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R. S. Bell, Superintendent
S Division

A STUDY OF PROPOSED SEMI-PARALLEL AND COMPLETE PARALLEL OPERATIONS OF THE CANYON AND CONCENTRATION BUILDINGS - 200 AREAS

The subject study assignment has been completed by the writer and the attached report is submitted for your consideration. It should be noted here that the basic development of both operating proposals can be attributed to the combined efforts of several members of S Division supervision with major credit being given to W. M. Mobley, Area Supervisor of the F Plant Canyon Building, for the initiative and effort he displayed early last Fall in presenting the semi-parallel proposal. The writer's efforts have been largely confined to the further refinement of this and the complete parallel proposals which were submitted as well as to the development of the economic and production factors involved.

JA Hollenbach
S DIVISION 5.25.

JA Hollenbach:ad

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A STUDY OF SEMI-PARALLEL AND COMPLETE PARALLEL
SEPARATIONS AREA OPERATING PROPOSALS

I PURPOSE OF THE STUDY

Due to the presently forecasted increase in pile area production as well as a possible decrease in batch size of the separations process, an increase in the capacities of the separations plants is indicated. It is the purpose of this report to review this relationship in the light of existing data and to determine how this additional capacity can best be attained through the use of either the proposed semi-parallel or complete parallel methods of operation. Emphasis will necessarily be given to consideration of cost, timing, use of minimum buildings and equipment, and the obtaining of optimum production time cycles.

It is the purpose of this study to develop these factors as realistically as present knowledge will permit so that their relationship with separations area plant capacities may be determined.

II SUMMARY

A. Capacities

Forecasted Requirements at the Constant Peak Four Pile Production

Plan 3 @ Batch Size 3	83 runs/month
@ Batch Size 2	124 runs/month
Plan 4 @ Batch Size 3	93 runs/month
@ Batch Size 2	139 runs/month

Estimated Capacities of the T and B Plants, Inclusive (88% Operating Efficiency)

Present Capacity	@ Batch Size 3	80 runs/month
	@ Batch Size 2	84 runs/month
"Semi-Parallel"	@ Batch Size 3	103 runs/month
	@ Batch Size 2	115 runs/month
"Complete Parallel"	@ Batch Size 3	126 runs/month
	@ Batch Size 2	141 runs/month

From the production forecasts and capacity estimates the following conclusions are drawn:

1. Two separations plants with "semi-parallel operation" and with Batch Size 3 can handle four pile production with an adequate safety factor.
2. Two separations plants with "complete parallel operation"

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By Authority of CH Henager,

1-27-92, CG-PR-2

by DK Harrison, 3-2-92

Verified By JK BURSTIE, 3-2-92

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HW-12730

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-3-

April 14, 1949

and with Batch Size 12 can handle four pile production with a minimum safety factor.

Based on forecasted pile production in accordance with Plan 14 and taking into consideration a realistic fourth pile start-up date of December 1, 1949, the pile production level up to June, 1950 will be moderate; 58 runs at Batch Size 13 and 86 runs at Batch Size 12 being the maximum requirements for the T and B Plants, inclusive.

B. Cost Estimates

An appropriation of \$18,600 was allotted in November, 1948 to permit the reduction of the operating cycle time from 24 hours to 14 hours by means of paralleling the extraction and the first decontamination operations. Section 7 in both plants was activated with a minimum expenditure since all required equipment was available. The extraction operation has been run in parallel since this time, affording a 15 hour time cycle for this step including rework. By means of minor process changes and more efficient utilization of time in the operating procedures the over-all 221 and 224 Building time cycle has been reduced to an approximate 16 hours or an assumed total plant capacity of 80 runs at no monetary expenditure.

To increase the total plant capacity from an assumed 80 runs to 103 runs/month an expenditure of \$32,300 is estimated for the installation of the semi-parallel operation. Of this amount the aforementioned \$18,600 has already been appropriated for the paralleling of the first decontamination operations. The additional expenditure of \$13,700 is proposed to permit a reduction of the over-all area cycle to 14 hours allowing for 12 percent down time or an 88 percent operating efficiency which has been derived from past experience.

To increase the total plant capacity from an assumed 80 runs to 126 runs per month an expenditure of approximately \$224,550 including 11,240 man-hours labor, is estimated for the installation of the "complete parallel operation."

To convert from a "semi-parallel" to a "complete parallel operation" \$18,000 of the \$32,600 expended for semi-parallel conversion will apply toward the total expenditure of complete parallelism.

C. Factors for Consideration

The present plant capacities are adequate for the forecasted pile production through June, 1950, operating at either batch size 12

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HW-12730

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-4-

April 14, 1949

or 3. Since the forecasted production after this date will require additional separations area capacity, "semi-parallel" facilities will have to be installed in advance of this time. There is justification in effecting the necessary conversion immediately despite the relatively low production schedule between now and June, 1950. Reasons are as follows:

1. The additional capacity gained will enable the S Division to carry out a program of major maintenance work such as vessel repairs, regasketing of connectors, necessary corrections for piping creepage, etc.
2. The additional capacity will provide a greater insurance factor against major breakdowns and process difficulties which may conceivably be encountered.
3. The additional capacity will permit more freedom for the evaluation of additional process and rework tests for the reduction of waste losses during the interim period. Such tests are vitally needed in order to take maximum advantage of the metal enrichment program currently in effect.

