SEQUOYAH FUELS
CORPORATION

REPORT No. 3

TECHNIQUE FOR LIQUID DECONTAMINATION OF EQUIPMENT

This report is prepared and submitted as a Task 1 requirement in accordance with contract DE-AC06-83RL10382.

U. S. Department of Energy
Richland Operations Office
P. O. Box 550
Richland, Washington 99352

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INDEX

I. EXECUTIVE SUMMARY

Sequoyah Fuels Corporation is in the process of decommissioning the Cimarron Facility's mixed oxide (Pu-U) fuel fabrication plant. This operation has called attention to the need for economical methods of removing radioactive contamination from the internal surfaces of gloveboxes and the process equipment contained in the gloveboxes. Methods which effectively remove contamination without generating excessive volumes of contaminated cleaning solutions and wiping materials for disposal are actively being sought.

Sequoyah fuels, in an attempt to reduce decontamination costs, has modified two existing ion exchange systems which were used in the production process. These systems used plutonium nitrate as feed solution, and as a result, still showed high levels of radioactivity when the modifications were made. The modifications to the systems consisted of the following: (1) filters were added ahead of the resin columns to filter out the solids and (2) the resin was changed from acid Dowex 4 to basic Dowex 21K for use with strong basic cleaning solutions having a pH in the range of 11-12.

The results of the first ten batches processed indicate that filtration and ion exchange of these decontamination solutions is an effective way to reduce levels of radioactivity and that significant economic benefits can be realized by this process. These savings result from reducing levels of radioactivity from transuranic (T.R.U.) levels which is greater than 100 nanocuries per gram to low specific activity (L.S.A.) levels.

An additional system has been assembled which has proven to be effective for processing mop and scrub water. This system effectively reduces most of the solutions to releasable levels. The remainder is solidified as L.S.A. waste.

II. INTRODUCTION

The eventual retirement of radioactive contaminated facilities will involve the decontamination of large areas and quantities of contaminated tooling, equipment and building surfaces. This will require expensive handling, storage and ultimate permanent geologic disposal , particularly for those facilities contaminated with transuranic elements. The nuclear industry is exploring ways to develop cost effective washing methods and processes to remove surface contamination and also to reduce the volumes of contaminated cleaning solutions.

Liquid decontamination methods which use chemical cleaning agents such as solvents, detergents, soaps, phosphates and acids along with steam have long been the standard methods in most facilities. These methods are reasonably effective, but have the disadvantage of generating volumes of contaminated liquid waste solutions which must be neutralized and solidified for permanent disposal.

Sequoyah Fuels has applied the principals of filtration and ion exchange to reduce the volume of the contaminated cleaning solutions. This system effectively traps the solids in the filter media and the dissolved radioactive metals are captured by the ionized resin bed. Some of the waste solutions contaminated to high levels of radioactivity are made suitable for release and the remainder are reduced to L.S.A. waste levels for more economical disposal methods.

The filter and ion exchange media used to collect the radioactive material into a small volume is disposed of as T.R.U. waste.

III. PROCESS EQUIPMENT DESCRIPTION

The IX system for cleanup of decontamination solutions is illustrated in Figure 1. The apparatus is part of the original equipment installed in the plant for reprocessing coprecipitated mixed oxide scrap material. The apparatus is contained in three gloveboxes and a group of nuclear safe storage stand pipes. The piping network and gloveboxes are equipped with the same safety shutdown system which was applicable for the process solutions used during production to prevent overflow and leaks into the glovebox floor.

The modifications to the system are the addition of two 2 - micron sock type filters and one 0.75 micron cartridge type filter. These filters remove debris and solids from the liquid and most of the radioactivity. The resin for the production application was (acid) cation Dowex 4. Since the cleaning solution is basic, pH 11-12, the resin has been changed to Dowex 21K for anion exchange.

The system performs reasonably well, but is inconvenient to operate because of the different locations of the various pieces of equipment. If the system was being reconstructed for the present application of filtration and ion exchange of decontamination solutions, the arrangement of equipment would be more centrally located for convenience.

The mop and scrub water system is a cart-mounted pump and filter arrangement that connects to a holding tank, single IX column, flow meter and 55 gallon drum. The system is assembled using tygon tubing. Operation of this equipment is outlined in detailed procedure KM-NP-36-19 which states the conditions of operation. This system effectively reduces low level (L.S.A.) waste liquids to releasable levels suitable for discharge to the sanitary lagoon.

