FEB 02 1995
55 ; Sta. 5

ENGINEERING DATA TRANSMITTAL

1. EDT 609902

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distrubtion	PFP Process Engineering	N/A
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
HC-21C/15530	W. S. Lewis	N/A
8. Originator Remarks: For Release		9. Equip./Component No.:
		10. System/Bldg./Facility: 73T/234-5Z/2Z
11. Receiver Remarks:		12. Major Assm. Dwg. No.:
		13. Permit/Permit Application No.: N/A
		14. Required Response Date:

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-CP-ES-166	1	0	Engineering Study on Conveyor System for HC-21C Project	N/A	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1		Cog.Eng. W. S. Lewis	W S Lewis	1/30/95	T5-55	Central Files (2)			L8-04	3	
1		Cog. Mgr. M. W. Gibson	M W Gibson	1/31/95	T5-55	OSTI (2)			L8-07	3	
		QA									
		Safety									
		Env.									
3		M. L. De Vries			T5-55						
3											

18.	19.	20.	21. DOE APPROVAL (if required) Ctrl. No. N/A
M. L. DeVries 1/30/95 Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	M W Gibson 1/31/95 Cognizant Manager Date	☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

RELEASE AUTHORIZATION

Document Number:	WHC-SD-CP-ES-166, REV.0
Document Title:	Engineering Study on Conveyor System for HC-21C Project
Release Date:	February 1, 1995

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Tamara Kohm, for — February 1, 1995

Chris Willingham

A-6001-400.2 (09/94) WEF256

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SUPPORTING DOCUMENT

1. Total Pages 33

2. Title	3. Number	4. Rev No.
Engineering Study on Conveyor System for HC-21C Project	WHC-SD-CP-ES-166	0

5. Key Words	6. Author
HC-21C, HA-21C, HA-23S, HA-28 Conveyor, HC-4 Conveyor, HC-3 Conveyor, HC-2 Conveyor, Seal-in, Seal-out	Name: M. L. De Vries M.L. DeVries Signature Organization/Charge Code 15530/K6018

7. Abstract

This document provides the results and discussion of a study to compare current transportation of items from HA-23S to HC-21A using the conveyor system. This study was done for the current sludge stabilization campaign project.

8. RELEASE STAMP

OFFICIAL RELEASE
BY WHC
DATE FEB 02 1995
55 Sta. 5

TABLE OF CONTENTS

OBJECTIVE

The sludge stabilization process thermally stabilizes reactive plutonium bearing materials in a muffle furnace. This process is used to prepare the material for long term storage in the vaults. The process is conducted in Room 230A and 230B. The furnaces are located in glovebox HC-21C. Glovebox HC-21A is used for preparation of the charge and packaging of the high fired oxide. The feed for the process is located through out the PRF and RMC-line gloveboxes, with over half of the feedstock currently being located in HA-23S.

For readiness assessment, the sludge stabilization process at PFP was reviewed by the ALARA team to see how the process could be improved. One suggestion was made that the conveyor system be used to transfer items from HA-23S to the process glovebox (HA-21A) instead of sealing items in and out of the gloveboxes. The following discussion describes and compares past and current methods. In addition, actions are addressed that would need to be completed before the conveyor method could be used.

The transportation of the feedstock to the process and all the different influencing factors will be examined to determine the best method.

This assessment is being performed considering only the current campaign for HC-21C. However, there is a possibility that in the future, additional furnaces will be installed and further campaigns done.

METHOD 1: SEAL-IN and SEAL-OUT

DESCRIPTION

Current mode of transferring items from HA-23S to HC-21A is by sealing items out of HA-23S, placing them in a lard can or interim transportation can, ITC, and transporting them from Room 235 into Room 230B. Transportation of the item is by hand from Room 235 to the mezzanine level and down into Room 230B where the item is sealed into glovebox HC-21A. Major tasks involved in this activity are the seal-in and seal-out.

When performing a seal-in or seal-out, the job requires at least two operators and one Radiation Control Technician (RCT). The problems that can occur during these tasks are contamination of the room and personnel due to loss of containment and excessive exposure due to handling time of the items. The following precautions are taken to minimize these concerns.

During the seal-in or seal-out, operators are on mask and dressed in the appropriate protective clothing. Masks are worn to prevent internal deposition in case of airborne contamination from breach of containment. Continuous Air Monitoring (CAM) equipment is in the room to warn if airborne contamination exists. Lead vests, which are part of the protective clothing, are worn to reduce exposure to the individual's organs and 2 pairs of ant-cees are warn to protect against skin contamination. Both activities are controlled by plant procedures ZO-170-299, SEAL OUT and ZO-170-301, SEAL IN.

DISCUSSION OF METHOD

The potential problem areas in using the seal-in and seal-out method are addressed in the following paragraphs:

EXPOSURE - From the plant records the average dose rates on the polyjars in HA-23S are 225 mrem/hr on contact and 19 mrem/hr at 30 centimeters. Estimates provided by the health physics show average time an item would be handled at the 30 cm is 5 minutes for both operators and 1 minute for a RCT. In addition, the operators and the RCT are in the work area for about two hours to perform the job and the dose rate for the general area is 10 mrem/hr. The approximate two hour job moves 3 items which include three seal-outs and three seal-ins. Calculations on attachment A show a potential to receive 4045 mrem of exposure for moving 150 items from HA-23S to HC-21A.

RISK - A major drawback using this method is an increased risk of contaminating either room 235 or 230B or personnel. Every seal-in and seal-out creates a potential situation for losing the integrity of the glovebox containment. This method's daily operation has a larger risk then the alternative conveyor method. If a contamination spread were to occur large costs are associated with decontamination and the project is set back for days depending on the extent of the spread.