The need and justification of the "complete parallel operation" can be reviewed at a later date when the forecasted production requires the capacity increase. However, the design work for this proposal could be initiated now as a time saving step in anticipation of the required installation.

It should be emphasized that the procedure capacities claimed for each of the two proposals are based on the assumption that there will be no interference from major equipment failures, process leaks or technical difficulties and therefore optimum scheduling of runs will be adhered to very closely. The standby relationship of U Plant with respect to the T and B Plants is covered in some detail in Document HW-12344, R. S. Bell to J. E. Mador, 3-3-49, "Placement of U Plant in Standby Condition."

Consideration must also be given to the economics of deliberately increasing product yield losses as an alternative to the proposed expenditures since, in general, the time cycles are inversely proportional to increased waste losses.

It is also to be noted from Table "1 that neither parallel nor complete parallel operation will reduce the extraction section time cycle below 15 hours if extraction effluent wastes are to be routinely reworked in Sections 7 and 8.

III DISCUSSION

A. Forecast of Production Requirements

A forecast of future LTD discharge from the piles was obtained from the P Division through G. B. Carlton. Two of the four proposed plans of pile operations were considered; final choice pending development work and Atomic Energy Commission approval. Plan 3 considers operation of

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HW-12730

HW-12730

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-5-

April 14, 1949

four piles at a 275 LTD rate with a product concentration of Size 4 per ton of metal. Plan 4 considers operation of three piles at a 275 LTD rate and one pile at 400 LTD rate with a product concentration of Size 4 per ton of metal. Both forecasts were made assuming the start up date of the fourth pile to be December 1, 1949.

Graph I shows the forecasted LTD pile discharge in relation to time for both plans.

From this forecasted pile production the number of runs per month required to be processed through the separation plants was computed assuming a 90 day cooling period and a 30 day month. This forecasted production schedule for the 200 Areas is plotted on Graphs 2 and 3, both for Size #2 and Size #3 batches.

The ultimate capacity required for the separations plants from four pile production is 83 runs at Batch Size #3 or 124 runs at Batch Size #2 for Plan 3, and 93 runs at Batch Size #3 or 139 runs at Batch Size #2 for Plan 4.

B. Semi-Parallel Operation

221 Building

The present canyon process includes the parallel operation of the extraction step. In order to further increase the capacity, a proposal was made to parallel the first cycle decontamination operation and provide facilities to make the product reduction step for the second decontamination cycle in the by-product section effluent tank. This plan has been termed "semi-parallel operation." The proposed cell layout for this operation is shown in Diagram I.

The required equipment changes are relatively minor; namely, the fabrication and installation of six cell connectors and the installation of an agitator in 18-3 tank. These changes activate Sections 13 and 14 and 16 and 17, for the first decontamination operation and Sections 18 and 19 for the second decontamination operation.

The necessary design work for the above proposal has been completed. An estimated cost for the installation in 221-T and B is \$18,600. The completion time estimate depends on the priority of the fabrication work.

With the installation of these changes, the present 15.8 hour cycle time in the 221 Building could be reduced to a 12.3 hour cycle allowing for 12 percent downtime but assuming no rework of extraction wastes. (See Table I)

224 Building

In order for the 224 Building to maintain this production rate, the time cycles of Cells D, B, E and F require reduction.

Reduction in Cell D can be attained by making several process changes of

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147-12730

R. S. Bell

-6-

April 14, 1949

a generally minor nature and in rearranging the steps to be done so that all time is efficiently utilized. These changes are itemized in the Appendix and the Separations Technology Section of the Technical Divisions should take steps to initiate this program. All indications are that these changes will lower the D Cell cycle within the required time. However, if the required reduction is not found possible, the conversion of D-4 tank to the D Cell rework precipitator will afford ample time savings at a reasonably small expense. This is discussed under the complete parallel operation.

The required reduction in the Cell B and E cycles can be attained by placing in service B-6 tank as the D Cell rework effluent hold-up tank. The cost of this work has been estimated at \$2,300 for both Concentration Buildings.

Reduction in Cell F from the present 15 hour cycle to a cycle comparable to or shorter than the "semi-parallel operation" in 221 requires the use of F-2 centrifuge for the metathesis and metathesis wash centrifugations and F-22 for the rework centrifugation. Using this proposed method, no additional tanks would be needed. F-1 and F-9 would be the precipitator and catch tank respectively for F-2; and F-7 and F-8 would likewise serve F-22. Floor washes would be routed to C-7 instead of to F-8. The resulting cycle time in F Cell would be 12 hours allowing for 12 percent downtime.

The equipment changes consist of the installation of two jots, two gang valves, two process lines, the extension of the sump lines to C-7, and the installation of the electrical cubicle and control panel for F-22. The cost of these changes was estimated at \$11,400, including 312 hours labor, for both areas.

The proposed changes in the 224 Building are shown in the 224 Piping Diagram, Diagram #2.

221 and 224 Building

The total cost of the changes in both 221 and 224 to obtain the termed "semi-parallel operation" is estimated at \$32,300, for both T and B Plants. The capacity of the process would be increased to approximately 51 runs per plant or an equivalent time cycle of 13.8 hours allowing for 12 percent downtime.

C. Complete Parallel Operation

221 Building

Since the second decontamination cycle will be the critical cycle in the 221 Building operation, if the semi-parallel proposal is adopted, an increase in the building capacity would require the paralleling of this cycle. In order to effect this complete parallel operation, it would be necessary to utilize Sections 9 and 10 for hold up and oxidation, Sections 11 and 12 for first decontamination, and Sections 18 and 19 for second decontamination.

