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Hanford Works
Manufacturing Department
Separations Section
Plant Engineering Services Unit

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SEPARATIONS P.E.S. REPORT NO. 11

TASK I, ACTIVATION STUDY, RMA LINE

234-5 BUILDING

By

A. J. Andersen

B. M. Stark

R. Overson

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May 12, 1952

By Authority of J. S. Lewis - 3-23-92

C.G. - PR2

By J. H. Wells - 11-19-94

Verified By J. E. Savely 11-22-94

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Hanford Works
Manufacturing Department
Separations Section
Plant Engineering Services Unit

TO: R. S. Bell, Manager
Separations Section

May 12, 1952

SEPARATIONS P.E.S. REPORT NO. 11

TASK I. ACTIVATION STUDY, RMA LINE - 234-5 BUILDING

I - SUMMARY

PROBLEM UNDER INVESTIGATION: It was the purpose of this study to determine whether it will be more desirable when activating Task I of the RMA Line to revise the existing remotely operated equipment or to remove existing equipment and install a manually operated facility.

It was also the purpose of this study to provide sketches and cost estimates for each alternative which could be used as a guide for preparation of a Project Proposal.

At present, the process to be used in Task I has not been established. This study, therefore, necessarily covers only processes similar to those for which Task I was originally designed. Information received from the Process Unit indicates adoption of such a process is probable.

IMPORTANT RESULTS: All results herein reported are specifically limited to the conditions disclosed in "Problem Under Investigation". If process solution necessitates major changes to Task I a re-study of the problem will be required.

Assuming that the work will be performed by Minor Construction, the total adjusted project cost including additives and engineering for revising existing Task I equipment was estimated to be \$25,000 - \$44,500. The range of this estimate reflects uncertainties associated with feed concentration and use of Saram Valves.

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The cost of providing a new greenhouse type operation was estimated on the same basis to be \$90,000. It is anticipated that the maintenance costs will be approximately \$5,000/yr. higher in the remotely operated installation because of increased electrical maintenance.

Present reactor vessels are of sufficient size to process material according to the flow sheet in reference Document HW-23633. (Exhibit D) For \$1,000 the present reactor head assemblies can be revised to accommodate a larger vessel in which material of lesser concentration could be processed. (Figure 5)

The saran valves performed satisfactorily in tests conducted by the General Engineering Laboratory at Schenectady and in subsequent shake-down tests at Hanford Works. The present saran valves will require reworking, at a total cost of \$1,200, to eliminate leakage at the saran tubing connections to the valve body. The estimated minimum cost for revising the existing Task I equipment is based on the assumption that saran valves will give satisfactory service and replacement at this time with valves made of other materials is not justified. Should later information prove the saran valve to be unsatisfactory, an additional estimated replacement cost of \$18,500 would be incurred.

Records of personnel contamination incidents in the 234-5 Building show that operation and maintenance of either a manual or remote Task I installation can be performed with equal safety.

RECOMMENDATIONS AND CONCLUSIONS: It is recommended that if Task I is activated, the existing equipment be revised.

The recommendations to utilize presently available equipment in Task I should not be considered a basis for justification of installation of other remotely operated facilities. In Task I a satisfactory production

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facility can be obtained by revising existing remotely operated equipment. If, however, there were no existing equipment, a satisfactory manually operated installation could be designed, procured, and installed much more cheaply.

W. A. Brown
Contact Engineering

By A. J. Andersen
A. J. Andersen

B. M. Stark
B. M. Stark

R. Overson
R. Overson

WAB:AJA:ga

II - DISCUSSION

ORIGIN OF INVESTIGATION: This investigation was initiated at the request of the Manager of the Separations Section. The two alternative methods of activating Task I were first brought to attention by a letter from O.F. Beaulieu to V. R. Chapman, "Recommendations for Reactivation of Task I", dated January 9, 1952.

Activation of Task I came under consideration when tests indicated that sufficient purification of the Redox plutonium nitrate solution could be obtained by a single +4 oxalate precipitation. The Recuplex study was based on the assumption that Task I would be operating to process any nitrate solutions produced by Recuplex and that the Task I process would be a +4 oxalate precipitation.

At present, this process has not been firmly established. This study, therefore, necessarily covers only processes similar to those for which Task I was originally designed. Information received from the Process Unit indicates adoption of such a process is probable.

PRESENT CONDITIONS: The existing Task I equipment was designed to receive a sample can containing product from the 231 Building and to deliver a +3 oxalate slurry to Task II by means of an overhead slurry transfer line. The original boat loading station in Task II has been replaced to permit introduction of filter boats containing a plutonium oxalate cake which are loaded in the 231 Building. With the exception of introducing and removing sample cans and taking process samples, all operations were to be performed from behind a steel and lucite barrier.

The Task I equipment is contained in several stainless steel process hoods. Product lines between hoods are enclosed in stainless steel ducts. Hood 1B contains a remotely operated balance for weighing the sample cans and their contents. Hoods 2 and 3 contain the sample can handling equipment with provisions for diluting, agitating, and sampling the sample can contents.