WASTE - The waste produced from the seal-in and seal-out method waste is in the form of plastic bags that are disposed of as Transuranic Waste (TRU) waste. The item is double bagged and heat sealed when sealing out, with an additional bag added for transportation in a lard can. The item is sealed into the glovebox using a another plastic bag. The waste produced during the seal-in and seal-out process is sealed out and double bagged. There is a potential to produce 7 waste bags when using the seal-in and seal-out method. Waste calculations are shown in attachment A.

TIME - One factor associated with the seal-in and seal-out method is the amount of time it takes to perform the task. The actual seal-in and seal-out may only take 5 minutes per item but additional time is required in handling the item to prepare it for transportation and the actual transferring of the item from one glovebox to another. Also, contamination control measures take time such as putting the room on and off mask, and preparing the operator for the task. Total labor costs associated with this method are around $11,000 calculated on an assumption that 3 items are moved in approximately 2 hours.

COST - Large costs of this method are contributed by exposure cost for exposure taken by the worker, the worker's time, and waste cost. Additional costs could be experienced if a contamination spread occurs during a seal-out or seal-in.

METHOD 2: CONVEYOR SYSTEM

DESCRIPTION

In the past, items were moved from glovebox to glovebox by a conveyor system for time efficiency and worker safety. Glovebox HA-23S, which currently stores many feed stock items, is located in room 235 and is connected to room 230B where HC-21A is located by conveyor gloveboxes.

The conveyor configuration to move material from HA-23S to HC-21A would consist of the following conveyors. The main conveyor in Room 235, HA-28, would move the item to cross conveyor, HC-4, which connects to HC-3 conveyor in room 230C and joins to HC-2 conveyor in room 230B. See Figure 1 for location of the conveyors and rooms for the conveyor system. Currently the plant's condition does not have the ability to utilize this capability, as HA-28 does not operate properly and HC-4 and HC-3 conveyors are in large part disassembled.

CONVEYOR UPGRADES NEEDED FOR OPERATION

The following is a list of tasks that would need to be completed before the conveyor system could be implemented to transfer items from HA-23S to HC-21A.

A. TROUBLESHOOT AND REPAIR HA-28 CONVEYOR & SWEEP ARM

The HA-28 conveyor only operates in one direction and will be troubleshot for problems and then repaired. In addition, sweep arms on the conveyor will need to be repaired to aid in transporting the items from HA-23S to the conveyor. The conveyor is an older piece of equipment but parts from several other conveyors on C-line are available if needed. During repair some exposure will be taken by personnel involved with fixing the conveyor. A job control package (JCS package) will be needed to determine the problem and repair the conveyor. An Engineering Change Notice (ECN) will be needed if any modifications are made.

FIGURE 1

CONVEYOR LOCATION

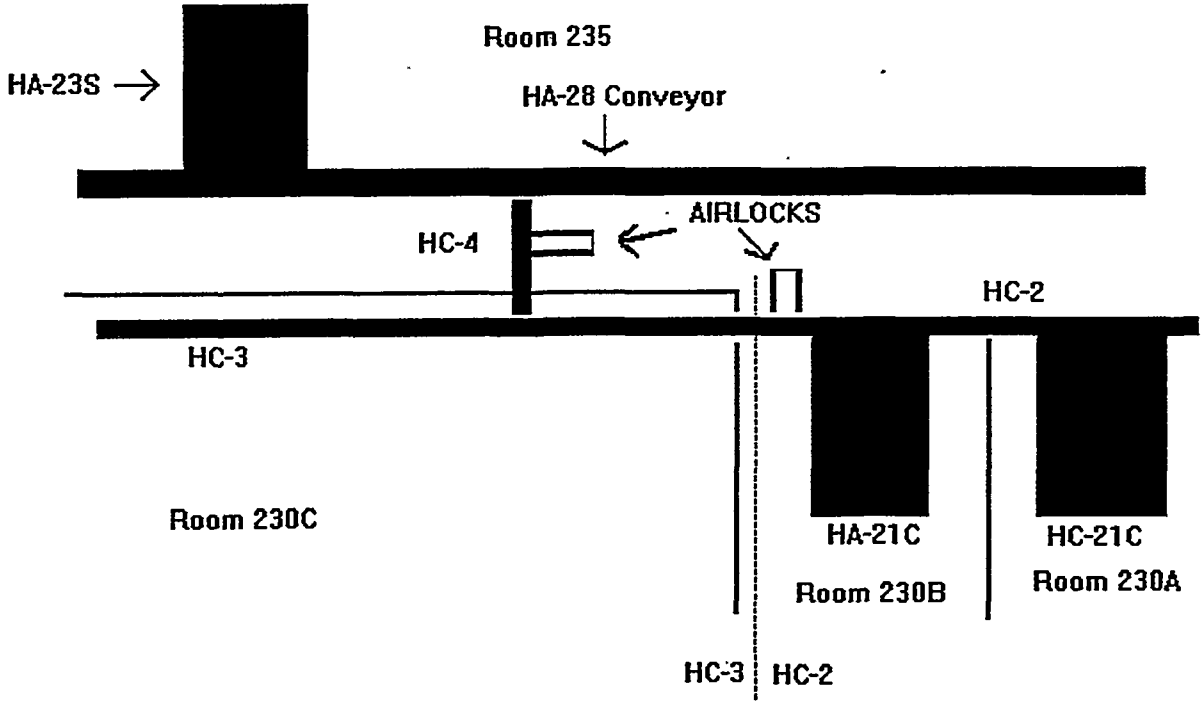


FIGURE 1

B. DESIGN MODE OF TRANSPORTING ITEM THROUGH HC-4 AND HC-3

Status of HC-3: The HC-3 conveyor was deactivated and the motor and conveyor belt removed from the glovebox. The rails that held the conveyor belt are still left in the glovebox.

Status of HC-4: The HC-4 conveyor was deactivated and only part of the rollers used for the conveyor are present. The conveyor goes through the wall and is in both Room 235 and Room 230C, making the location difficult to upgrade or repair.