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HW-12730
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-7-

April 14, 1949

Diagram 3 shows the proposed piping and cell layout for this "complete parallel" operation.

The following list outlines the equipment requirement of one plant for this proposal:

- 2 - Precipitator Tanks (9' x 9'), for 11-1 and 12-1
- 7 - Trench jumpers averaging 100' in length (140' maximum)
- 10 - Standard cell connectors
- 3 - Cell connectors requiring specialized design.
- 7 - Operating Gallery Scale Tanks
- 2 - Centrifuge Spray Pumps
- 4 - Electrical cubicles and switch gear
- 1 - Panel board assembly identical to Section 13, including 12 gang valves, 6 instruments, and 47 piping and wiring connections from panel board to pipe gallery wall connectors.
- 29 - Alterations to wiring and piping from panel boards to pipe gallery wall connectors.

The following cell equipment changes would be required:

- (1) Transfer of 10-2, 10-3, and 10-4 equipment pieces to Section 11.
- (2) Transfer of the 9-2 centrifuge and its 9-3 effluent vessel to Section 12.
- (3) Transfer of the present 12-8 to Cell 12-L to serve as the 12-4 vessel.
- (4) Transfer of 12-7 and 12-6 vessels to Cell 10 R to serve as the 10-7 and 10-8 vessels, respectively.
- (5) Transfer of the 12-9 tank to Cell 9R to serve as the 9-7 vessel.

The "complete parallel" installation appears mechanically feasible since the major portion deals with standard equipment and their rearrangement or installation. The seven trench jumpers, maximum length of 140 feet, required for fabrication and installation would result in the main potential difficulties to be encountered. This problem has been reviewed with the Project Engineering and Maintenance personnel and there is every indication that these jumpers can be designed without conflicting with the present trench jumpers and with enough support to be lifted and installed by two cranes. The radiation level at the deck of the open pipe trench at Section 8, waist high, is approximately 750 mr/hr. This level would permit manual assistance to aid in the placement of these jumpers, if required.

An estimated cost for this installation in 221-T and B is approximately \$221,750, including 13,940 man hours of labor. The time required to complete the installation would be dependent on the priority given to the proposal and the consequent maintenance manpower assigned to the work. An estimated downtime of the process required for the conversion is two weeks.

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117-12730

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-8-

April 14, 1949

The complete parallel operation would reduce the 221 cycle time to 11.2 hours, allowing for 12 percent downtime.

224 Building

To increase the 224 production capacity to a comparable level to the 221 proposal, a reduction of the D cell time cycle is required. This would be attained by installing facilities to allow for the rework precipitation to be done in the D-4 tank and centrifuging directly to D-2 while the next run is being oxidized and precipitated in the D-1 tank. This reduces the D cell time cycle by more than two hours.

The equipment changes consist of a chemical addition line to D-4 and a process jet and line from D-4 to D-2. The cost for this change was estimated at \$2,800, including 300 hours labor for both plants.

Additional reduction of the time cycle in Cell D, although not deemed necessary, would require the installation of D-22 centrifuge in C Cell for the D-4 rework centrifugation. This installation will not be included in this study other than an estimation of the cost found in the Appendix.

221 and 224 Buildings

The total cost of the changes in both 221 and 224 to obtain the termed "complete parallel operation" is estimated at \$224,550 for both plants. The capacity of the process would be increased to approximately 63 runs for one plant or an equivalent time cycle of 11.2 hours allowing for 12 percent downtime.

Consideration was given to the use of Section 20 for this proposal. However, 20-R Cell has several objectionable features for its use in the operation.

- (1) There are no sampler reservoirs or assemblies.
- (2) The location of the 10-T crane makes it the only crane available to service this cell. This limits the load that can be placed in this cell, 14 ton cell blocks being the maximum.
- (3) The right hand wall connectors are difficult to be serviced.

The use of Sections 3 to 19 and the corresponding cell equipment would cause the present problem of jacket leakage, cell drainage capacity, and availability of spare equipment to become more acute.

D. Time Requirements for Installation

The installation of the "semi-parallel operation" will necessitate an approximate 8 hour process shutdown in 221 and a 48 hour shutdown in 224. A total of 1675 hours of maintenance labor is the estimated requirement; the over-all time needed for completion is therefore dependent on the priority given to the work.

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HW-12730
11-12730

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-9-

April 14, 1949

The estimated downtime of the process required for the conversion to the "complete parallel operation" is two weeks. A total of 14,240 hours of maintenance labor is estimated for the completion of the job; the over-all time required for completion is dependent on the priority given to the work.

E. Time Cycle Studies

The semi-parallel and complete parallel proposals would reduce the present cycles considerably by means of paralleling portions of the process by additional equipment. A reduction in volume of the run would also affect the time cycle. Consultation with the Process Section of the Technical Divisions indicates the following time reduction due to volume reduction:

- (1) Heating and cooling steps - Slight reduction utilizing the same sized equipment.
- (2) Centrifugation - Reduction proportionate to volume reduction.
- (3) Digestion periods and addition times - No change. Less chemicals to add but at a slower rate.
- (4) Cake wash - Slight increase due to loss initial dilutions and larger proportionate heels.
- (5) Cake solution - No change.
- (6) Transfer times, slight reductions.

The future program for the separations process has two possible means for volume reduction.

