5-49

SUBJECT Feasibility Report: 105 DR as

Replacement for 105-F

To: File

FROM J.R. Thayer

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plus 3 unclassified
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DOCUMENT AUDIT AND
INVENTORY UNIT

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This document consists of

12 Pages No.

*Plus 3 unclassified Prints*FEASIBILITY REPORT: '105-DR' AS REPLACEMENT FOR '105-F'I INTRODUCTION

Following inquiry by Operations regarding the feasibility of operating Building 105-DR in conjunction with the 100-F Area Water Plant with 105-F in a "long time" shutdown condition, a preliminary study has been made. The results of this study appear herein.

A study now under way, GFO-3, considers simultaneous operation of 105-D & 105-DR with separate water plants. Primary consideration in this study is that of furnishing a reliable water supply with improved or simplified operating features and at a minimum cost. In the event 105-F was permanently shut down, the water plant would be available for the production of water for 105-DR provided inter-connection and operation of a widely separated water plant and pile can be accomplished economically and practically.

The obvious advantage of the proposed arrangement is the savings, if any, realized by a difference in initial costs and extended operating cost.

The purpose of this report is to investigate the feasibility of the proposed scheme from the standpoint of engineering, operation and economics. Certain probable trouble spots such as steam capacity, corrosion, etc. are mentioned and possible solutions are suggested. However, no recommendations are intended, as the necessary detailed study of these items is considered to be beyond the scope of present request and was not entered into.

II DISCUSSIONA. Schemes considered and reasons for further consideration or rejection.

1. Use of entire 100-F water plant discharging from 190-F pumps to pipe line to 105-DR with boosters as necessary.

Because of the inefficiency of operation of such a system, lack of back-up facilities near the pile to provide reliability, and the awkwardness of control, this scheme received only passing consideration.

2. Use of entire 100-F water plant discharging from 190-F pumps to pipe line, thence to a 190-DR Building similar to existing 190 Buildings. Thence through 190-DR to 105-DR.

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Because of the inefficiency of operation, this scheme received only passing consideration.

Authority of

By

Classification Cancelled and Changed To

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By Authority of RM 10701

CG-NMP-1, 7-7-94

By J. E. Savely 7-26-94

Verified By J. J. Mody 7-28-94

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3. Same as 2 above, except for use of more suitable pumps in 190-~~DR~~.

Rejected because of the consideration that "F" will be reactivated in the future, and because change over would consume production time.

4. Use of 100-F water plant up to the 183-F process water supply pumps, these pumps connected to new pipe line running between 183-F and a new 190-DR similar to existing 190 Buildings.

This scheme was developed for the following reasons:

1. 183-F Process Pumps are ideally suited for this application.
2. Terrain of route between 183-F and 190-DR is favorable.
3. 100-F water plant is left intact for future operation in conjunction with 105-F or 105-FE.
4. Minimum expenditure in 100-F.
5. Operating cost least of available alternates.

B. Technical Considerations

1. Topography of route and accessibility of site.

The straight line route between 183-F and a 190-DR is approximately 5 miles long, characterized by a gradually rising slope from a sea level elevation of approximately +416 ft. at 100-F to approximately +460 at the site of 100-DR. Road, railroad and electrical facilities are existent at both sites requiring only extensions for 190-DR. Construction facilities at White Bluffs lie about half way between sites near the route of the pipe line. These features of the site are shown on Attachment A.

2. Pumping

Based on the use of 2-36" parallel pipelines between 183-F and 190-DR connected as shown on Attachment B, the matched characteristics of existing pump and the proposed pipe line are as shown on Attachment C.

From this it is apparent that the four 10,000 GPM Process Pumps in 183-F are adequate for the proposed duty under normal conditions as four units can deliver 36,000 GPM allowing no operating spares. An impeller change in these pumps will permit operation of three units to develop 36,000 GPM at 200 ft. TDR. Operation in an emergency condition is discussed under Paragraph 11-B-3 "Emergency Operations" on the following page.

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Pumping between the river and 183-F will remain unchanged. However, it should be recognized that due to an overrating of pumps in original design of 100-F, there are inherent inefficiencies that will increase operating costs considerably over what would be expected in a new water plant design. For example, the 182-F Filter Plant Supply pump units are rated at 6000 GPM at 100 ft. TDH, whereas the application demands a head of 30 ft at most. The remainder of the head or about 70% is dissipated in the Filter Plant inlet control valves.