To move the item through HC-4 and HC-3 there are several options:

1. Hand pass the item from HA-28 through HC-4 and HC-3 to HC-2. The approximate distance is 12 to 15 feet. Extremity exposures may increase and the risk of dropping the item does exist due to the position of the gloves and the glovebox layout. Exposure can be reduced for this option by using lead gloves for all glovebox gloves used to pass item.

2. Hand pass the item from HA-28 through HC-4 to HC-3, then place on a cart in HC-3 that runs on the old conveyor belt rails. Any number of different scenarios could be used to transport the material in HC-3.

3. Develop a simple cart or transportation system between HA-28 and HC-2 through the HC-4 and HC-3 gloveboxes.

Transportation options 2 and 3 would require a design for the equipment and a safety evaluation. Other costs incurred would be equipment cost and installation. Exposure during installation and waste from the installation would be determined by the design used for method 2 and 3. Both options would require a considerable amount of time to implement.

Options 2 and 3 are not in the cost analysis because dollar figures will be largely dependent on the exact design and option chosen. These options would be investigated further if the conveyor method is chosen.

C. OPEN HYDRAULIC AIRLOCK DOORS

There are 2 sets of airlock doors with 2 doors each in the conveyor system that will need to be removed or propped open. The first door set is located between HA-28 and HC-4 conveyors and the second is located between HC-3 and HC-2.

The airlock doors have been used by security as a protection for the Material Boundary Area (MBA). As long as MBA 213 is not a category 1 or 2 area the airlock doors are no longer needed for security reasons, allowing the doors to be left open. The airlocks do have an affect on ventilation for RMC and RMA gloveboxes. A preliminary review shows that leaving the airlock open should not cause a ventilation problem but an in depth review will need to be done before the airlocks are removed.

The doors are run by hydraulics that have been disconnected and the hydraulic fluid drained. This prohibits the airlock doors from being opened and closed by the original control panel. Potential options for opening the airlock door are:

1. Use a portable hydraulic pump to open the doors (cap drain leg) and then place a mechanical block under the doors to ensure the position of the door.

2. Disconnect the coupling on the airlock doors and open the door by hand. Would require a greenhouse and the door may be too heavy for this to work.

D. PANEL CHANGES

There are a minimal number of glovebox panels that will need to be changed before the conveyor gloveboxes could be used. The following are panels that have been identified.

1. Panel on the connection between HC-3 and HC-2 in room 230B. Dimensions are approximately 17 X 24. Relamping needs to be done in this section of glovebox.

2. Panel in room 230C on HC-3 conveyor between wall and HC-4. Dimensions are 28 X 40. May be able to change only the lead shielding and not the glovebox panel behind the shielding. Relamping needs to be done in this section of glovebox.

3. Panel in room 235 on the north side of HA-28, where HC-4 links to HA-28. Dimension of panel is 12 X 12.

D. PANEL CHANGES (cont.)

4. OPTIONAL: Panel in room 235 on south side of HA-28, where HC-4 links to HA-28. Dimension of panel is 10 X 12.

E. REACTIVATE GLOVES

Because some of these gloveboxes have not been used for several years the gloves have expired or the gloves were removed and ports pie-plated. In order to move material through these gloveboxes some gloves will have to be changed or reactivated. The original estimate shows 6 to 8 gloves but possibly up to 15.

F. REACTIVATE CPS POSTINGS ON GLOVEBOXES

Posting of the criticality limits will need to be changed to show that the gloveboxes are in an active status.

G. HOUSEKEEPING OF THE CONVEYOR GLOVEBOXES

All gloveboxes used for the transfer of items would need to cleaned out of waste and unwanted items. Also, gloveboxes may need to be relamped for visibility into the gloveboxes.

H. PROCEDURE UPDATE

Plant operating procedure(s) may need to be updated to include guidelines for using the conveyor system.

DISCUSSION OF METHOD

The potential problems in using the conveyor method are addressed in the following paragraphs:

COSTS - Costs due to this method are largely work package costs that include maintenance and operator costs to prepare the conveyor for usage. The total costs run around $ 70,000 which were figured using normal plant operating efficiency. The modification costs are one time costs. Once the conveyor is in use the operating costs are around $16,000 for 150 items. The operating costs are low due to the amount of handling time of the item and there is no waste produced except with the initial work.

Costs (cont.)

Calculations and assumptions for the modification work are shown in attachment A along with operating costs calculations that include personnel and exposure costs.

TIME FACTOR - Time is a big factor in this method since modifications would need to be done and could delay the campaign. Approximate time schedule to prepare the conveyor system for use would be 3 to 6 months and possibly longer depending on the design of a transportation system through the conveyors.

EXPOSURE - The potential exposure for performing the maintenance work and for upgrading the gloveboxes would be around 2355 mrem. The exposure for personnel transferring items is very low due to the amount of time it takes and using lead gloves in the glovebox.

RISK - Risk of contamination is greatly reduced using the conveyor method because the glovebox containment integrity is never changed when moving the item. However, there is some risk of contamination during repairs, especially panel changes. These risks would be minimized by using green houses.

CONCLUSIONS

After reviewing the above information on both transportation methods, with regards to exposure, cost, risk, and time, the seal-in/seal-out method is the favored for the current sludge stabilization campaign. The following table is a brief overview of the comparison of the calculation attachments.