IX SYSTEM FOR CLEAN UP OF GLOVEBOX DECON SOLUTIONS

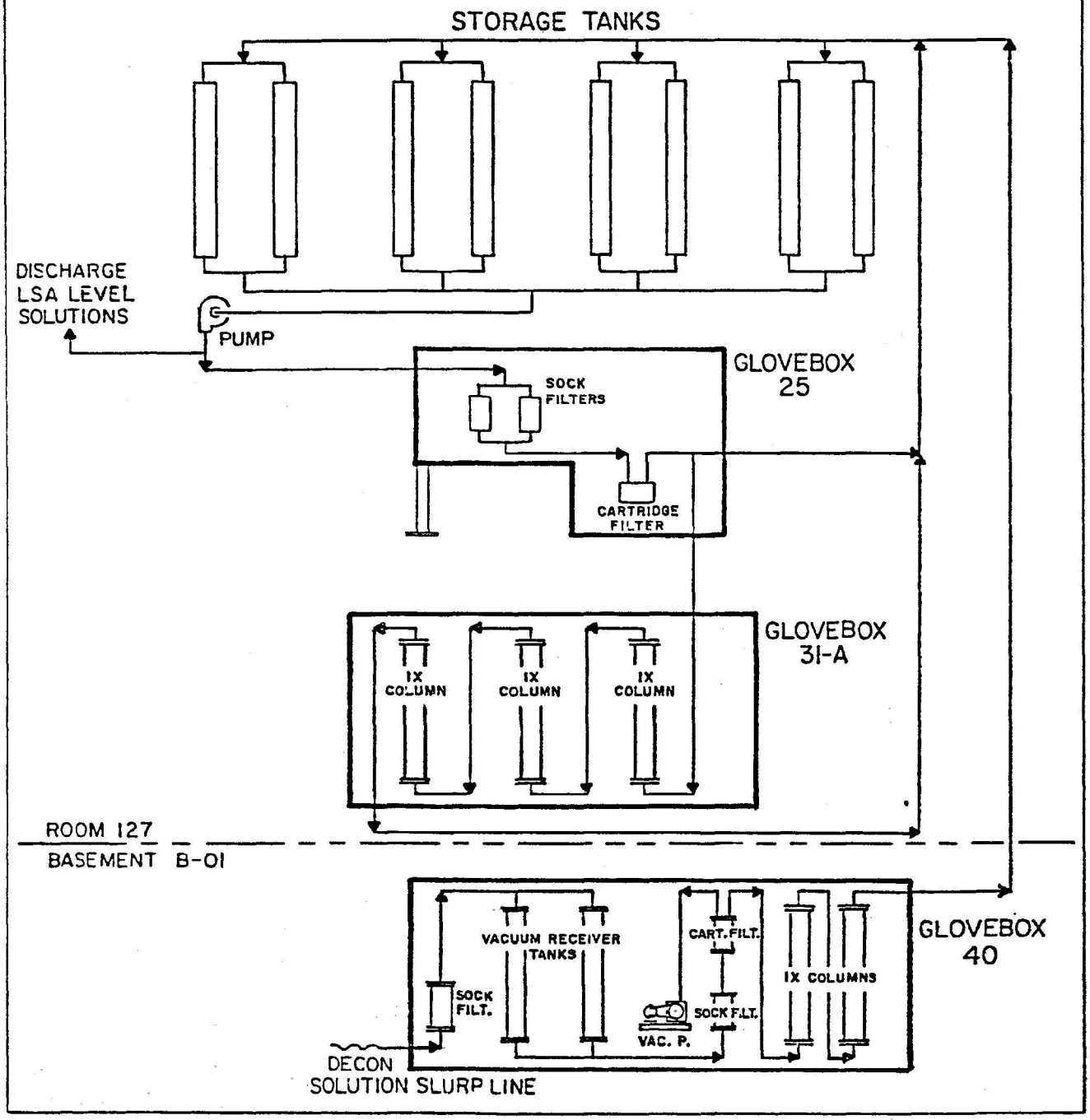
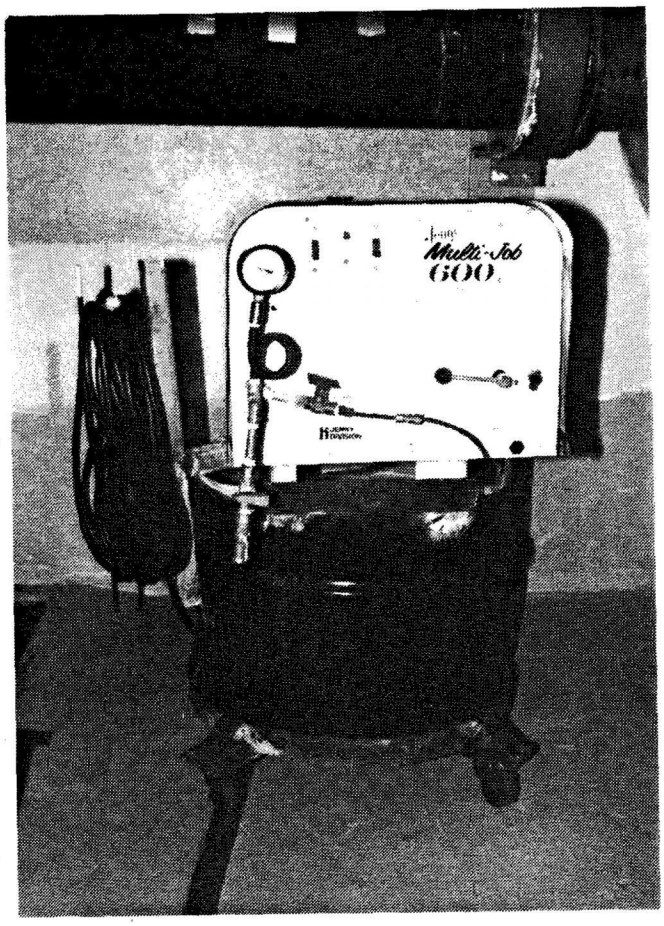