- (1) Decrease in batch size.
- (2) Increase in concentration of the pile metal.

The effect of the reduction of batch size from Batch Size #3 to Batch Size #2 was discussed with the Technical Divisions. Their reasoning is that the present 70 percent volume for Size #3 runs would be a 100 percent volume basis for Size #2 runs. Since the 70 percent volume reduction has been proved to be chemically feasible, this volume could be reduced 70 percent, resulting in a 50 percent volume from the original basis. This is the volume reduction used for the estimations of time cycles for Size #2 runs.

Development work and test runs would have to be initiated before postulations can be made on the effected volume reduction due to concentration of the pile metal. The volume reduction is dependent on the reduction of the Bi-Pu ratio. However, the Technical Divisions are of the opinion that the volume may be reduced by a factor of 50 percent with the concentration of metal to Size #4 per ton. The following data show the reduction of uranium metal required for processing per run at Size #4 concentration.

Batch Size #2 - .565 T. of U processed/run

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HW-12730
HW-12730

R. S. Bell

-10-

April 14, 1949

Table I gives the tabulation of the estimated time cycles in the various sections or cells for the two parallel proposals both at Size #2 and #3/hun bases. Time cycles other than the present cycle were formulated from present knowledge of the process and postulated effects of volume reduction and parallel operation. No consideration was given to the possible effects of metal concentration.

F. Equipment Capacity

Due to the postulated reduction of volumes, some concern has been placed on equipment capacities. The following data show the tank capacities for the various proposals.

	9' x 9' Pre- cipitator Tank	14' x 7' Solu- tion Tank
Capacity to overflow line (1.1 Sp.Gr. Solution)	36,000 ⁴	7,000 ⁵
Minimum weight for 70 percent volume runs	221 12,000 ⁵	1,350 ⁵
	224 8,000 ⁵	1,550 ⁵
Minimum weight for 50 percent volume runs	221 8,000 ⁵	1,000 ⁴
	224 5,600 ⁵	1,100 ⁵

These data show that though the volumes under consideration are from 1/4 to 1/7 of the total tank capacity there is adequate volume for agitation, sparging, heating, and cooling.

The replacement of the equipment with more suitable equipment is not being considered in this study due to the cost involved and the uncertainties of the future program.

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TIME CYCLE ESTIMATIONS

Table 1

	Present Process Batch Size *3	Present Process Batch Size *2	Semi-Parallel Process Batch Size *3	Semi-Parallel Process Batch Size *2	Complete Parallel Process Batch Size *3	Complete Parallel Process Batch Size *2
Extraction Sections 7 & 8 Including Rework No Rework	15 Hours 9.5 "	13 Hours 8.5 "	15 Hours 9.5 "	13 Hours 8.5 "	15 Hours 9.5 "	13 Hours 8.5 "
1st Decon. By Prod Section 13	14.3 "	13.5 "	7 "	6.5 "	7 "	6.5 "
1st Decon. Prod Section 14	15.5 "	14.7 "	8.3 "	7.3 "	8.3 "	7.3 "
2nd Decon. By Prod Section 16	9.5 "	9.0 "	10.5 "	9.8 "	6. "	5.5 "
2nd Decon. Prod Section 17	15.8 "	14.8 "	12.3 "	11. "	7 "	6.3 "
221 Plant Capacity	45 Rung/Month	42.5 Rung/Month	52.5 Rung/Month	65.5 Rung/Month	75 Rung/Month	89 Rung/Month
88% Time Efficiency	39.6 "	43.6 "	51.5 "	57.7 "	66 "	74 "
% Extraction Rework Allowed	100%	100%	51%	51%	0%	0%
Cell A	7 Hours	6 Hours	7 Hours	6 Hours	7 Hours	6 Hours
Cell B & E	13 "	10 "	10 "	8 "	10 "	8 "
Cell D	14 "	12.5 "	12 "	11 "	10 "	9 "
Cell F	15 "	15 "	9 "	9 "	9 "	9 "
221 Plant Capacity	48 Rung/Month	48 Rung/Month	60 Rung/Month	65.5 Rung/Month	72 Rung/Month	80 Rung/Month
88% Time Efficiency	72 "	72 "	53 "	57.7 "	63 "	72.5 "

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Forecast of [redacted] Production in MWJs [redacted] [redacted]

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W.D.
1964
1965
1966
1967

[redacted]

W.D.
1964
1965
1966
1967

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Required Runs per Month

Plan 3

Runs
per
Month

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Required Runs per Month vs Time

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Diagram 2

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CABLE PAMULE DESIGN - 111

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APPENDIX

Table of Contents

- A. Proposed changes and process streamlining for the reduction of D Cell cycle time.
- B. Equipment requirements for "semi parallel operation" of 221.
- C. Equipment requirements for "complete parallel operation" of 221.
- D. Cost estimate for "complete parallel operation" of 221.
- E. Equipment requirements for increased capacity of F Cell in 221.
- F. Cost estimate for D-22 centrifuge in G Cell.