The main process hood, Hood 6, contains six pyrex-reactor vessels equipped with agitators, dip tubes, etc. The upper portion of the hood contains a slurry head tank which was used in the operation of transferring slurry to Task II. Solution transfers are accomplished by evacuating the receiving vessel and venting the vessel from which the liquid is being transferred.

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Special saran valves are used which are solenoid controlled, air operated. The major portion of the valves which handle contaminated fluids are located in Hoods 5 and 7. These are special valve hoods located adjacent to Hood 6. Hood 8 contains two pyrex vessels of the same size as the Hood 6 reactors and is used as a measuring and sampling station for the supernatant solution which is decanted from the reactors in the #3 oxalate process.

The existing equipment was operated on a shakedown and training basis for a period of approximately 4 months following acceptance of the facility from construction forces. During this period over 300 runs were processed using cerous nitrate and ceric nitrate as stand-in materials. At the end of the shakedown period the equipment was flushed out and has not since been operated. With the exception of removal of the wet transfer station at Hood 9, the equipment exists essentially as it was installed.

All of the equipment associated with Hood 6 operated satisfactorily during the shakedown period. There were a great number of leaks at the tubing connections to the saran valves, however, and for this reason the cost of revising these connections has been included in the estimate.

EQUIPMENT USED ELSEWHERE: The type of wet chemistry operation that is contemplated for Task I is currently being performed in the 231 Building and in the RG Line of the 234-5 Building.

In the 231 Building the process equipment is located inside of "greenhouses" made of glass. Piping, valves, and process vessels are stainless steel. Valve handles are extended through the hood panels for manual operation. Access for maintenance is obtained by removing the necessary glass panels.

In the 234-5 Building, RG Line, process equipment is located in hoods made of stainless steel and lucite. The reactor vessels are glass. Valves and piping are stainless steel and valves are operated manually either through rubber gloves or by valve handles extended through the hood wall. Maintenance work is performed through rubber gloves.

COURSE PURSUED IN INVESTIGATION: The Superintendent of the Process Unit, Separations Section, was requested to furnish a description of the process to be used in Task I upon its activation. Based on this information which was issued as HW-23633 (see Exhibit D), design sketches were prepared to show what revisions would be required if the existing equipment were used

and what equipment would be required if a new manually operated facility were installed (Figure 1-5). Based on these design sketches, cost estimates for the various alternatives were made by the Project Services Unit of the Engineering Department. (Tables II and III, Exhibits B and C)

Supplemental information was obtained from personnel of the General Engineering Laboratory, Power and Maintenance Unit, Radiation Monitoring Unit, Separations Technology Unit Pile Technology Unit, and Operations Unit.

RESULTS: All results herein reported are specifically limited to the conditions disclosed in "Problem Under Investigation". If process selection necessitates major changes to Task I, a re-study of the problem will be required. Cost estimates of the alternatives proposed indicate that revision of the existing hoods and equipment will be less costly than providing a new greenhouse type hood. It was estimated that revision of existing equipment would cost approximately \$25,000 while providing a new greenhouse type operation would cost approximately \$90,000. (Exhibit B)

One of the larger cost items in the proposal was the removal of the existing hoods and equipment. The estimated cost is based on equipment removal in large units. It will be necessary to package the sample can balance. Careful handling of glass vessels will be required. Hoods are to be removed with the saran valves intact. The only dismantling contemplated is that necessary for simplification of handling and parts reserved for reuse. A more detailed breakdown of the elemental cost estimates comprising the basic cost estimate may be found in Exhibit C.

Maintenance costs will be roughly the same for all cases whether stainless steel or saran valves are used. (Table V) It is estimated that Electrical maintenance costs will be \$5,000/yr. higher for remote type operation. Shakedown experience indicated that the saran valves are satisfactory. General Engineering Laboratory Engineers stated that saran valves were used at Los Alamos with relatively few failures. They stressed, however, that the problem of HI corrosion was the only basis for use of saran valves in their design.

The existing Task I reactors are large enough, to process an incoming solution volume of 2.7 liters. At an estimated cost of \$1,000 the six reactor assemblies can be modified as shown on Figure 5, to increase the reactor volume sufficiently to handle a product volume of 7 liters. Information obtained from the Pile Technology Unit disclosed that utilization of larger reactors presents no critical

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mass problem in Hood 6 if at least a 24 inch reactor spacing were provided.

The purification process which will be performed in Task I can be performed with equal safety in either a remotely operated or manually operated facility. At least one operator will be required in Zone 3 for all cases. The annual cost of providing SWP clothing for an additional operator in the 234-5 Building is not significant. (Table VI)

Three reactors are adequate to handle the maximum anticipated plant production. The present reactor spacing of 18" on centers will not be adequate from a critical mass standpoint to permit simultaneous use of all six reactors. For this reason the production capacity of the present installation was based on using alternate reactors or 3 of the 6 reactors at any one time. Critical mass protection will be provided with locked sequence switches, locked valves or intermediate tanks. (Table I) In a new greenhouse installation the reactors spacing can be increased so that inter-action between vessels is no longer a problem.