Figure 1

IV. DECONTAMINATION SOLUTIONS USED

The decontamination solution consists of: .1 pound of Truco (Trade name) Powr-Steam and .1 pound of soda ash per gallon of water. The chemistry is adjusted to a pH of 11 to 12, as required, with a sodium hydroxide solution made up of 1 pound sodium hydroxide dissolved in one gallon of water. The pH adjustment is usually required only when acid residues are encountered in the process of cleaning glovebox internals and machinery.

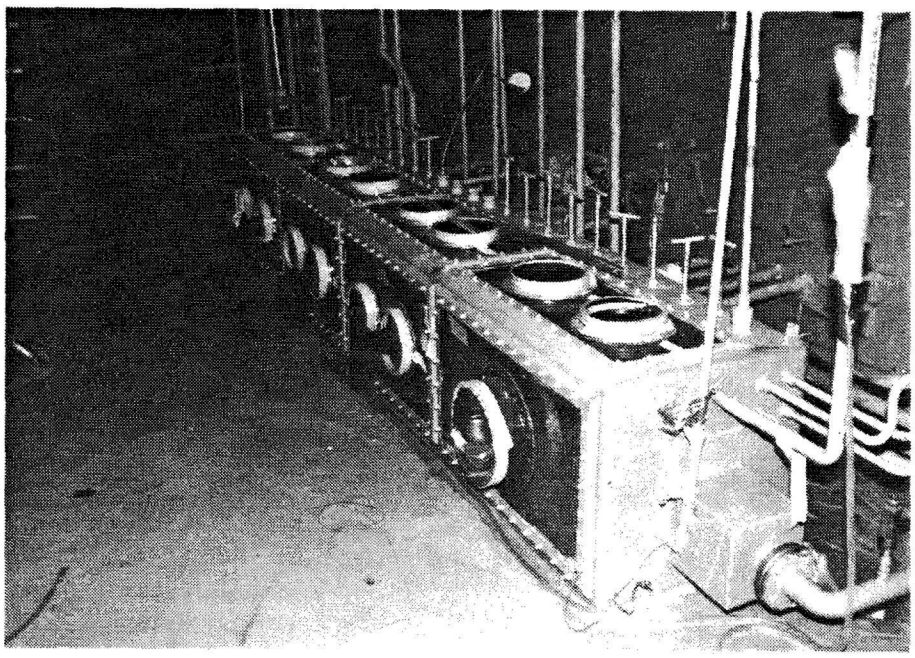
The cleaning equipment which is used in conjunction with the cleaning solution is a Model 600 Jenny Multi-Job Combination Steam Cleaner and Power Washer manufactured by Homestead Industries, Coreopolis, PA.