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157-12730

A. Proposed Changes and Process Streamlining for the Reduction of D
Cell Cycle Time (Suggestions by D. McDonald)

1. Add recycle and KNO_3 to D-1 while heating D-1 to 75°C instead of doing these after D-1 is at 75°C - this applies to both first precipitation and rework.
2. Take D-1-O sample while run is cooling; instead of waiting until after it has reached 35°C.
3. Count the time spent blowing the HP lines as part of the digestion time which follows immediately.
4. Start heating the first D-1 SP rework in D-1 before the second rework arrives, thus shortening the time required to heat both together.
5. Reduce the amount of time spent spinning the cake after washing the double rework cake, (this time is now 27 minutes before skimming - 17 minutes would be more than enough).
6. Reducing the amount of water used for cake removal. Such reduction shortens cake removal time and shortens centrifugation times in D, B and E Cells.
7. The steam garger could be used to shorten the long time now required for heating batches and reworks in the D-1 tank. Also, the runs could be heated partially in A-3 before transferring to D-1.
8. The oxidation period for the rework is 60 minutes, whereas the same period for a whole batch is only 30 minutes. This should be tested to see whether or not the rework oxidation can be cut to 30 minutes.
9. The rework cake wash procedure requires approximately 110 minutes. Since the product content of the rework solution is low (approximately 0.8 to 1.0%), there is very little product to be displaced from the cake. Therefore, a simplified and shorter cake wash procedure seems to be in order at this point.

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B. Equipment Requirements for Semi Parallel Operation of 221

1. Fabricate connector 48 to nozzle 4, 12-8 tank
2. Fabricate connector 42 to nozzle 14, 15-9 tank
3. Fabricate connector 79 to nozzle 14, 15-8 tank
4. Provide 15 H. P. agitator assembly for 18-3 tank
5. Fabricate connector 58 to 18-3 agitator - power for motor
6. Fabricate connector 62 to 18-3 agitator - lubrication
7. Provide switch gear and install in galleries
8. Fabricate and install piping from 19-1A scale tank outlet to connector 60, Section 18 Pipe Gallery

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C. Equipment Requirements for Complete Parallel Operation of 221

Section 6

No changes

Section 7

1. 7-4 to 9-4 transfer jet would be changed to 7-4 to 9-9.

Section 8

1. 8-4 to 10-7 - Use 8-4 to 12-7 jet. Install new trench jumper (Details on following page.)

Section 9

1. Equipment Changes

Transfer present 9-2 & 9-3 tanks to 12-2 & 12-3. 9-R connectors to be used in 12-2

Install present 12-9 tank in 9-R as 9-7. No piping required.

2. Connector Installations

1. 9-9 to 11-1 - Install jet Conn 13-14. Install new trench jumpers (Details on following page).

Section 10

1. Equipment Changes

Transfer 10-4 to 11-4 as 11-4. 10-L connectors to be used in 11-4 as required.

Transfer 10-2 & 10-3 to 11-R as 11-2 & 3. 10-R connectors to be used in 11-R as required.

Transfer 12-7 and 12-6 to 10-R as 10-7 and 10-8. No piping required for 10-8.

2. Connector Changes and Installations

1. Transfer Conn 81; 82 from 12-R and install as 10-7 to 13-1 jet. Present 82 conn is blanked. Tie steam line from panel board to pipe gallery.
2. Conn 80 - Lubrication - Transfer from 12-R. Present 80 to be changed from hydraulic to lubrication.
3. Conn 78 - Sparger - Transfer from 12-R. Present 78 is liquid level. Requires piping changes from 10-3 sparger gang valve to Conn 70 in pipe gallery.

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4. Conn 77 - Temperature - Transfer from 12-R. Present 77 is power to motor. Requires wiring changes from panel board to pipe gallery.
5. Conn 76 - Jacket Inlet - Transfer from 12-R. Present 76 is steam. Requires piping changes from raw water at panel board to pipe gallery.
6. Conn 75 - Sampler - Transfer from 12-R. Present 75 is spare.
7. Conn 52 - Jacket Outlet - Transfer from 12-R. Present 52 is spare.
8. Conn 51 - Speaker - Transfer from 12-R. Present 51 is same.
9. Conn 50 - Power to Motor - Transfer from 12-R. Present 50 is tachometer. Requires wiring changes from panel board to pipe gallery.
10. Conn 47 - Liquid Level - Transfer from 12-R. Present 47 is Lubrication. Requires piping changes from panel board to pipe gallery.
11. Conn 45 - Chemical Feed - Transfer from 12-R. Present 45 is bowl spray. Requires piping changes from scale tank to pipe gallery.
12. Conn 43 - Install new process inlet from Conn 43 to Nozzle 1 (8-4 to 10-7). Install new trench jumper (Details on following page).

Section 11

1. Tank Installations and Transfers

1. Install new 11-1 precipitator
2. Transfer 10-2; 3, and 4 tanks in Sect. 11 as 11-2, 3, and 4.

2. Panel board requirements - identical to Sect. 13 Panel Board (11-2-911) including 6 sections of panel, 12 gang valves, 3 Ring Balance Instruments, 2 Temperature Recorder Instruments, and other misc. items.

3. Scale Tank Requirements

1. 11-1A, 11-1E, 11-2D, and 11-2G installed identical to Sect. 13.