Pumping from 190-DR to process will be similar to existing areas including features of control and storage.

3. Emergency Operation

Operation during periods of extended electrical power outage will revert to steam driven pumps. As no steam driven facilities are included in the 183-F Process Supply system except through the Emergency to Process by-pass, additional steam driven pumps will be required in 183-F as shown on the "Detail" of Attachment B. 5000 GPM will constitute the shut down requirements of both 105-F and 105-DR; therefore, one 10,000 GPM pump similar to existing pumps, except turbine driven, will be required, plus a second identical unit for an operating spare. Space is available in the 183-F pumproom to accommodate these units.

Emergency operation of the 100-F water plant between the river and the 183-F Pumps will remain unchanged.

Emergency operation of 190-DR will be similar to existing 190 Buildings.

4. Water Supply and Demand

A Water Balance of the proposed system is shown under Attachment D. Salient features of the water balance are that:

1. Three additional filters will be required to furnish the 5000 GPM for 105-F and 36,000 GPM for 105-DR.
2. Additional normal process pumping capacity in 183-F will be required to furnish bleed-off of 5000 GPM for 105-F or a separate stand-by pump unit for 105-F must be established in 183-F. For purposes of this study the former is assumed thereby giving one of the additional turbine driven pumps the dual duty of augmenting the motor driven units as well as acting in emergency stand-by capacity.

5. Steam Supply and Demand

A Steam Balance of the proposed system is shown under Attachment E. Salient features of the steam balance are that under normal conditions, the 184-D boiler capacity will be exceeded and an additional boiler will be required.

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Special attention is directed to the steam demand during successive stages of emergency operation. Immediately after shut down, the 190 turbines pick up the entire process pumping load automatically imposing a load of approximately 128,000 lbs. per hour on the boilers within one minute. In addition, the T-G set in the powerhouse comes on automatically to furnish energy to emergency lighting, backwash facilities and other emergency circuits. This imposes an additional load of 34,500 lbs. per hour on the boilers within one minute. These two loads, in addition to condenser water pump drives, process ventilation, boiler auxiliaries, and line losses, are included under "ESSENTIAL" and can be furnished by four boilers operating at the 24 hour design overload of 120,000 lbs. per hour each, thereby requiring the installation of one additional boiler for an operating spare.

However, operating practice calls for starting manually all turbine driven pumps in the water plant upon occurrence of an electric power failure or shortly thereafter. This practice imposes an additional 99,000 lbs. per hour load on the boilers, as shown under "NON-ESSENTIAL." If this practice continues under the proposed system, added boiler capacity of 200,000 lbs. per hour will be necessary.

6. Electrical Supply and Demand

Present demand on the 151-D Building is 11,000 KVA to 12,000 KVA. An additional electrical load imposed by 190-DR will be 8000 KVA to 9000 KVA, making a total load of 21,000 KVA maximum. Existing transformer capacity may be increased as required from 18,750 KVA to 31,000 KVA by auxiliary cooling, thereby accommodating the additional load.

7. Auxiliary Water Connections

In addition to the supply of process water for 100-DR discussed in previous paragraphs, the auxiliary demands of Emergency Filtered and Raw Water to Process, Export Water, Fire and Sanitary Water and Condenser Cooling Water must be met as well as Normal and Emergency shut down flow to 105-F.

Referring to Attachments ~~EE~~ the first four auxiliary demands mentioned above are already provided for in the 105-DR project and no change is necessary.

In regard to Normal and Emergency flow to 105-DR, this demand can be most easily furnished by bleeding the required flow of 5000 GPM from the Filtered Water to 190-DR header through the existing 36" Filtered Water to 190-F line and control the flow with the existing tank level control valves. Two Process Pump Units in 190-F would be used for shut down purposes. Emergency flow would be provided in the same manner, except that turbine

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driven pumps in 183-F will furnish water as discussed in II-B-3 above. Existing, turbine driven, Emergency Filtered Water to Process Pumps in 183-F would constitute an auxiliary source of emergency flow, either through the 190-F Building or by-passing through the elevated tanks, depending upon whether the existing motor operated tie valve was open or closed.