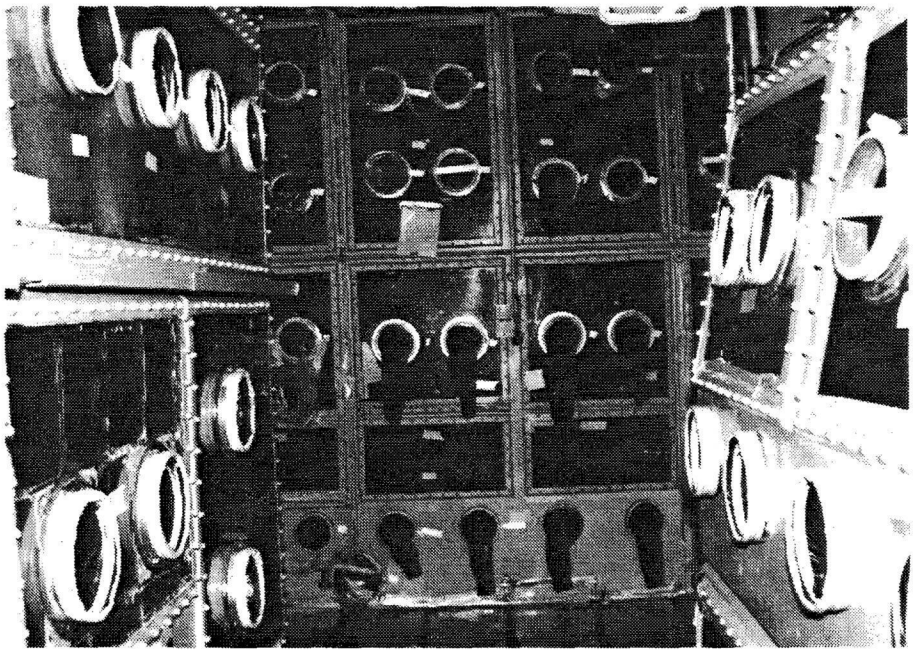
Jenny equipment installed on open top 55 gallon drum for cleaning solution supply.

V. DESCRIPTION OF EQUIPMENT AND MACHINERY TO BE DECONTAMINATED

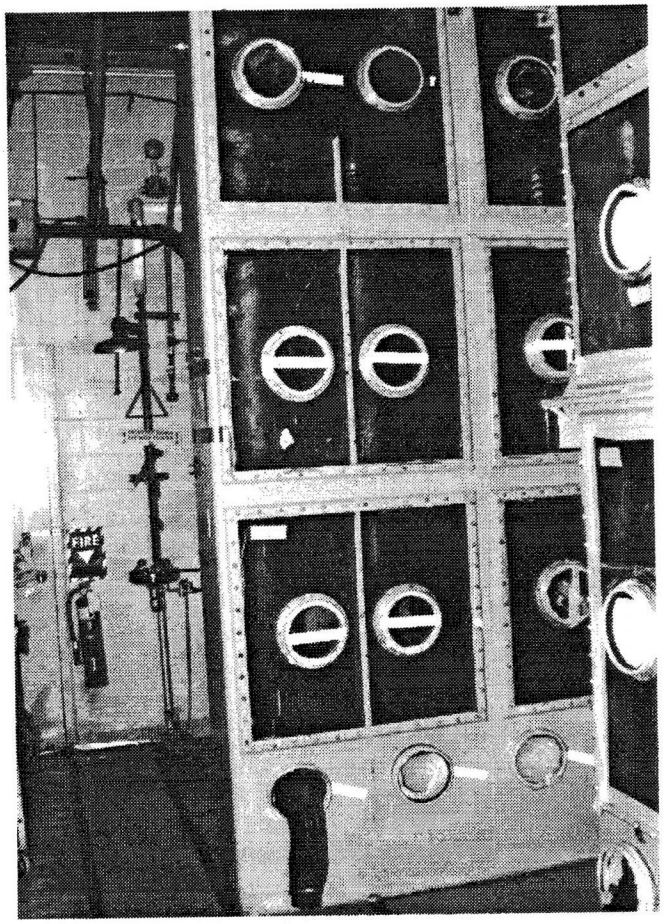
The type of equipment and tooling that requires decontamination consists of all the process systems used in the manufacturing of mixed oxide fuel pellets. The equipment and tooling can best be illustrated by the following pictures.