Comparison		Seal-in/Seal-out	Conveyor
EXPOSURE		4045 mrem	2355 mrem
COSTS	Exposure	$64,800 - $ 80,900	$37,700 - $47,100
	Waste	$18,400	$12,000
	JCS (3 packages)	N/A	$67,500
	Operating Costs	N/A	$ 16,300
	Personnel Costs	$ 11,200	$ 5,300
TOTAL COSTS		$ 94,400 - $110,500	$138,800 - $148,200

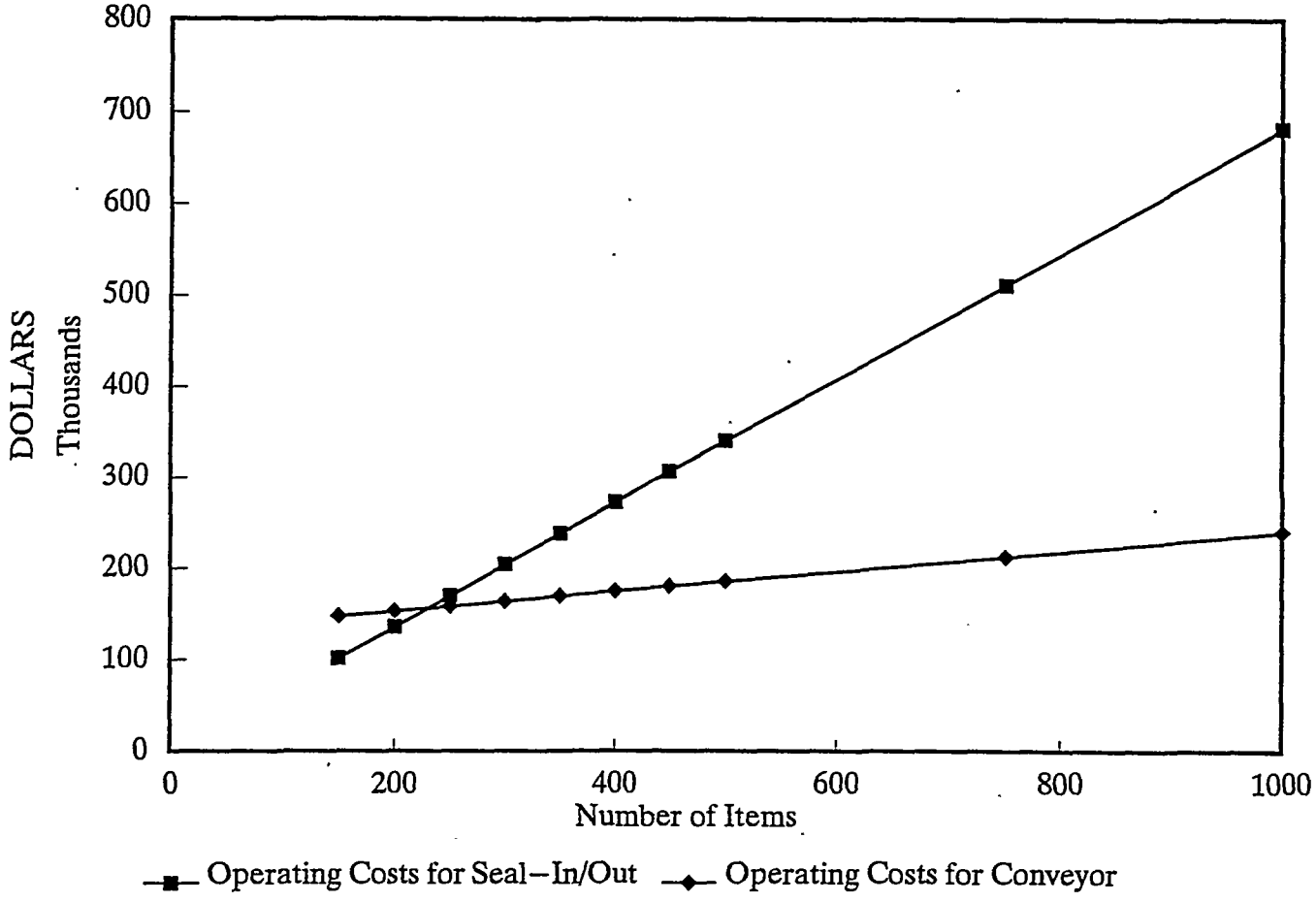
The current campaign has a deadline date for completion of processing the items identified for the campaign. With the conveyor method, an allotment a time is needed up front to get the system up and operating, making this method impossible to use if the campaign is going to be completed by the deadline.

The exposure for the seal-in and seal-out method will be higher than the conveyor but measures are taken to reduce dose to the worker. By implementing the conveyor method for future campaigns, dose to the operating personnel should decrease.

Overall costs are still cheaper using the seal-in/seal-out method for the current campaign. If additional items were added to the campaign or additional campaigns were done, the conveyor method should be considered from a cost standpoint. A projected cost was done by increasing the number of items to be processed and calculating the cost. The projected cost analysis shows that if the project were to process 100+ more items, (250 items total from HA-23S), the conveyor system would be favored from a cost perspective. See attachment B for the projected calculations of the operating expenses for both methods when processing 250 items and a table for number of items verse cost. Figure 2, shows the comparison of between the conveyor and seal-in/out operating costs when the amount of items is varied in a graph form.