SAFETY AND SPECIAL HAZARDS: The type of operation that will be performed in Task I of the RMA Line is not a particularly hazardous one. Considering only the normal industrial hazards, the operation could be performed manually or by the use of remotely operated equipment with equal safety.

Records of personnel contamination incidents in the 234-5 Building show that operation and maintenance of either a manual or remote Task I installation can be performed with equal safety. A breakdown of 170 incidents of personnel contamination within the 234-5 Building during 1950 and 1951 (Table VII) showed that 22% of these occurred in Rooms 229 and 231 which are the operating gallery of the RG Line. 29% of the incidents occurred in Zone 3 of the RG Line and were the result of equipment maintenance, contaminated waste disposal, equipment decontamination, sampling, etc. The operations which are performed in Zone 3 of the RG Line will also be required in Zone 3 of the RMA Line.

Of the 37 incidents of personnel contamination occurring in Zone 2 of the RG Line (Rooms 229 and 231), only 2 were related to Hoods 5, 6, and 7 in which the purification step of the RG Line process is performed. Both of these incidents were the result of the type of non-routine

activity that would also be required in a remotely operated facility.

The lack of contamination incidents associated with Hoods 5, 6, and 7, of the RG Line indicates that the purification step can be performed safely in a manually operated hood. In the proposed manual installation for Task I, all valve operation will be done by means of valve handles extended through the hood walls. This is an improvement over the existing RG installation. The major sources of personnel contamination, equipment maintenance, waste disposal, sampling, etc., exist in a remotely operated installation as well as in a manually operated one.

In a remotely operated installation one operator will be required in Zone 1, and one in Zone 3. In a manually operated facility both operators will be in Zone 3. This does not appear to be a great disadvantage. Room air conditions in Zone 3 of Task I are expected to be good. A sealed barrier has been erected between Tasks I and II to prevent any spread of plutonium fluoride powder from Task II to Task I should a special hazards incident occur in the vicinity of Hood 9.

NUCLEAR SAFETY: With the proposed increased batch size, the safety of using all six reactors simultaneously in the existing Task I installation from a critical mass standpoint is questionable. The reactors in the present Hood 6 are spaced at a center to center distance of 18 inches.

The problem of Nuclear Safety in Task I was discussed with the Physics Group of the Pile Technology Unit. The following statements are based on the information obtained:

1. It may be possible to use simultaneously all six existing reactors at their present spacing but this is questionable (based on the possibility of getting two runs in each of two adjacent reactors).
2. A 24 inch spacing of the reactors would probably reduce the interaction to a safe amount but the problem should be reviewed carefully during the design stage.

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3. If the proper locked sequence switches or locked valves are adjusted so that runs are never placed in adjacent vessels, the existing installation can be operated safely. This item was provided for in the cost estimate. (Exhibit C)

For the above reasons the production capacities for remote operation were based on using only three of the six reactors at any one time. For greenhouse operation the reactor spacing was increased to 24 inches.

Figure 1. TASK 1 MODIFICATION-FLOW DIAGRAM

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 TASK 1 MODIFICATION
 FLOW DIAGRAM
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 HW-24046
 SK 2-781

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Figure 2. TASK I MODIFICATION-EQUIPMENT ARRANGEMENT

TASK I MODIFICATION
EQUIPMENT ARRANGEMENT

210 11 P.M.
SEP 795

PRELIMINARY

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FRONT VIEW

Figure 3. TASK I MODIFICATION -
PROCESS PIPING

U.S. ATOMIC ENERGY COMMISSION HANFORD WORKS DIVISION OF CHEMISTRY	
PRELIMINARY Not Approved For Operation	
DESIGNATION T-100-1-100	
REVISION 1. 10/1/54	
10/1/54

4 JOPPI 7

6 BARRIER OUTLINE

PLAN

FRONT ELEV

SECRET
SECURITY INFORMATION

SK-21046

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Figure 4. TASK I MODIFICATION -
GREENHOUSE TYPE HOOD
& EQUIPMENT ARRANGEMENT

SECRET

REVISIONS		DATE	BY
SCALE: 1" = 1'-0"	APPROVALS		
DESIGN: G.M.K.	DATE: 4-1-51		
DRAWN: G.M.K.	CHECKED: G.M.K.		
FILE NO.:	PROJECT NO.:		
PRELIMINARY Not Approved For Construction			
U. S. ATOMIC ENERGY COMMISSION HANFORD WORKS GENERAL ELECTRIC			
TASK I MODIFICATION - GREENHOUSE TYPE HOOD & EQUIPMENT ARRANGEMENT			
SK-21046-16			

PROVIDE STAINLESS STEEL CAP RING

PROVIDE STAINLESS STEEL LOCK RING
DRILL THRU 6 HOLES

WELD TO EXISTING HOLES IN COVER PLATE WITH E 307 WELDING ROD
AND FINISH FLUSH WITH SIDE

REWORK TOP OF LUCITE SHIELD TO ACCOMMODATE LARGER VESSEL
TAP DRILL THRU 2 HOLES

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TASK I MODIFICATION-
ALTERATION TO
PURIFICATION VESSEL

Figure 5.