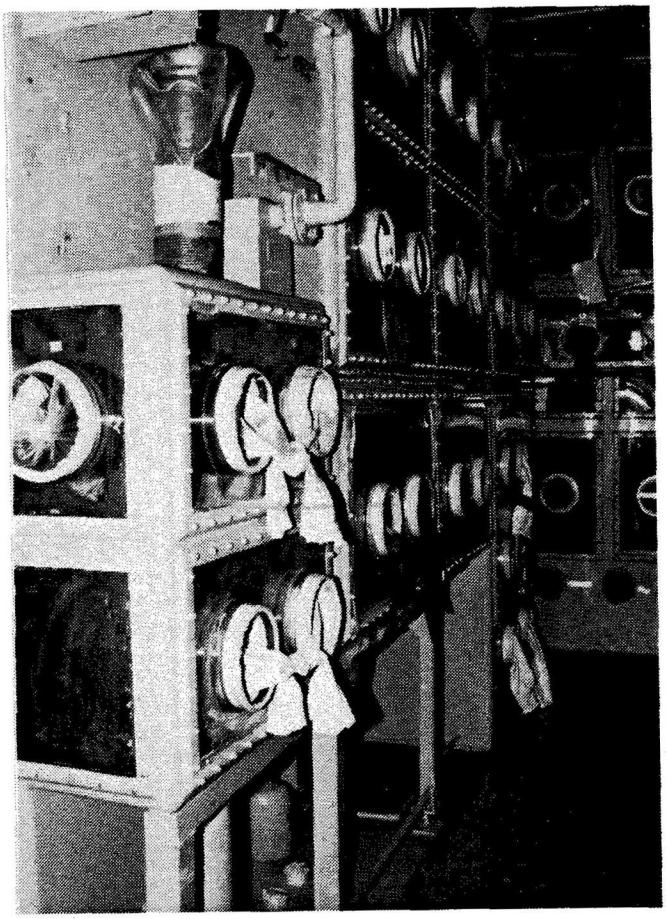
Nitrate solution was directed to production operations from the piping manifold contained in this glovebox. (NOTE: Extended "T" handles for controlling valves).