FIGURE 2

TOTAL COST vs. ITEMS

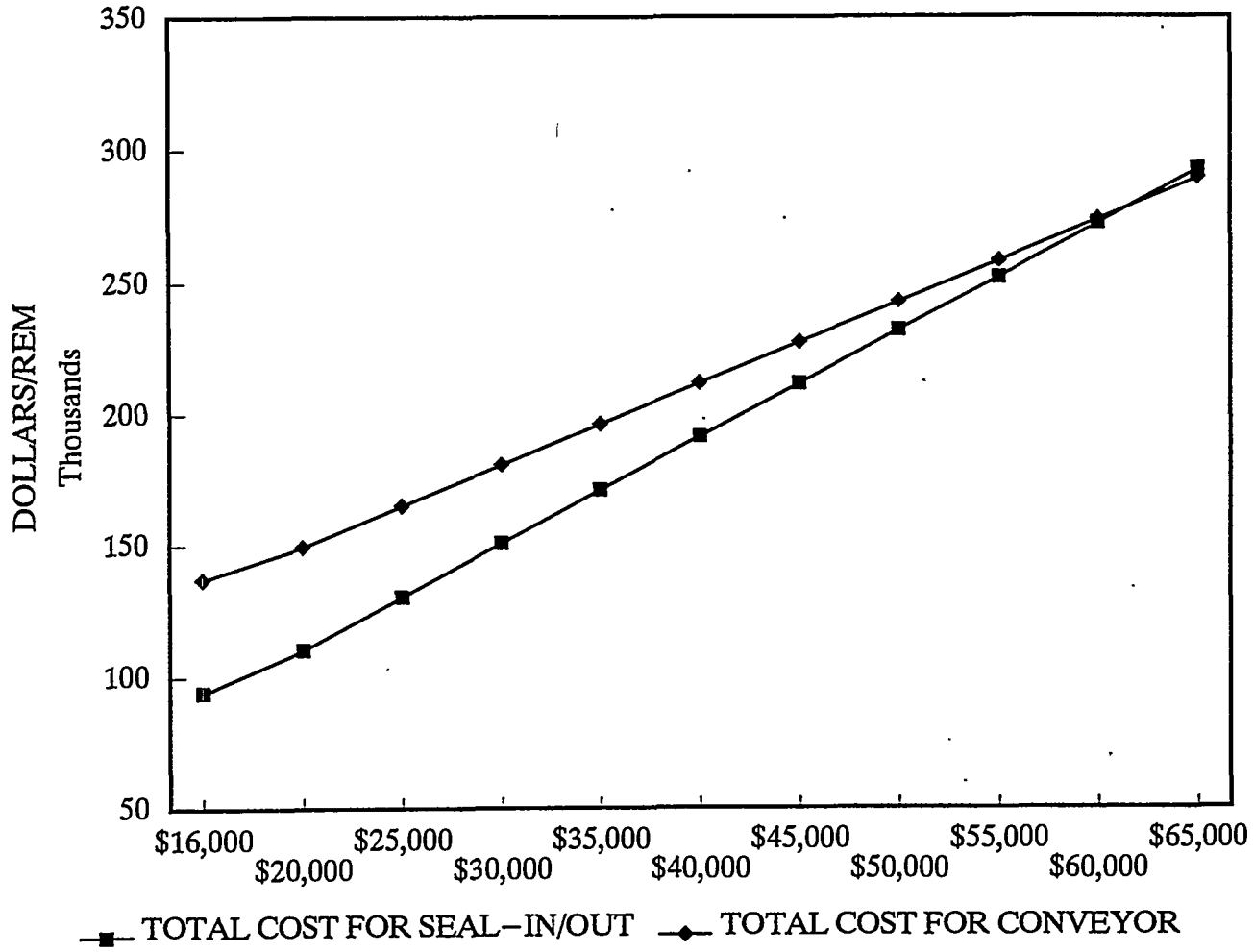


CONCLUSIONS (con.)

One variable that could greatly affect the costs analysis is the cost per rem of exposure received by plant personnel. The average the cost per rem is between $16,000 and $20,000 and this figure was used for the cost analysis. Additional calculations found in attachment B were completed using several different cost per rem figures. Figure 3 demonstrates how as the cost per rem increases the cost of the seal-in and seal-out method becomes more costly for 150 items than the conveyor method. In exceptional cases, the figure of $65,000 per rem may be valid but generally the cost per rem is lower.

FIGURE 3

COST/REM vs. TOTAL COST



RECOMMENDATION

The seal-in and seal-out method should be used for the current campaign or until conveyor system is repaired (if future campaigns are identified.)

For future campaigns the conveyor method should be used. The conveyor would reduce operating costs and lower personnel exposure due to the reduced amount of time needed for handling the items. Using the conveyor method also lowers the risk of a contamination spread and internal depositions. All these factors add up to increasing the operating efficiency of the project and the safety to the worker.

ATTACHMENT A

ATTACHMENT B

COST CALCULATIONS FOR SEAL-IN AND SEAL-OUT METHOD

ASSUMPTIONS:

150 Items for transferring from HA-23S to HA-21A

* Personnel involved are 2 operators and 1 RCT
* Dose Rates on the Polyjars:
  CONTACT – 225 mrem/hr
  At 30 cm – 19 mrem/hr
* Dose Rates in Rooms:
  General field – 10 mrem/hr
* Workers Cost per Rem $ 16000 to 20000
* All Charge out rates include a functional overhead only.
  (Overhead for PFP 19.8% except RCTs are 32%)

Union:

Operators $36.07
RCT $39.11

OPERATOR COSTS/EXPOSURE

Time for sealout/sealin = 5 minutes at 30 cm
3 Number of items done during one operation
2 hours in general dose field during operation

*EXPOSURE CALCULATION PER OPERATOR

Exposure Time – 5 minutes 475 mrem/operator
General Exposure –2 hours 1000 mrem/operator

* COST CALCULATION PER OPERATOR

Exposure Time –5 minutes $7,600 to $9,500 /Operator
Exposure Time – 2 hours $16,000 to $20,000 /Operator

RT COSTS/EXPOSURE

Time for sealout/sealin = 1 minutes at 30 cm
3 Number of items done during one operation
2 hours in general dose field during operation

*EXPOSURE CALCULATION PER OPERATOR

Exposure Time – 1 minutes 95 mrem/RCT
Exposure Time – 2 minutes 1000 mrem/RCT

* COST CALCULATION PER OPERATOR

Exposure Time – 1 minutes $1,520 to $1,900 /RCT
Exposure Time– 2 hours $16,000 to $20,000 /RCT

TOTAL COSTS FOR EXPOSURE

* 2 Operators and 1 RCT

TOTAL Exposure = 4045 mrem
TOTAL Cost = $64,720 to $80,900

COST CALCULATIONS FOR SEAL-IN AND SEAL-OUT METHOD (cont.)