FOR-ESTIMATING-PURPOSES-ONLY

U. S. ATOMIC ENERGY COMMISSION HANFORD WORKS GENERAL ELECTRIC	
TASK I MODIFICATION ALTERATION TO PURIFICATION VESSEL	
PROJECT DRAWING NO. REV. DATE DESIGNED BY CHECKED BY SCALE: FULL SIZE	APPROVALS DATE BY TITLE
SECRET	

SK-2-782

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PAGE 1

ALTERNATIVE METHODS OF ACTIVATING TASK I

ITEM	MODIFICATION OF PRESENT EQUIPMENT		GREENHOUSE FACILITY		
	CASE A	CASE A-1	CASE B	CASE B-1	CASE B-2
LOCKED HOOD	Use Existing Hoods	Use Existing Hoods	New Hood	New Hood	New Hood
TYPE OF VALVE	Saran (S.S.) (At Boat) (Loading) (Station)	Saran	Stainless Steel	Saran (S.S.) (At Boat) (Loading) (Station)	Stainless Steel
CRITICAL MASS PROTECTION	Locked Sequence Switches	Locked Sequence Switches	Locked Valves	Locked Sequence Switches	Intermediate Tanks
OPERATOR'S LOCATION FOR REACTOR OPERATION	Zone I	Zone I	Zone 3	Zone 3	Zone 3
OPERATOR'S LOCATION FOR FILTER STATION OPERATION	Zone 3	Zone 3 Zone 1	Zone 3	Zone 3	Zone 3

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TABLE III
COST ESTIMATES SUMMARY AND COMPARISON OF
PRESENT TASK I EQUIPMENT

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>A</u>	<u>CASES</u> <u>A-1</u>
1.	Remove Sample Can Handling Facilities.	\$ 828	\$ 828
2.	Relocate Hood 8.	709	709
3.	Rework Hood 3.	270	270
4.	Relocate Desk 31	310	310
6.	Procure 4 - 30 liter S.S. Catch Tanks.	100	100
7.	Install Head Tank In Hood 5.	96	96
8.	Install Catch Tanks In Hood 7.	322	322
9.	Install Double Filtering Station In Hood 7.	360	360
10.	Fabricate and Install Duct to Hood 9.	679	679
11.c-h	Remove Cooling Coils and Rework Motor Mounts.	666	666
12.	Hood 6, Revisions.	2459	2459
13.	Revision To Process Piping.	3123	3123
16.	Remove All Saran Valves From Hood 7.	536	
17.	Procure and Install S.S. Valves For Hood 7.	443	
18.	Install Process Piping To S.S. Valves.	128	
19.	Relocate 2 Saran Valve Shelves.	292	
22-1	Revise Saran Valves Connections.	1200	1200
23.	Install Filter In Vacuum Header.	196	196
30.	Install Sampling Facilities In Hood 7.	427	427
8.(b-c)	Remove 12 Saran Valves From Hood 7. (Included in Item 8 and not required in Case A)	-192	
	SUB TOTAL	\$12,952*	\$11,745*
	Adjusted Total Project Cost Including Additives and Engineering		<u>\$25,000</u>
11.(a-d)	Cost Of Revising Reactor Unit To Provide Larger Vessel.	\$1000	\$1000

*Basic Cost Figures Include Only Direct Labor and Material Costs.

**Item Numbers Correspond To Those In Exhibit C.

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TABLE III

ESTIMATED COSTS FOR

GREENHOUSE FACILITY

	DESCRIPTION	CASES		
		B	B-1	B-2
14.	Remove All Existing Equipment From Task I, Zone 3 Area.	1,450	\$21,450	\$21,450
16.	Procure and Install Greenhouse Facility, per SK2-796.	23,489	23,489	23,489
22.	Install Saram Valves in Greenhouse with Piping.		13,300	
15.(k-n)	Procure S.S. Valves and Install Valves and Piping. (Included in Item 15 and not required in Case B-1)		-13,350	
22-1	Revise Saram Valve Connections.		1,200	
23.	Install Filter in Vacuum Header.	196	196	196
24.	Design Means for Sequencing Operation.		300	
25.	Procure and Install Sequencing Equipment.		200	
26.	Install Intermediate Hold-Up Tanks.			2,315
27.	Procure eight Valve Locks.	440		
31.	Install Sampling Facilities on Greenhouse.	620	620	620
	SUB-TOTAL	\$46,195*	\$47,405*	\$48,070*
	Adjusted Total Project Cost Including Additives and Engineering.	\$90,000	\$90,000	\$90,000
11.(a-d)	Cost of Revising Reactor Unit to Provide for Larger Vessel.	\$1,000	\$1,000	\$1,000

*Basic Cost Figures Include Only Direct Labor Charges and Material Costs.