4. New Connector Requirements in 11-4 and B

1. B Jet - Conn 2, 37 to Nozzle on 11-1
2. Chem. Feed Inlet - Conn. 3 to Nozzle 3 on 11-1

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3. Process Inlet - Conn. 4 to Nozzle 4 on 11-1
4. Lubrication - Conn 5 to Nozzle 19 on 11-1
5. Sparger - Conn 7 to Nozzle 6 on 11-1
6. Power to Motor - Conn 8 to Nozzle 20 on 11-1
7. To Speaker - Conn 9 to Nozzle 7 on 11-1
8. Jacket Outlet - Conn 10 to Nozzle 17 on 11-1
9. Jet 11-4 to 15-8 - Conn 29, 30 to Nozzle 13 on 11-1
10. Process Inlet - Conn 32 to Nozzle 9 on 11-1
11. Sampler - Conn 33 to Nozzle 10 on 11-1
12. Chemical Feed Inlet - Conn 34 to Nozzle 11 on 11-1
13. Temperature - Conn 35 to Nozzle 12 on 11-1
14. Jacket Inlet - Conn 36 to Nozzle 18 on 11-1
15. Liquid Level - Conn 38 to Nozzle 13 on 11-1
16. A jet - Conn 39, 40 to Nozzle 15 on 11-1
17. Spray - Conn 41 to Nozzle 14 on 11-1
18. Process Inlet - Conn 46 to Nozzle 2 on 11-2
19. 11-3 to 12-1 jet - Conn 72, 73 to Nozzle 1 on 11-3

All of the above 19 connectors are standard connectors.

All of the above 19 connectors require piping and wiring connections from the pipe gallery wall connectors to the respective panel boards.

5. Standard Connectors to be Transferred from Section 10 and Installed in Section 11

1. Jacket Outlet - Conn 15 to Nozzle 14 on 11-4
2. Power to Motor - Conn 16 to Nozzle 16 on 11-4
3. Chemical Feed Inlet - Conn 18 to Nozzle 6 on 11-4
4. Sparger - Conn 19 to Nozzle 7 on 11-4
5. Lubrication - Conn 20 to Nozzle 17 on 11-4
6. Sampler - Conn 21 to Nozzle 8 on 11-4
7. Liquid Level - Conn 23 to Nozzle 9 on 11-4

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HW-12730
HW-12756

8. Jacket Inlet - Conn 24 to Nozzle 15 on 11-4
9. Temperature - Conn 27 to Nozzle 10 on 11-4
10. Process Inlet - Conn 28 to Nozzle 11 on 11-4
11. Chemical Feed Inlet - Conn 44 to Nozzle 1 on 11-2
12. Bowl Spray - Conn 45 to Nozzle 3 on 11-2
13. Lubrication - Conn 47 to Nozzle 4 on 11-2
14. Tachometer - Conn 50 to Nozzle 5 on 11-2
15. Speaker - Conn 51 to Nozzle 6 on 11-2
16. 11-2 to 11-4 Jet - Conn 53, 54 to Nozzle 8 on 11-2
17. 11-3 to 11-1 Jet - Conn 55, 56 to Nozzle 2 on 11-3
18. Jacket Outlet - Conn 57 to Nozzle 17 on 11-3
19. Chemical Inlet - Conn 60 to Nozzle 6 on 11-3
20. 11-3 Spray - Conn 61 to Nozzle 7 on 11-3
21. Sampler - Conn 63 to Nozzle 8 on 11-3
22. 11-3 Sparger - Conn 64 to Nozzle 9 on 11-3
23. Liquid Level - Conn 65 to Nozzle 10 on 11-3
24. Temperature - Conn 69 to Nozzle 11 on 11-3
25. Jacket Inlet - Conn 71 to Nozzle 18 on 11-3
26. Power to Motor - Conn 77 to Nozzle 11 on 11-2
27. Liquid Level - Conn 78 to Nozzle 9 on 11-2
28. Hydraulic - Conn 80 to Nozzle 12
29. Case Spray - Conn 82 to Nozzle 13

All of the above 29 connectors require piping and wiring connections from the pipe gallery wall connectors to the respective panel boards.

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157-12730

6. Trench Jumper Installations

1. 11-3 to 12-1 Jumper - See details on following page.
2. 11-4 to 15-8 Jumper - See details on following page.

Section 12

1. Tank Installations and Transfers

1. Install new 12-1 precipitator
2. Transfer 12-8 to 12-1 as 12-9
3. Transfer 9-2 and 9-3 to 12-R as 12-2 and 12-3

2. Scale Tank Requirements

1. 12-4F, 12-1E, and 12-2D tanks are arranged identical to Section 14.

3. New Connector Requirements in 12-1 and 12-R and the Corresponding Required Piping and Wiring Changes from the Pipe Gallery Wall Connectors to the Respective Panel Boards

1. B Jet - Conn 2, 37 to Nozzle 1 on 12-1. Present conn 2 is sparger requiring pipe changes from panel to pipe gallery.
2. Chemical Feed Inlet - Conn 3 to Nozzle 3 on 12-1. Present Conn 3 is steam inlet requiring pipe changes from panel to pipe gallery.
3. Lubrication - Conn 5 to Nozzle 19 on 12-1. Present Conn 5 is liquid level requiring pipe changes.
4. Process Inlet - Conn 6 to Nozzle 5 on 12-1. Present Conn 6 is the same.
5. Sparger - Conn 7 to Nozzle 6 on 12-1. Present Conn 7 is chemical feed line requiring pipe changes.
6. Power to Motor - Conn 8 to Nozzle 20 on 12-1. Present Conn 8 is pipe gallery spare, requiring pipe installation.
7. To speaker - Conn 9 to Nozzle 7 on 12-1. Present Conn 9 is pipe gallery spare, requiring pipe installations.
8. Jacket Outlet - Conn 10 to Nozzle 17 on 12-1. Present Conn is same.
9. Process Inlet - Conn 28 to Nozzle 11 on 12-1. Present Conn 28 is the same.