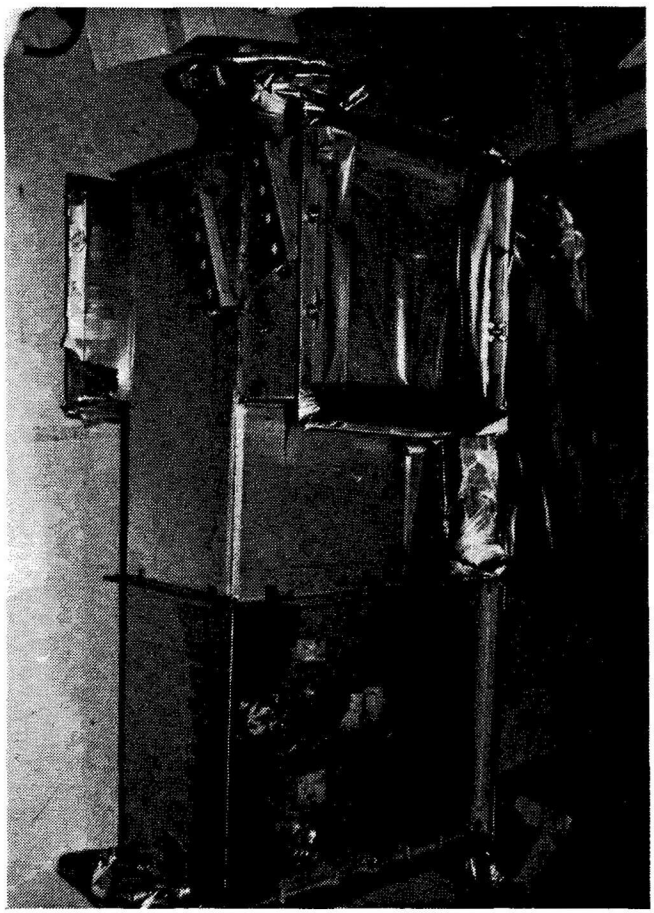
Scrap Area Glovebox Arrangement



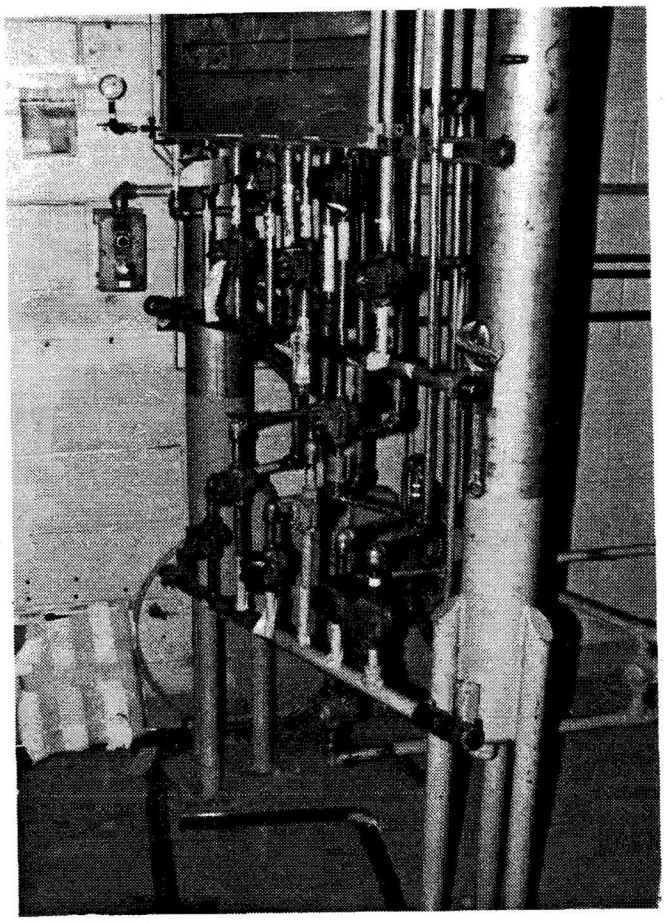
Typical Glovebox Installation



Typical Glovebox Installation



Duct Work and HEPA Filter Adapter Awaiting Cut up in Plasma Arc Glovebox



Manifold Valving Station for IX Storage Tanks

VI. RESULTS OF IX PROCESSING

The ion exchange system was started utilizing highly contaminated gloveboxes, IX columns, piping and storage tanks with the full knowledge that it would take a long period of time for the system to clean itself.

Batch #1 consisted of approximately 28 gallons of decon solution which was used to wash the gloveboxes which house the IX columns. The same solution was used to flush the columns, tanks and lines to the receiver tanks in glovebox #40 (illustrated in Figure #1) prior to installing the resin. Analysis of Batch #1, after circulating several times through the 5 micron sock filter and the one micron cartridge filter in glovebox #40 and prior to pumping thru the glovebox #40 resin, showed 26×10^6 d/m alpha per ml (11 grams Pu/28 gallons or 0.1 grams/liter). 26.6 grams of Pu was removed from Batch #1 by the filters in glovebox #40 in room B01.

After pumping Batch #1 through the resin in glovebox #40 to the tanks in room 127, analysis showed 10.6×10^6 d/m alpha per ml (4.6 grams Pu/28 gallons or 0.043 grams per liter). Batch #1 was circulated several times through the 2 micron sock filter and the 0.75 micron cartridge filter in glovebox #25 (illustrated in Figure #1) which resulted in removal of an additional 4 grams of Pu before Batch #1 was pumped through the resin in glovebox #31A.

The IX feed storage tanks in room 127 consists of 4 sets of two tanks each. After circulating through the filters in glovebox #25, Batch #1 was circulated from one set of tanks through the filters and IX columns to another set of tanks several times until the radioactivity was reduced to LSA levels. The decon solution was then allowed to set several days. During this time, the radioactivity level in the decon solution would increase to several hundred thousand d/m alpha per ml from material being leached from the tank walls. The solution was again circulated through the IX columns. This process was periodically repeated with all four sets of tanks for several months before Batch #1 was finally pumped to a barrel for solidification as L.S.A. waste.

Batch #2 consisted of approximately 28 gallons of decon solution generated from steam cleaning glovebox #4. Batch #2 was also periodically circulated through the system for several months before it was pumped to a barrel for solidification as L.S.A. waste. Batches #3 through #10, also 28 gallons each, were generated from steam cleaning of other gloveboxes.