**Item Numbers Correspond To Those In Exhibit C.

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TABLE IVDESIGN BASIS USED FOR TASK I ACTIVATION STUDY

1. Product will be received either in PR cans from Redox or through piping from Recuplex.
2. The product slurry will be collected on a filter boat at a filter boat loading station. All transfers will be made directly from the reactor to the filter boat.
3. Filter boats will be transported between Tasks I and II by means of a small conveyor enclosed in a hood.
4. Filtrate and washes will be returned through piping for processing in Recuplex.
5. All sample can handling equipment will be removed.
6. Existing reactor vessels and reactor head assemblies will be used in all cases.
7. Zone 4 maintenance work will be performed through rubber gloves or plastic mittens.
8. All material transfers between Zones 3 and 4 will be made by the plastic bag transfer procedure now in use in the RMA Line.
9. Movement of boats within the boat filtering station will be done manually.
10. A spare filtrate catch tank will be provided at the boat filtering station.
11. A pre-filter will be provided for filtering the incoming product if this proves to be necessary, and provisions will be included for backwashing the filter to a tank.
12. The graduated chemical head tank originally provided for HI measurement will be retained so that small volumes of chemicals may be measured with acceptable accuracy.
13. Existing scrubbers will not be used. The scrubber detrainment chamber will be used as a detrainment chamber for the vacuum header.

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TABLE V

TASK I MAINTENANCE COSTS AND MAINTENANCE PROBLEMS

	<u>CASE A</u>	<u>CASE A-1</u>	<u>CASE B</u>	<u>CASE B-1</u>	<u>CASE B-2</u>
Instrument Maintenance	Same For All Cases				
*Electrical Maintenance	Base + \$5000/yr.	Base + \$5000/yr.	Base	Base + \$5000/yr.	Base
**Mechanical Maintenance	Same For All Cases				

*Additional expense for remote installation covers the cost of maintaining control wiring, control switches, solenoids, etc.

**The same reactor equipment will be used in all cases. It is expected that the new greenhouse will facilitate maintenance by providing improved access and visibility, but no attempt was made to assign a dollar value to this benefit. It is estimated that maintenance work required for saran valves or stainless steel valves would be approximately the same, provided that the tubing connections to all saran valves are modified to eliminate leaks. Use of saran valves, however, requires additional solenoid operated air valves which also will require maintenance. Although mechanical maintenance has been considered the same for all cases, costs will actually be slightly higher if saran valves are used.

The existing tantalum dip tube in each reactor is welded to the reactor head assembly. Replacement of a dip tube would be extremely difficult under contaminated conditions. Damaging of a dip tube to the extent that it would require replacement, however, appears to be such a remote possibility that additional expenditure for a revision is not warranted.

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TABLE VIESTIMATED ANNUAL COST FOR PROVIDING PROTECTIVE CLOTHINGFOR ONE ADDITIONAL OPERATOR IN THE 234-5 BUILDING

(Based on 24 hr/day coverage, 7 days/week)

<u>LAUNDERING COST</u>	Estimated No. Of Pieces Laundered Per Month	Weight In Pounds Per Piece	Total Weight In Pounds Per Month
Coveralls	180	2.5	450
Shoe Covers (pr)	180	0.5	90
Canvas Gloves (pr)	180	0.125	23
Surgeon's Caps	180	0.05	9
			<u>572</u>

At a laundering cost of \$0.12/pound the annual cost would be:

$$(12) (0.12) (572) = \$825$$

Since no additional labor would be required at the laundry until the load had been increased by 5,000 pounds per month, the additional 572 lbs/month would probably only increase the over all laundry cost by the cost of the materials used which are only approximately 5% of the total or \$40 per year.

<u>REPLACEMENT COST</u>	Estimated No. Of Pieces Laundered Per Year	Average Life Of Garment In Launderings.	Replacements Per Year	Cost Of Replacements (each)	Total Annual Cost Of Replacements
Coveralls	2160	40	54	\$4.10	\$221.40
Shoe Covers (pr)	2160	12	180	0.39	70.20
Canvas Gloves (pr)	2160	12	180	0.20	36.00
Surgeon's Caps	2160	40	54	0.18	9.72
					<u>\$337.32</u>

The total additional cost, neglecting laundry labor costs, would be:

$$(\$40) + (\$337) \text{ or approximately } \$380 \text{ per year.}$$

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TABLE VII

SOURCES OF PERSONNEL CONTAMINATION

PERSONNEL CONTAMINATION INCIDENTS 234-5 BUILDING
1950 - 1951

The information shown below was compiled from follow-up sheets of the 234-5 Building Radiation Monitoring Unit. The compilation was made from the records available in the 234-5 Building and does not necessarily represent all personnel contamination incidents for the period.