9. Iron Pickup

Process requirements specify a maximum iron content in process water of .03 ppm. With this limitation, the iron pickup resulting from internal corrosion of a long cast iron or steel line as required by the proposed system becomes a matter of considerable importance.

Using the best available corrosion data, viz. CMX Report (Document 7-1444) and iron determination tests from 100 Area taken between 183 and 185 (a cast iron line), it develops that the iron pickup from two 36 inch steel lines with filtered water of pH 7.5 will amount to 0.4 ppm. Iron pickup from a similar cast iron line will amount to .25 - .3 ppm. Although the accuracy of these figures is questionable, it can be concluded with some degree of confidence that, resultant pickup from an iron bearing pipe line will be in the neighborhood of 10 times the tolerable amount. The use of corrosion inhibitors and higher pH with subsequent adjustment are indicated; however, the question of iron pickup will demand extensive investigation.

10. Soil Corrosion

The possibility of soil corrosion in the proposed line, if iron or steel is the pipe material, is a problem which will deserve further consideration. Although soil conditions in the vicinity of the proposed line should be suitable for a buried pipe line, electrolytic corrosion has caused extensive damage to buried pipe in the 200 areas and cathodic protection have been forcibly adopted.

Soil corrosion is mentioned here as another problem inviting further consideration.

11. Water Hammer

Water hammer resulting from pump shut downs is a potential hazard in a long pipe line discharging to an elevated point. Conditions on the proposed line do not indicate a severe surge problem. However, pending further study, it would be expected that the addition of surge suppressors and timed closure check valves would be required on the 183-F process water pumping system.

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12. Pine Materials

The choice of pine materials for the proposed line is practically limited to steel, cast iron or reinforced concrete. Again, pending further study, reinforced concrete offers somewhat lower costs, reduces or eliminates iron pickup and, to some extent, reduces soil corrosion mentioned in paragraphs 11-12-3, Iron Pickup and 11-12-10, Soil Corrosion above.

13. Economics

Rough estimates have been made of the construction costs, both for an F-DR combination and a D-DR combination. These estimates are detailed in the attachments.

It must be understood that these are order of magnitude estimates only and will probably not be closer than plus or minus 5% of the actual cost. However, it is believed that the difference in cost between the two projects will hold in their present relation, although the amount of the difference may vary substantially from that shown. With this explanation, the total estimated project costs are as follows:

For an F-DR Plant	\$12,656,000.00
For a D-DR Plant	15,000,000.00

The above costs include an overhead item which has allowed for contingencies, design costs, field engineering costs, contractors' fee, and other miscellaneous items.

No complete figures are available on operating costs. However, estimates obtained with the assistance of the Power Division indicate that power costs for the F-DR combination will be about \$541,000.00 per year and for the D-DR combination, \$395,000.00 per year. There is no substantial difference in the cost of chemicals.

XII CONCLUSION

It is concluded from the above that the proposed scheme of operating 100-F water plant in conjunction with 105-DR is technically feasible and worthy of further consideration and comparison with other available schemes.

JR Thayer/hr

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INITIAL COSTS

	<u>F-DR</u>	<u>DR</u> <i>Comm System</i>
115-D - Increase Capacity	\$ 100,000	\$ 100,000 ✓
190-DR - Process Pump House	2,800,000	2,800,000 ✓
Pipe Line 2- 36" Steel 1/2" Wall 26,000 Ft. with Cathodic Protection	2,300,000	
2- 36" RCP 26,000 Ft.	1,500,000*	
2- 36" C. I. Class D 26,000 Ft. Figures not available. Probably somewhat above those for steel.		
182-F - 1- 6000 GPM Filter Supply Pump	7,000	
183 - 2- 10,000 GPM Pumps & Turbine Drivers and 3- 3000 GPM Filter Units for F-DR New Plant for DR	1,309,000	5,000,000 ✓
184-D - 100,000 #/hr. Additional Boiler Capacity	1,000,000	1,000,000 ✓
200,000 #/hr. Additional Boiler Capacity	2,000,000*	
1500, 1600, 1800, 1900	<u>100,000</u>	<u>600,000</u>
Total (Labor & Material)	\$ 7,616,000	\$ 9,500,000
Heavy Equipment Charges	700,000	1,000,000 ✓
Imp. Constr. & Prep. of Site	<u>140,000</u>	<u>200,000</u> ✓
Total Direct Cost	8,456,000	10,700,000
Overhead (50%) **	<u>4,200,000</u>	<u>5,300,000</u>
Total Project Cost	\$ 12,656,000	\$ 16,000,000 ✓