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HW-12730

10. Jet 12-4 to 18-1 - Conn 29, 30 to Nozzle 13 on 12-4. Present Conns. 29, 30 are pipe gallery spares, requiring pipe installation.
11. Jet 12-4 to 12-1 - Conn 31 to Nozzle 1 on 12-4, to Nozzle 8 on 12-1. Present Conn 31 is steam, requiring pipe changes from one gang valve to another.
12. Process Inlet - Conn 32 to Nozzle 9 on 12-1. Present Conn 32 is same.
13. Sampler - Conn 33 to Nozzle 10 on 12-1. Present conn 33 is same.
14. Chemical Feed Inlet - Conn 34 to Nozzle 11 on 12-1. Present Conn 34 is jacket inlet, requiring pipe changes.
15. Temperature - Conn 35 to Nozzle 12 on 12-1. Present Conn 35 is same.
16. Jacket Inlet - Conn 36 to Nozzle 18 on 12-1. Present Conn 36 is steam inlet, requiring pipe changes.
17. Liquid Level - Conn 38 to Nozzle 13 on 12-1. Present Conn 38 is pipe gallery spare requiring piping installation.
18. A jet - Conn 39, 40 to Nozzle 15 on 12-1. Present Conn 40 is pipe gallery spare requiring piping installation.
19. Spray - Conn 41 to Nozzle 14 on 12-1. Present Conn 41 is pipe gallery spare requiring piping installation.

All of the above 19 connectors are standard connectors.

4. Standard Connectors to be Transferred from 12-R to 12-L with the 12-R Tank and from 9-R to 12-R, and the Corresponding Required Piping and Wiring Changes from the Pipe Gallery Wall Connectors to the Respective Panel Boards

12-L

1. Jacket Outlet - Conn 15 to Nozzle 14 on 12-4. Present Conn 15 is same.
2. Power to Motor - Conn 16 to Nozzle 16 on 12-4. Present Conn 16 is pipe gallery spare requiring piping installations.
3. Chemical Feed Inlet - Conn 18 to Nozzle 6 on 12-4. Present Conn 18 is pipe gallery spare requiring piping installations.
4. Sampler - Conn 19 to Nozzle 7 on 12-4. Present Conn 19 is steam inlet, requiring piping changes.
5. Lubrication - Conn 20 to Nozzle 17 on 12-4. Present Conn 20 is pipe gallery spare, requiring piping installation.

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HW-12730

HW-12730

6. Sampler - Conn 21 to Nozzle 8 on 12-4. Present Conn 21 is same.
7. Liquid Level - Conn 23 to Nozzle 9 on 12-4. Present Conn 23 is same.
8. Jacket Inlet - Conn 24 to Nozzle 15 on 12-4. Present Conn 24 is pipe gallery spare requiring piping installations.
9. Temperature - Conn 27 to Nozzle 10 on 12-4. Present Conn 27 is same.

12-R

1. Chemical Feed Inlet - Conn 44 to Nozzle 1 on 12-2. Present Conn 44 is pipe gallery spare requiring piping installations.
2. Bowl Spray - Conn 45 to Nozzle 3 on 12-2. Present Conn 45 is chemical feed inlet, requiring pipe changes.
3. Process Inlet - Conn 46 to Nozzle 2 on 12-2.
4. Lubrication - Conn 47 to Nozzle 4 on 12-2. Present Conn 47 is liquid level requiring pipe changes.
5. Process Inlet - Conn 48 to Nozzle 7 on 12-2.
6. Tachometer - Conn 50 to Nozzle 5 on 12-2. Present Conn 50 is power to motor, requiring wiring changes.
7. Speaker - Conn 51 to Nozzle 6 on 12-2. Present Conn 51 is same.
8. 12-2 to 12-4 Jet - Conn 53, 54 to Nozzle 8 on 12-2. Present Conn 54 is pipe gallery spare requiring pipe changes.
9. 12-3 to 12-1 Jet - Conn 55, 56 to Nozzle 2 on 12-3. Present Conn 56 is pipe gallery spare requiring piping installation.
10. Jacket Outlet - Conn 57 to Nozzle 17 on 12-3. Present Conn 57 is the same.
11. Chem. Feed Inlet - Conn 60 to Nozzle 6 on 12-3. Present Conn the same.
12. Spray - Conn 61 to Nozzle 7 on 12-3. Present Conn 61 is the sparger requiring piping changes.
13. Sampler - Conn 63 to Nozzle 8 on 12-3. Present Conn 63 is the same.
14. Sparger - Conn 64 to Nozzle 9 on 12-3. Present Conn 64 is a pipe gallery spare requiring piping installations.