LOCATION OF CONTAMINATION SOURCE

	<u>ROOMS</u> <u>227 & 228</u>	<u>ROOMS</u> <u>230 & 234</u>	<u>ROOMS</u> <u>229 & 231</u>	<u>LABS</u>	<u>*OTHER</u>	<u>TOTAL</u>
Operations	27	10	30	-	23	90
Maintenance	7	4	7	1	7	26
Technical	1	-	-	49	1	51
Patrol	-	-	-	-	2	2
Design	-	-	-	-	1	1
TOTAL	35	14	37	50	34	170

*"Other" includes the Recovery Area, Waste Storage Area, Unknown, etc.

Contamination incidents occurring in Zone 3, of the RG Line:

$$\frac{35 + 14}{170} (100) = 29\%$$

Contamination incidents occurring in Zone 2, of the RG Line:

$$\frac{37}{170} (100) = 22\%$$

The Purification step of the RG line, equivalent to Task I of the RMA Line, is performed in Hoods 5, 6, and 7. Of the 37 incidents of personnel contamination in Zone 2, of the RG Line only 2 were related to Hoods 5, 6, and 7 and both of these were the result of the type of non-routine work that would also be required in a remotely operated facility.

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EXHIBIT A

BIBLIOGRAPHY

DOCUMENTS

JP-349	"Instructions G.E.I. 34943, Remote Mechanical Line, Volume 3".
JP-345	"Instructions G.E.I. 34943, Remote Mechanical Line, Volume 2".
HW-23633	"Flow Sheet - Preliminary RM Task I on Pu (IV) Oxlate".

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EXHIBIT B

ADJUSTED COST ESTIMATES FOR TASK I REVISIONS

PROJECT COST ESTIMATES

BUILDING 234-5

WORK PERFORMANCE - BY MINOR CONSTRUCTION

<u>PROJECT</u>	<u>TASK I MODIFICATION</u>	<u>GREENHOUSE</u>
<u>Description:</u>		
Mechanical	\$10,558	\$40,000
Electrical	<u>1,250</u>	<u>5,400</u>
SUB-TOTAL DIRECT CONSTRUCTION COST	\$11,808*	\$45,400*
Adjusted Total Project Cost Including Additives and Engineering	\$25,000	\$90,000

*Sub-Total Basic Costs differ from those found in Tables II and III because of the rearrangement of cost items necessary to evaluate the various alternatives.

Estimating
Project Services
April 22, 1952

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EXHIBIT CBASIC COST ESTIMATES FOR TASK I REVISIONS

Cost estimates were made by the Project Services Unit of the Engineering Department. Only direct labor charges and material costs are shown in this exhibit.

A. TASK I MODIFICATION

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>COST OF EACH ITEM</u>	<u>REFERENCES</u>
1.	<u>Remove Sample Can Handling Facilities Zone 3</u>		H2-14710
a.	Dismantle sufficiently to remove and remove mechanical handling mechanisms.		H2-15545 H2-15645
b.	Remove attached ducts and blank vents near ceiling.		H2-15644
d.	Remove Saran Valves and piping.		JP-345
f.	Remove Solenoid Valves air tubing.		(GEI-34943)
g.	And electrical leads from source.		
h.	Remove balance, cover and protect against elements in handling and storage.		
i.	Remove air pressure reducing and regulating equipment, tubing piping,		H2-15633 JP-345
j.	and Rack.		Picture 559
k.	Detach Hoods 1, 2, 3 from each other and remove Hoods 1 and 2, and appendages thereto. (Hood 3 is to remain in place)	\$828	
2.	<u>Relocate Hood 8</u>		H2-13827
a.	Remove the two existing glass vessels from Hood 8.		H2-13528
b.	Remove Duct D-7 and Ducts 6D-3 and 6D-4. (Hold for reworking)		H2-13897
c.	Disconnect Saran tubing and air lines leading from the hood.		
d.	Move hood to new position and anchor. Connect new ducts and service piping.		Sk-2794 SK2-795
e.	Provide and install pre-filter in Hood 8.		
f.	Install six additional Saran Valves. (8 Total)		
g.	Install six additional Solenoid Valves and air lines to Saran Valves.		
h.	Install wiring to existing control desks.		
i.	Install duct connecting Hoods 8 and 5 (Rework D-7 for this).		
j.	Leave Duct D-2 attached to H-5 for future extension to other facilities.	\$709	