OPERATING COSTS

Power	\$ 541,000/yr.	\$ 395,000
Chemicals	<u>159,000</u>	<u>159,000</u>
Total (Power & Material)	700,000/yr.	\$ 554,000

Not included in total

Includes General Overhead 36% plus Design Engr., Field Engr., Contingencies, Contractor's Fee, Start-up, etc.

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Addendum

In view of the fact that it may be desirable to consider operation of 105-DR at a reduced level to avoid the expenditures necessary for expansion of the water plant, an additional estimate is presented below including no increased water capacity.

115 - Increase Capacity	\$ 100,000
190 - Process Pump House	2,800,000
Pipe Line 2- 36" Steel 1/2" Wall 26,000 Ft. with Cathodic Protection	2,300,000
182-F - Reservoir	---
183-F - Filter Plant	---
184-D - 100,000 #/hr. Additional Boiler Capacity	1,000,000
1500, 1600, 1800, 1900	<u>100,000</u>
Total Labor & Material	\$ 6,300,000
Heavy Equipment	600,000
Temporary Equip. & Prep. of Site	<u>100,000</u>
Total Direct Costs	7,000,000
Overhead (50%)	<u>3,500,000</u>
Total Project Cost	\$ 10,500,000

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ATTACHMENTS

- A - Feasibility Study, DR as Replacement for F
Site Plan
- B - Feasibility Study, DR as Replacement for F
Water Flow Diagram
- C - Feasibility Study DR as Replacement for F
Pump and Pipe Line Characteristics 183 F to 190 DR
- D - 100-D Water Balance
- E - 100-D Steam Balance
- F - SK-1-~~4~~37 Interconnection of 100-D & 100-DR Water Plant

DWG. No. SK-1-436

DATE: 3/1/49
DRAWN BY: L.M. Berry
PRELIMINARY - APPROVALS

HANFORD WORKS
RICHLAND, WASH.
FEASIBILITY REPORT
PROPOSED PIPE LINE INTERCONNECTION
100 F WITH 100-DR
LOCATION PLAN

1st ISSUE
2-7-49

J. H. Hays
3-8-49

CROSS CONNECTIONS

1. PROCESS WATER (EXISTING EXCEPT FOR CONNECTION & VALVES)
2. EXPORT (EXISTING)
3. FIRE & SANITARY (EXISTING FOR 105-DR BLDG.)
4. CONDENSER COOLING WATER (IF REQUIRED)

J. F. Thayer
3-8-44

(53.1741 D)

2-36" F/PFL IN 55
FROM 100-1"

105-D
PROCESS

[illegible]

EMERGENCY
7500 GPM
150' HD.

181

475 HD. EXPORT
2- 3,000 GPM
475' HD.
9 FILT. SUPP. 6,000
10MG GPM 100' HD

EXPORT

100 - D

100 - DR

4

CROSS CONNECTIONS

1. PROCESS WATER (EXISTING EXCEPT FOR CONNECTION & VALVES)
2. EXPORT (EXISTING)
3. FIRE & SANITARY (EXISTING FOR 105-DR BLDG.)
4. CONDENSER COOLING WATER (IF REQUIRED)

REFERENCE	DWG. NO.

1st I:

CONNECTIONS
EXCEPT FOR CONNECTION & VALVES)
R 105-DR BLDG.)
F REQUIRED)

PRELIMINARY
NOT APP. USED FOR CONSTRUCTION

TITLE

DRAWINGS

NO.	DESCRIPTION	BY	DATE	APPD.	DATE	APPD.