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DECLASSIFIED

-28-

• H7-12730

15. Liquid Level - Conn 65 to Nozzle 10 on 12-3. Present Conn 65 is the same.
16. Temperature - Conn 69 to Nozzle 11 on 12-3. Present Conn 69 is the same.
17. Jacket Inlet - Conn 71 to Nozzle 18 on 12-3. Present 71 is pipe gallery spare requiring pipe changes.
18. 12-3 to 15-8 Jet - Conn 74, 76 to Nozzle 16 on 12-3. Present 76 is jacket inlet requiring pipe changes.
19. Power to Motor - Conn 77 to Nozzle 11 on 12-2. Present Conn 77 is temperature requiring wiring changes.
20. Manometer - Conn 78 to Nozzle 9 on 12-2. Present Conn 78 is sparger requiring pipe changes.
21. Case Spray - Conn 82 to Nozzle 13 on 12-2. Present Conn 82 is steam inlet requiring pipe changes.
22. Hydraulic - Conn 80 to Nozzle 12 on 12-2. Present Conn 80 is lubrication.
5. Trench Jumper Installations
 1. 12-4 to 18-1 - See details on following page
 2. 12-3 to 15-8 - See details on following page

Section 13

1. Fabricate and install process inlet - Conn 6 to Nozzle 5 of 13-1

Section 14

1. Fabricate and install jumper from Conn 6 to 13 in 14-1.

Section 15

1. Fabricate and install process inlet - Conn 42 to Nozzle 4 of 15-9
2. Trench Jumpers - See details on following page.

Section 16, 17, 18, and 19

No changes or installations required.

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-29-

WT-12730

6. Pipe Trench Jumper Requirements

1. 8-4 to 10-7 Approx. 100 ft.

Remove trench jumper 8-4 to 12-7 (Conn 13 Sect. 8 to Conn 4 Sect. 12).
Install new jumper 8-4 to 10-7 (Conn 13 Sect. 8 to Conn 43 Sect. 10).

2. 9-9 to 11-1 Approx. 80 ft.

Remove present trench jumper 6-4 to 9-4 (Conn 29 Sect. 6 to Conn 13 Sect. 9). Install new jumper 9-9 to 11-1 (Conn 13 Sect. 7 to Conn 4 Sect. 11).

3. 10-7 to 13-1 Approx. 100 ft.

Install new jumper 10-7 to 13-1 (Conn 81 Sect. 10 to Conn 6 Sect. 13)

4. 11-1 to 12-1 Approx. 30 ft.

Install new jumper 11-3 to 12-1 (Conn 72 Sect. 11 to Conn 6 Sect. 12)

5. 11-4 to 15-8 Approx. 160 ft.

Loosen trench jumper Conn 72 Sect. 15 (16-4 to 15-8). Install new jumper 11-4 to 15-8 (Conn 30 Sect. 11 to Conn 72 Sect. 15)

6. 12-3 to 15-8 Approx. 120 ft.

Loosen trench jumper conn 70 Sect. 15 (18-4 to 15-8). Install new jumper 12-3 to 15-8 (Conn 74 Sect. 12 to Conn 70 Sect. 15).

7. 12-4 to 18-1 Approx. 80 ft.

Install 12-4 to 14-1 (Conn 30 Sect. 12 to Conn 6 Sect. 14).

Install Jumper in 14-1 from Conn 6 to 13 which is discharge from 14-4 to 18-1 line. If this installation is not feasible a 1" line could be installed from 12-4 to 18-1.

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-30-

HW-12730

D. Cost Estimate for Complete Parallel Operation - 221-T & B

Item	Labor	Mat'l.	Total
2 - 9' x 9' Tanks and agitators		\$ 30,000	\$ 30,000
7 - Trench Jumpers - average 100 feet	1,400 hrs.	6,000	13,000
40 - St'd. Cell connectors	2,800 hrs.	20,000	34,000
3 - Cell connectors requiring design	240 hrs.	1,500	2,700
6 - 75 Gal. Scale Tanks @\$258 each		1,548	1,548
1 - 400 Gal. Scale Tank		962	962
12 - Gang Valves @\$250 each		3,000	3,000
8 - Panel board Sections @\$32 each		256	256
2 - Reinforced Skimmers	200 hrs.	163	1,163
Panel Board Instruments		7,250	7,250
2 - Spray Pumps		290	290
Hydraulic System and Controls	200 hrs.	750	1,750
4 - Electrical cubicles and Switch Gear	250 hrs.	1,000	2,250
47 - Connections from new panel board	500 hrs.	3,000	5,500
29 - Alterations to piping in gallery	350 hrs.	400	2,050
33 - Connectors to be regasketed	30 hrs.		150
Additional Misc. Labor	1,000 hrs.		5,000
Total - 1 Plant	6,970 hrs.	\$76,119	\$110,869
Total - 2 Plants	13,940 hrs.	\$152,238	\$221,738

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-51-

HW-12730

E. Equipment Requirements for Increased Capacity of F Cell in 224

1. Process jet and gang valve from F-7 to F-22.
2. Process jet and gang valve from F-8 to F-7.
3. Process jet and gang valve from F-22 to F-1.
4. F-22 overflow line to F-8.
5. Chemical addition line from F-1A to F-7.
6. Sump lines extended from F-8 to C-7.
7. Control Panel for F-22 including panel board, electrical switch, manometer, etc.
8. Switch gear and electrical cubical for F-22.

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-2-

HW-12730

P. Cost Estimate for D-22 Centrifuge in C Cell

Item	Labor	Mat'l.	Total
1 - Centrifuge	600	12,000	15,000
Centrifuge Block	50	475	725
Hole through C Cell Wall	16		80
Effluent Line from D-22 to B-6	30	450	600
Electrical Cubicle and Centrifuge Controls	140	1,400	2,100
2 - Jets and piping	32	1,000	1,160
2 - Gang valves and piping	160	800	1,600
Hydraulic hook up and controls	200	750	1,750
D-2-D pump line discharge to D-22	10	50	100
Total - 1 Plant	1,238 hrs.	\$ 16,925	\$23,115
Total - 2 Plants	2,476 hrs.	33,850	46,230

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