PERSONNEL COST

Assumptions:

* 3 Items sealed out at one time.
* 2 Hours average time taken for a total job
* 50 Number of seal-outs/seal-ins

Operator Cost for Two:

Number of Hours =	200 hours
Labor Cost =	$7,214

RCT Cost:

Number of Hours =	100 hours
Labor Cost =	$3,911

TOTAL COST =	$11,125

TOTAL COST CALCULATIONS FOR SEAL-IN AND SEAL-OUT METHOD	
Average Exposure Costs =	$72,810
Waste Costs =	$18,364
Personnel Costs =	$11,125
TOTAL COSTS =	$102,299

WASTE CALCULTIONS

Seal-In and Seal-Out Method

ASSUMPTIONS:

*	150	Items to be transferred from HA-23S to HA-21A
*	7	Number of bags to Waste for Seal-in and Seal-out
*	75	Estimated Number of Bags per Waste Drum
*	$178.46	Disposal Cost per cubic foot of Waste
*	$1,311.68	Disposal Cost per Waste Drum

Total Costs for Seal-In and Seal-Out Waste
$18,363.53

Conveyor Method

ASSUMPTIONS:

*	15	Number of Disposal for Gloves
*	3	Number of Panels
*	3	Greenhouse
*	1	Standard Waste Box needed for waste
*	$178.46	Disposal Cost per cubic foot of Waste
*	$11,994.30	Disposal Cost per Standard Box

Total Costs for Conveyor Method Waste
$11,994.30

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION

ASSUMPTIONS:

* 3 Panel Changes for Preparing conveyor Gloveboxes
* Reactivate Gloves
* Personnel involved are listed under the Activity
* Dose Rates in Rooms:
  - General field – 10 mrem/hr
* Workers Cost per Rem $ 16000 to 20000
* Doserates for performing maintenance on the following activites are included
  1. Troubleshooting/Repair of the HA–28 Conveyor
  2. Removing the airlock doors

ACTIVITES:

* INSTALL GREENHOUSE

PERSONNEL: 2 Operators
TIME: 2 hours
NUMBER: 3 Greenhouses

– Exposure per Activity
120 mrem
– Cost Calulation
$1,920 to $2,400

* REMOVE GREENHOUSE

PERSONNEL: 2 Operators
TIME: 2 hours
NUMBER: 3 Greenhouses

– Exposure per Activity
120 mrem
– Cost Calulation
$1,920 to $2,400

* PANEL CHANGE

PERSONNEL: 2 Operators, 1 RCT, 2 Maintenance
TIME: 3 hours
NUMBER: 3 Panel Changes

– Exposure per Activity
450 mrem
– Cost Calulation
$7,200 to $9,000

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION (cont.)

* REACTIVATE GLOVES
  - PERSONNEL: 2 Operators and 1RCT
  - TIME: 30 minutes
  - NUMBER: 15 Gloves

  – Exposure per Activity
    225 mrem
  – Cost Calulation
    $3,600 to $4,500

* TROUBLE SHOOT AND REPAIR HA–28
  - PERSONNEL: 2 Maintenance, 1 Operator and 1RCT
  - TIME: 40 hours – both maintenance
    16 hours – operator
    8 hours – RCT
  - TOTAL: 64 hours

  – Exposure per Activity
    640 mrem
  – Cost Calulation
    $10,240 to $12,800

* AIRLOCK DOORS
  - PERSONNEL: 2 Maintenance, 2 Operators and 1RCT
  - TIME: 40 hours – both maintenance
    32 hours – both operators
    8 hours – RCT
  - TOTAL: 80 hours

  – Exposure per Activity
    800 mrem
  – Cost Calulation
    $12,800 to $16,000

* TOTALS
  – Exposure Calculation
    2355 mrem
  – Cost Calulation
    $37,680 to $47,100

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION (cont.)

JCS PACKAGE COSTS

ASSUMPTIONS:

* 3 Number of work packages needed for the Conveyor method
* Work Package Scope:
  - Open up both airlock doors on the conveyor system
  - Perform three panel changes
  - Trouble shoot and repair the HA-28 conveyor and sweep arm from HA-23S
* All Charge out rates include a functional overhead only.
  (Overhead for PFP 19.8% except RCTs are 32%)

Exempt	$44.16
Non-exempt	$22.62
Union:	
Material Control	$35.80
Maintenance/Operators ..	$36.07
RCT	$39.11

Package Preparation	
* Average hours for package preparation	
47 hours schedule/planning (exempt)	
2.75 hours work control engineer (exempt)	
2 hours work control clerk (non-exempt)	
8 hours material control people (material control union)	
Functional Cost =	$2,528.60
TOTAL Costs =	$7,585.80

Engineering	
- Airlock Doors	150 hours
- Panel Changes	100 hours
- HA-28	200 hours
Total Hours of Eng =	450 hours
Cost for Engineering =	$19,872.00

Work Package Completion			
- Maintenance work			
* Airlock Doors:	2 Millwrights	20 hours	
* Panel Changes:	(Estimation for 3 Panel Changes)		
	1 Boilermaker	10 hours	
	2 Sheetmetal	15 hours	
	3 Ironworker	5 hours	
	1 Pipefitter	20 hours	
* HA-28:	2 Millwrights for	20 hours	
TOTAL Maintenance Hours =		155 hours	
TOTAL Maintenance Costs =	$5,590.85		

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION (cont.)