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<u>ITEM</u>	<u>DESCRIPTION</u>	<u>COST OF EACH ITEM</u>	<u>REFERENCES</u>
3.	<u>Rework Hood 3</u> a. Anchor in position. b. Install new duct connecting Hoods 3 and 8. c. Rework existing crane to handle 8" dia. x 12" P.R. cans and to raise and lower dip tube and stopper. d. Re-locate and invert sliding door to receive cans at lower elevation.	\$270	SK2-794 SK2-795
4.	<u>Re-locate Control Desk 31</u> a. Disconnect wiring. b. Remove desk from anchors. c. Extend Conduit and wiring. d. Anchor desk. e. Connect wiring.	\$310	SK-2-795
5.	Procure 30 SS 10 liter carrying containers and carrying jackets (M.S. Painted). (Container - 8" dia. x 12" high x 12 ga. wall dish bottom). Closed top w 2" tapered opening and teflon clamp-on type stopper; Jacket - 12" dia. x 16" x 12 ga. with cover and handles.	\$900	
6.	Procure four 30 L SS catch tanks (12" dia. x 16 x 1/8" wall) having six 1/2" pipe threaded nozzles in top.	\$100	
7.	Install 30 liter head tank in Hood 5, re-locate Saran Valves in Hood 5 per	\$ 96	SK2-794 H2-13530 H2-13822 BPF810-8#2
8.	<u>Install three 30 L Catch Tanks in Hood 7</u> a. Remove upper and lower shelves including valve in right hand end (front view). b. Remove 12 Saran Valves from H-7 Remove Saran piping - not needed. c. Remove twelve airlines and Solenoid Valves. d. Install three tanks. e. Remove electrical items not used.	\$322	H2-15602 H2-15553 H2-13821 SK2-794 BPF810-14

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ITEM	DESCRIPTION	COST OF EACH ITEM	REFERENCES
9.	<u>Install Double Filter Boat Station In Hood 7</u> a. Fabricate and install two covers with inlet line and soft gasket with raising, lowering, and clamping features. b. Socket outlet to fit boat outlet and a boat support. Jacks and linkages to seal, etc.	\$360	SK-2-781
10.	<u>Fabricate and Install Filter Boat Duct from H-7 to Top of H-9</u> a. Cut 10 x 10 hole through partition. Fabricate duct w/access ports and b. install (10 x 10 duct). c. Procure materials and install transfer cord, pulleys and hooks in duct (to pull boats back and forth through duct). d. Fabricate and install manually operated boat receiving fixture which is capable of lowering boat to peelbars of furnace "Lathe" e. Provide Filter Boat Sled w/Teflon Runners.	\$679	SK2-795 H2-15638
11.	<u>Alter Six Purification Vessels</u> a. Procure larger glass pots. b. Procure larger gaskets. c. Procure clamp ring. d. Procure, rework and alter jacket and cover, etc. as called for. e. Remove cooling coils and seal pipe openings in jacket except one. f. Provide dip tubes with blanked outlets. Install dip tube in jacket. g. Remove sharp corners on motor mounts. h. Mill edge of motor base to permit removal of R.T.D. (remote thermal detector) without removing motor base.	\$1602	SK2-782 H2-15600 H2-145A2 BPF800-165
12.	<u>Hood 6 Changes and Additions</u> a. Remove six scrubbers (1c, 2c, 3c, 4c, 5c, 6c) b. Remove six purification vessels for alteration.. c. remove slurry head vessel and agitator. d. Re-install six purification vessels. e. Install - Saran Valves in H-6.		BPH810-10 SK2-781 H 2-13818 H 2-15538

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<u>ITEM</u>	<u>DESCRIPTION</u>	<u>COST OF EACH ITEM</u>	<u>REFERENCES</u>
12.	<u>Hood 6 Changes and Additions (Cont'd)</u> f. Cut 20 3" holes in rear panels; fabricate and install 20 glove ports. g. Disconnect water piping and vessels and hood and remove all piping back to header and blank. h. Install hood drain to D-6 floor drain.	\$2459	
13.	<u>Task I Process Piping</u> a. Install Saran piping indicated for Hoods 3, 5, 6, 7, 8, Reagent vessels and valves on shelves. b. Remove all process piping, valves and vessels not needed. c. Remove Solenoid Valves and air tubing not needed. d. Re-locate air tubing and connections as required. e. Re-locate and connect Solenoid Valves as required.	\$3123	SK2-794 H2-15548- phte. 1&2
<u>B. GREENHOUSE FACILITY</u>			
14.	<u>Remove All Existing Equipment From Task I Zone 3, Area Except The Sink, And Service And Ventilation Headers</u> a. Disconnect, remove and store air pressure reducing station (Items l, j, and k.) b. Disconnect Saran lines inside and outside hoods, hold for re-use. c. Remove reactor vessels from Hood 6, (Hold for re-use). d. Remove scrubber vessels from Hood 6 and store. e. Remove air tubing inside and outside hoods. f. Remove Solenoid air control valves and regulating valves. g. Remove electrical leads from source to Solenoid valves. h. Disconnect ventilation ducts from all hoods and blank (hold ducts and parts where feasible for Greenhouse ventilation). i. Disconnect hood lights and wiring. (Hold for re-use).		