SCALE: *NONE*

APPROVALS

DRAWN BY L. M. S. L. R. 3/2/79
CHECKED BY L. J. J. 1403 DATE 3/2/79
DATE

BY	DEPT.	DATE
THAYER	D.E	3-2-49

ENG. REP. NO. _____
PROJECT NO. _____

GENERAL ELECTRIC CO. HANFORD WORKS

FEASIBILITY STUDY
DR AS REPLACEMENT FOR F
INTERCONNECTION OF 100-D & 100 DR WATER PLANTS
SCHEMATIC ARRANGEMENT

BLDG.
NO'S . . .

DWG.
NO.

SK-1-437

PRELIMINARY
Not Approved For Construction

100-F
104 Jm B-1-49
ATTACHMENT B

DATE 2-21-49 DRAWN BY J.R.T.
CHECKED _____ PROJ. NO. _____
E. R. NO. _____ BLDG. NO. _____

DWG. NO. SK-1-8222-DR

Sheet 1 of 2

ATTACHMENT C

Attachment D

WATER BALANCENormal

System	100-D	Demand 100-DR	100-F	Total	Source	Amount (1) Available	Excess (+) or Deficit (-)	Changes Required
Process	32,000	36,000	5,000	32,000 41,000	183-D 183-F	42,000 30,000 to 33,000	+ 10,000 - 8,000 to - 11,000	None (2) Add 3 Filters to 183-F. Add Turb. Driven F.W. to process 10,000 GPM & establish stand-by pump unit for 10
Condenser	6,000	6,000		12,000	182-D 182-F	20,000	+ 8,000	None None None None
Fire & San.	300	300	1,000 300	600 300	183-D 183-F	600 600	0 + 300	None None None None
<u>Emergency</u> (long electrical power outage over 1 hr.)								
Process	5,000	5,000	5,000	5,000 10,000	183-D 183-F	8,000 0	+ 3,000 - 10,000	None (2) Add one turb. driven 10,000 GPM F.W. to process pumps
(3) Condenser	3,500	1,200	1,900	4,700 1,900	182-D 182-F	10,000 10,000	+ 5,300 + 8,100	None None
Fire & San.	600	600	600	1,200 600	183-D 183-F	1,200 600	0 0	None E.P. 806 & 812 can be used inter- None changeably.
Export & Powerhouse								

Supply are ample

To eliminate the need for three new filters in 183-F and to make use of the excess filter capacity in 183-D, it is physically possible to furnish 190-DR with water from both 183-F and 183-D in the proportion of about 70-30, respectively. The difficulty with this arrangement is operational due to the fact that control of both quantity and quality of water entering the pile will call for close control of two independent supplies.

DECLASSIFIED(1) Filter capacity less 1% backwash
500 GPM boiler supply, 500 GPM F&S
1000 GPM incidental(2) Total of 2-10,000 GPM F.W. to process turb.
driven pumps. 1 Emerg. 1 Emerg. stand-by & normal
spare.(3) Cond. demand will exceed supply immediately after
shutdown but turbines are rated non-cond. and
pumps operate high on the curve normally so no
actual deficiency should occur.

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Attachment E

STEAM BALANCE

System	100-D	Demand 100-DR	100-F	Total	Source	Amount Available	Excess (+) or Deficit (-)	Changes Required
<u>Normal</u>								
Heating	30,000	20,000	30,000					
Power	167,740 ↓	153,660 ↓	25,460 55,460	55,460 371,400	184-F 184-D	300,000 300,000	+ 244,500 - 71,400	None Add Boiler (1- 100,000 #/hr.)
<u>Emergency</u> (long electric power outage over 3 hrs.)								
Heating	30,000	20,000						
Power	226,000 ↓	51,000 ↓	30,000 226,000	256,000 327,240	184-F 184-D	300,000 300,000	+ 44,000 - 27,240	None Add Boiler (1- 100,000 #/hr.)
<u>Emergency</u> (During first 3 hrs.)								
Heating	30,000	20,000			after elec. power outage)			
Power - (ESSENTIAL)	237,560	186,360	30,000					
	267,560	206,360	138,760 168,760	168,760 473,920	184-F 184-D	300,000 360,000	131,240 - 113,920	None Add 1 Boiler (load to 24 hr. rating of 120,000 #/hr.)
Power (NON- ESSENTIAL)	99,090 366,650	0 206,360	0	573,010	184-D	360,000	213,000	Add 2 Boilers (load to 24 hr. rating of 120,000 #/hr.)

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