All ten batches were reduced to L.S.A. levels, cemented and shipped as L.S.A. waste. 231.715 grams of Pu were removed from the 280 gallons of decon solution. The average radioactivity level of the ten batches was 23,870 d/m alpha/ml (0.01 grams Pu/28 gallons) when they were solidified for shipment as L.S.A. waste. The following activity reduction was experienced with these IX systems:

System	Radioactivity
Glovebox #40 Filters (single pass)	60.8% removed
Glovebox #40 IX resin (single pass)	5.4% removed
Glovebox #25 filters (recirculated - multiple passes)	26.2% removed
Glovebox #31A IX resin (recirculated - multiple passes)	7.6% removed

Mop Water IX System

For ALARA purposes, unrestricted release of liquids from the mop water IX system is limited to $\leq$ 0.1 MPC levels ($< 4.0 \times 10^{-7}$ μci/ml alpha). To date, 39 batches of mop water have been processed through the system resulting in the release of 24 batches (930 gallons) and the solidification of 15 batches (613 gallons) as L.S.A. waste.

The recent success rate of the system has been improved by reducing the quantity of chemicals (especially detergents) used in the decontamination solutions in compliance with the attached Procedure No. KM-NP-36-19. The reduction of chemicals did not adversely affect the decontamination process.

VII. CONCLUSIONS

The results of the ten batches processed indicate that filtration and ion exchange of decontamination solutions is an effective way to reduce levels of radioactivity. There are opinions that the IX columns also act as a fine filter during the ion exchange process. Waste solutions from the Plutonium Plant were processed through the system resulting in significant economic benefits. T.R.U. waste burial and transportation costs are $253 per cubic foot, compared to L.S.A. waste burial and transportation costs of $27 per cubic foot. This results in savings in excess of $1,500 per drum for disposal and transportation costs when the radioactivity can be reduced to L.S.A. levels. Approximately 60% of the mop and scrub water solutions are reduced to releasable levels, the remainder is solidified as L.S.A. wastes.

TABLE OF APPENDICES

PROCEDURES FOR ION EXCHANGE OPERATION

Box 31A Ion Exchange Operation
KM-NP-36-9, Rev. 5

Operation of Glovebox 40 Ion Exchange Columns
KM-NP-36-18, Rev. 3

Mop Water IX System Operation
KM-NP-36-19, Rev. 0

PROCEDURES FOR ION EXCHANGE OPERATION

The gloveboxes and internal equipment are steam cleaned using the Jenny equipment and (clearcoated) before disassembly to reduce airborne contamination and to reduce operator exposure during the decommissioning operations of the plant. The waste solutions generated are processed through the IX systems to reduce radioactivity.

Procedures for the operation of the systems in gloveboxes 31A and 40 are described in detail in the following procedures, KM-NP-36-9, Rev. 5 and KM-NP-36-18, Rev. 3. The procedure for the operation of the mop water IX system is described in procedure KM-NP-36-19, Rev. 0.

PROCEDURE

DATE October 29, 1984 NO. KM-NP-36-9, Revision 5

SUBJECT

SEQUOYAH FUELS CORPORATION

BOX 31A ION EXCHANGE OPERATION

CIMARRON FACILITY

R5 I. INTRODUCTION

The effluent from the glovebox 40 ion exchange columns is collected in room 127 tank farm tanks (see procedure KM-NP-36-18) and becomes the feed solution for the glovebox 31A ion exchange columns. The feed solution in the tank farm tanks is pumped through a 2 micron sock filter and a 0.75 micron cartridge filter located in glovebox 25 before entering the ion exchange columns located in glovebox 31A; therefore, this procedure covers glovebox 25 operations as well as glovebox 31A operations.

This filtration and ion exchange system is used to clean up glovebox decon solutions to a level that can be solidified and disposed of as Class A LSA waste. The clean up is primarily by filtration in glovebox 25 prior to contacting the solutions with the Dow 21-K resin in glovebox 31A for removal of the remaining collodial suspended particles ($<$ 0.75 micron size) and a small percent as complexes of plutonium and uranium with sodium carbonate.

The ion exchange resin is preconditioned before it is put in the columns. When the resin has been loaded to a level that it will no longer reduce the decon solutions to LSA levels, as determined by radiometric analysis of the ion exchange effluent, the resin is removed for disposal and replaced with new resin.

II. HEALTH AND SAFETY

1. Care must be taken not to bump or strike glass columns. Column expanded metal screens must be in place unless resin has been removed to work on the column.