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>COST OF EACH ITEM</u>	<u>REFERENCE</u>
14.	<u>Remove All Existing Equipment etc. (Cont'd)</u> j. Remove vessels from Hood 8 and store. k. Remove balance (Hood 1) protect and store. i. Dismantle sample can handling equipment. m. Disconnect process piping ducts between hoods (H2D, H5D, H6D1, H6D2, H6D3, H6D4, and D7). n. Remove control desk 31. o. Remove Solenoid valve racks and supports. (E19, E29A, E29B) p. Remove Hoods 1, 2, 3, 5, 6, 7, and 8. q. Remove saran valves from shelves. r. Remove glass vessels from shelves on wall (Hold 5 large and 5 small vessels for re-use). s. Remove electrical distribution boxes P-106, 105-TB, 106-TB and 107-TB. t. Remove electrical conduit down to floor and cap, (except those needed for greenhouse lights and agitators).	\$21,950	
15.	<u>Procure and Install Greenhouse Facility</u> a. Procure greenhouse. b. Install greenhouse. c. Install four reactor vessels. d. Install P.R. Station facilities in P.R. Hood (Can handling and dip tube elevating means). e. Install pre-filter - 18 x 18. f. Install head tank. (30 liters) g. Install double filter boat station. h. Install filter boat conveyor to Hood O WTS. (See Item 10D). i. Install three, 30 liter catch tanks. (See Item 8). j. Install ventilation filters and ducts to existing flanges. k. Procure 100 SS quick opening (see Merco Nordstrom $\frac{1}{4}$ " gage cock) valves and valve anchors. l. Procure 100 SS extension shanks (k, l, n, includes nine spares each). m. Procure 100 SS extension shank seals. n. Install process piping, valves, valve shank seals, and valve shank extensions. o. Run electrical conduit wiring and gear to supply and control agitators and lighting. p. Install reagent vessels above Hood SK2-796. q. Extend reagent lines from ceiling to reagent vessels including nine SS valves and valve mounts.	\$23,489	SK2-796

NOTE: Items 16, 17, 18, 19 and 20 are required for comparison of two types of Hood 7 installations.

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ITEM	DESCRIPTION	COST OF EACH ITEM	REFERENCE
16.	<u>Remove All Saran Valves From Hood 7</u> a. Air and process piping. b. Saran valves. c. Solenoid valves. e. Wiring and conduit.	\$536	H2-15553
17.	<u>Procure and Install 19 SS Valves w/ext. shanks</u> through back of Hood 7 including valve mounts and shank seals at hood walls.	\$443	
18.	<u>Install Process Piping</u> in filter boat and catch tank hoods (Hood 7) to SS Valves.	\$128	
19.	<u>Relocate two Saran Valve Shelves Hood 7.</u>	\$292	
22.	<u>Install Existing 91 Saran Valves In</u> <u>Greenhouse Instead Of SS Valves</u> a. Mount Solenoid Valves. b. Mount Saran Valves. c. Connect air supply. d. Run copper tubing. e. Run Saran tubing. f. Run electrical conduit. g. Run electrical wiring or relocate existing wiring to new facility from existing control desks. (Control desks relocated to Zone 3)	\$4,428	H2-12931
22-1.	<u>Revise or Rework 200 (Approximate) Saran Valve</u> <u>Connections To Eliminate Leaking.</u>	\$1,200	
23.	<u>Procure and Install Filter</u> in present vacuum header including manometer and connections for measuring pres drop across filter.	\$ 196	
24.	<u>Design, Means For Electrically Controlling The</u> <u>Sequencing Of Operations</u> such as to prevent running more than one batch at a time into a reactor.	\$ 300-	
25.	<u>Procure and Install Sequencing Control Equipment</u> necessary to supplement or replace existing control equipment.	\$ 200	

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ITEM	DESCRIPTION	COST OF EACH ITEM	REFERENCES
26.	<u>Install Intermediate Hold Tanks In Series With Solution Transfer Lines From Pre-Filter To Each Reactor</u>		
	a. Enlarge hood to provide sufficient space for additional tanks. b. Procure four 9" ID x 18" inside depth x 7/16" wall glass vessel in lucite jacket w/ SS cover, 1 dip tube, three other nozzles- similar to SK2-782, four SS Valves, valve mounts and shank seals. c. Provide tank supports. d. Install Tanks. e. Install four mounts, valves, shanks and seals.	\$2,315	
27.	<u>Procure Eight Valve Lock-Open; Lock-Closed Locks For Product-In And Vacuum Lines, Including Linkage, Mounts Etc.</u>	\$ 440	
30.	<u>Install Sampling Facilities In Hood 7</u> a. Provide and install compartment. b. Procure and install samplers. c. Install 3 sample dip tubes and lines.	\$ 427	SK2-794
31.	<u>Install Sampling Facilities On Greenhouse</u> a. Provide and install additional Hood on main hood. b.) Same as 30 b. and c. c.)	\$ 620	

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