– Operators		
* Airlock Doors:	2 for	16 hours
* Panel Changes:	3 for	100 hours
* HA-28:	1 for	16 hours
TOTAL Operator Hours =		348 hours
TOTAL Operator Costs =		$12,552

– Radiation Tech		
* Airlock Doors:	1 for	8 hours
* Panel Changes:	3 for	100 hours
* HA-28:	1 for	8 hours
TOTAL RCT Hours =		316 hours
TOTAL RCT Costs =		$12,359

– Miscellounous Support		
1 QC	10 hours	
1 QA	15 hours	
1 ECO	5 hours	
1 Safety	15 hours	
TOTAL HOURS =	45 hours	
Cost =	$1,987.20	

WORK COMPLETION COSTS for 3 work packages:	
TOTAL Maintenance Costs =	$5,591
TOTAL Operator Costs =	$12,552
TOTAL RCT Costs =	$12,359
TOTAL Miscellounous Costs =	$1,987
TOTAL COSTS =	$32,489

MATERIAL COSTS FOR CONVEYOR	
– The following materials are going to be used for the conveyor upgrades, detailed costs were not determined but a general cost was estimated. Greenhouse materials Lenxon panels Parts for conveyor Parts for airlock doors	
– Estimated material costs for 3 work packages	$7,500

TOTAL JCS COSTS FOR CONVEYOR UPGRADES:	
Package Preparation	$7,586
Engineering	$19,872
Work Package Completion	$32,489
Material Costs for Conveyor	$7,500
TOTAL	$67,447

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION (cont.)

PERSONNEL COSTS FOR CONVEYOR HOUSEKEEPING AND GLOVE CHANGES

* REACTIVATE GLOVES

PERSONNEL:	2 Operators 1 RCT
TIME:	30 minutes
NUMBER:	15 Gloves

Total Operator Hours =	15 hours
Total Operator Costs =	$541
Total RCT Hours =	7.5 hours
Total RCT Costs =	$293
TOTAL COSTS =	$834

* HOUSEKEEPING OF THE CONVEYOR GLOVEBOXES

PERSONNEL:	2 Operators 1 RCT
TIME:	40 hours

Total Operator Hours =	80 hours
Total Operator Costs =	$2,886
Total RCT Hours =	40 hours
Total RCT Costs =	$1,564
TOTAL COSTS =	$4,450

TOTAL PERSONNEL COSTS	
Housekeeping Costs =	$4,450
Glove Change Costs =	$834
TOTAL =	$5,284

COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION (cont.)

PERSONNEL AND EXPOSURE COSTS FOR CONVEYOR OPERATION

Assumptions:

* 15 Minutes to transfer one item
* 2 Operators per item transfer
* 150 Items to be transferred

Operator Cost for Two:

Number of Hours =	75 hours		
Labor Cost =	$2,705		

Exposure Costs for Two Operators:

Number of Hours =	750 mrem/hr		
Costs =	$12,000	to	$15,000
Average Exposure Costs =	$13,500		

TOTAL OPERATING FOR CONVEYOR	
Personnel Costs =	$2,705
Exposure Costs =	$13,500
TOTAL OPERATING COSTS	$16,205

TOTAL COST CALCULATIONS FOR CONVEYOR PREPARATION/OPERATION	
Average Exposure Costs =	$18,840
Waste Costs =	$11,994
JCS Package Completion Costs =	$67,447
Personnel Costs =	$5,284
Operation of Conveyor =	$16,205
TOTAL COSTS =	$119,771

FUTURE COST CALCULATIONS FOR SEAL-IN AND SEAL-OUT METHOD

ASSUMPTIONS:

250 Items for transferring from HA-23S to HA-21A

* Personnel involved are 2 operators and 1 RCT
* Dose Rates on the Polyjars:
  CONTACT – 225 mrem/hr
  At 30 cm – 19 mrem/hr
* General Field Dose Rate in this RMA/RMC area is 10 mrem/hr
* Workers Cost per Rem $ 16000 to 20000
* All Charge out rates include a functional overhead only.
  (Overhead for PFP 19.8% except RCTs are 32%)

Union:
Operators $36.07
RCT $39.11

OPERATOR COSTS/EXPOSURE

Time for sealout/sealin = 5 minutes at 30 cm
3 Number of items done during one operation
2 hours at general exposure for operation

*EXPOSURE CALCULATION PER OPERATOR

Exposure Time – 5 minutes	792 mrem/operator
General Exposure Time – 2 hours	1667 mrem/operator

* COST CALCULATION PER OPERATOR

Exposure Time –5 minutes	$12,667	to	$15,833 /Operator
Exposure Time– 2 hours	$26,667	to	$33,333 /Operator

RT COSTS/EXPOSURE

Time for sealout/sealin = 1 minute at 30 cm
3 Number of items done during one operation
2 hours at general exposure for operation

*EXPOSURE CALCULATION PER OPERATOR

Exposure Time – 1 minutes	158 mrem/RCT
General Exposure Time – 2 hours	1667 mrem/RCT

* COST CALCULATION PER OPERATOR

Exposure Time – 1 minutes	$2,533	to	$3,167 /RCT
Exposure Time – 2 hours	$26,667	to	$33,333 /RCT

TOTAL COSTS FOR EXPOSURE

* 2 Operators & 1 RCT Total Exposure

TOTAL Exposure =	6742 mrem		
TOTAL Cost =	$107,867	to	$134,833
Average TOTAL Cost =	$121,350		

PERSONNEL COST

Assumptions:

* 3 Items sealed out at one time.
* 2 Hours average time taken for a total job
* 83 Number of seal–outs/seal–ins

Operator Cost for Two:

Number of Hours = 333 hours
Labor Cost = $12,023

RCT Cost:

Number of Hours = 167 hours
Labor Cost = $6,518

TOTAL PERSONNEL COST =	$18,542

WASTE CALCULTIONS

ASSUMPTIONS:

* 250 Items to be transferred from HA–23S to HA–21A
* 7 Number of bags to Waste for Seal–in and Seal–out
* 75 Estimated Number of Bags per Waste Drum
* $178.46 Disposal Cost per cubic foot of Waste
* $1,311.68 Disposal Cost per Waste Drum

Total Costs for Seal–In and Seal–Out Waste
$30,605.89

TOTAL PROJECTED COSTS FOR AN ADDITIONAL 100 ITEMS (250 Total Items):

* Exposure Cost =	$121,350
* Personnel Cost =	$18,542
* Waste Cost =	$30,606
TOTAL COST =	$170,498

FUTURE COST CALCULATIONS FOR CONVEYOR METHOD

* INITIAL INVESTMENT COST FOR THE CONVEYOR = $132,000

ASSUMPTIONS:

250 Items for transferring from HA-23S to HA-21A

* Personnel involved are 2 operators
* General Field Dose Rate in this RMA/RMC area is 10 mrem/hr
* Workers Cost per Rem $ 16000 to 20000
* All Charge out rates include a functional overhead only.
  (Overhead for PFP 19.8% except RCTs are 32%)

Union:

Operators $36.07

PERSONNEL AND EXPOSURE COSTS FOR CONVEYOR OPERATION

Assumptions:

* 15 Minutes to transfer one item
* 2 Operators per item transfer

Operator Cost for Two:

Number of Hours = 125 hours
Labor Cost = $4,509

Exposure Costs for Two:

Number of Hours = 1250 mrem/hr
Costs = $20,000 to $25,000
Average Exposure Costs = $22,500

TOTAL OPERATING and TOTAL COSTS FOR CONVEYOR	
Personnel Costs =	$4,509
Exposure Costs =	$22,500
TOTAL OPERATING COSTS =	$27,009
*TOTAL COSTS =	$159,009

NOTE * – Total cost includes initial cost of conveyor upgrade.

TABLE FOR ITEMS VERSE COST GRAPH

NUMBER OF ITEMS	CONVEYOR OPERATION COSTS/*TOTAL COSTS		SEAL-IN/OUT OPERATION COSTS
150	$16,200	$148,200	$102,300
200	$21,700	$153,700	$136,400
250	$27,100	$159,100	$170,500
300	$32,500	$164,500	$204,600
350	$37,900	$169,900	$238,700
400	$43,300	$175,300	$272,800
450	$48,700	$180,700	$306,900
500	$54,100	$186,100	$341,000
750	$81,100	$213,100	$511,500
1000	$108,100	$240,100	$682,000

NOTE * – Total cost includes initial cost of conveyor upgrade.

EXPOSURE CALCULATIONS

Basis:

* 150 Items for transferring from HA-23S to HA-21A

OPERATOR COSTS/EXPOSURE FOR SEALIN/OUT:

Time for sealout/se 5 minutes at 30 cm
3 Number of items done during one operation
2 hours in general dose field during operation

*EXPOSURE CALCULATION PER OPERATOR

Exposure Time-5 mins	475 mrem/operator
General Exposure-2 hrs	1000 mrem/operator
TOTAL Exposure =	1475 mrem/operator

RCT COSTS/EXPOSURE FOR SEALIN/OUT

Time for sealin/out 1 minutes at 30 cm
3 Number of items done during one operation
2 hours in general dose field during operation

*EXPOSURE CALCULATION PER RCT

Exposure Time - 1 minutes	95 mrem/RCT
Exposure Time - 2 minutes	1000 mrem/RCT
TOTAL Exposure =	1095 mrem/RCT

TOTAL EXPOSURE COSTS FOR SEALIN/OUT

* 2 Operators and 1 RCT

TOTAL Exposure =	4045 mrem

EXPOSURE COST FOR SEAL-IN AND SEAL-OUT TABLE:

* Exposure Cost is based on 150 Items

$/REM	OPERATOR (2) EXPOSURE COST	RCT EXPOSURE COST	TOTAL EXPOSURE COST	TOTAL COST
$16,000	$47,200	$17,520	$64,720	$94,320
$20,000	$59,000	$21,900	$80,900	$110,500
$25,000	$73,750	$27,375	$101,125	$130,725
$30,000	$88,500	$32,850	$121,350	$150,950
$35,000	$103,250	$38,325	$141,575	$171,175
$40,000	$118,000	$43,800	$161,800	$191,400
$45,000	$132,750	$49,275	$182,025	$211,625
$50,000	$147,500	$54,750	$202,250	$231,850
$55,000	$162,250	$60,225	$222,475	$252,075
$60,000	$177,000	$65,700	$242,700	$272,300
$65,000	$191,750	$71,175	$262,925	$292,525

EXPOSURE CALCULATIONS (cont.)

TOTAL EXPOSURE FOR UPGRADE TO THE CONVEYOR

– Exposure Calculation

2355 mrem

EXPOSURE COSTS FOR CONVEYOR OPERATION

Assumptions:

* 15 Minutes to transfer one item
* 2 Operators per item transfer
* 150 Items to be transferred

Exposure Costs for Two Operators:

Number of Hours = 750 mrem/hr

CONVEYOR EXPOSURE COSTS TABLE:

* Exposure Cost is based on 150 Items

$/REM	UPGRADE COSTS	OPERATING COSTS	TOTAL EXPOSURE COSTS	TOTAL COSTS
$16,000	$37,680	$12,000	$49,680	$137,180
$20,000	$47,100	$15,000	$62,100	$149,600
$25,000	$58,875	$18,750	$77,625	$165,125
$30,000	$70,650	$22,500	$93,150	$180,650
$35,000	$82,425	$26,250	$108,675	$196,175
$40,000	$94,200	$30,000	$124,200	$211,700
$45,000	$105,975	$33,750	$139,725	$227,225
$50,000	$117,750	$37,500	$155,250	$242,750
$55,000	$129,525	$41,250	$170,775	$258,275
$60,000	$141,300	$45,000	$186,300	$273,800
$65,000	$153,075	$48,750	$201,825	$289,325