2. Care must be taken to avoid introducing sharp edged objects into the box. Pliers and channel locks must be used to handle the metal fabric sheathed flex lines to prevent puncture wounds.

3. Constant attendance is required during operations.

III. NUCLEAR SAFETY

1. Tanks, columns and filter canisters are geometrically safe.

2. Box 25 is limited to two used filters (cartridge and/or sock filters) outside of filter canisters in addition to filters within canisters. All used filters and portable containers shall be kept at least 12" from the filter canisters and each other.

3. Box 25 and Box 31A are each limited to one portable geometrically safe two liter container that shall be kept 12" from columns, filter canisters and used filters.

4. Liquid level in bottom of glovebox 25 and 31A is limited to one inch. The liquid level alarms shall be maintained to alarm at $\leq$1.0".

   See Figures 1 and 2 for illustrations.

IV. PROCEDURE

1. Conditioning New Resin

   As purchased, new Dowex 21K resin does not come ready to use. The resin will be conditioned at the U-plant by the following procedure before it is placed in the glovebox 31A resin columns.

   For each cubic foot of resin:

   1.1 Prepare 24 gallons of 4% NaOH (200 lbs. of potable water plus 8 pounds of flake sodium hydroxide) in chemical make-up tank.

   1.2 Pump the solution through the resin at the rate of 0.5 gallon per minute.

   1.3 Follow with a resin rinse of 40 gallons (334 pounds) of potable water at the same flow rate.

   1.4 Prepare 24 gallons of 10% NaCl (200 pounds of potable water plus 20 pounds of salt).

   1.5 Pump the solution through the resin at the rate of 0.5 gallon per minute.

1.6 Follow with a resin rinse of 40 gallons (334 pounds) of potable water at the flow rate of 0.5 gallon per minute.

1.7 The resin is now ready to be put into the resin columns in glovebox 31A (~1 ft.^{3}/column). Leave 4 to 6" of space between resin and top of column.

1.8 Place the conditioned resin in plastic bags small enough to be bagged into glovebox 31A.

R_5 2. Ion Exchange Operation

Only six of the eight tank farm tanks can be filled at any one time. Each tank farm batch will consist of two tanks full (25 to 30 gallons) and there must be two tanks empty to receive the batch that is being pumped through the filters and/or ion exchange columns.

R_5 The feed solutions in the tank farm tanks may contain considerable amounts of very small particles, especially if some of the material was generated by the steam cleaning of a plasma arc cutup glovebox. Each batch (two full tanks) should be pumped through the filters in glovebox 25 back to two empty tanks without going through the ion exchange columns in glovebox 31A. This process should be repeated until the solution is essentially clear looking before it is routed through the filters and ion exchange columns back to the empty storage tanks.

Normally the feed solution should not require a pH adjustment. Sample each batch to determine the pH and radioactivity level before the batch is pumped through the filters and/or ion exchange columns. Submit a 50 to 75 mil sample to Health Physics for a gross alpha and pH measurement.

2.1 Pump sodium hydroxide solution into feed tanks as necessary to adjust pH to 11 to 12. The sodium hydroxide solution used for pH adjustment should be made by dissolving one pound of sodium hydroxide in a gallon of water.

2.2 Record the pH, radioactivity level, batch number and date.

2.3 Position valves for pumping solution through the filters in glovebox 25, through the ion exchange columns in 31A, and back to the two empty tank farm tanks. The flex lines should be connected to the IX columns to load from bottom up (columns will be loaded in series).

2.4 With the rotometer valve closed, start the tank farm pump and then open and adjust the rotometer valve to establish a flow rate of 0.5 gallon per minute.

2.5 After the batch has been pumped through the ion exchange columns several times, resample solution for radioactivity level. Submit a 3 to 5 mil sample to Health Physics.

R_5 2.6 Repeat step 2.5 until solution meets LSA limits of $<$38,358 d/m alpha/ml.

3. Decon Solution Disposal

Batches of decon solution (two tanks - 25 to 30 gallons) meeting LSA limits ($<$38,358 d/m alpha/ml) shall be pumped from the tank farm to drums with liners for cementing.

3.1 Operating personnel shall mark each drum pumped. The markings shall show batch number, sample results, date, and net weight.

3.2 Records showing batch number, sample results, date, and volume shall be maintained by Health Physics personnel.

R_5 4. Changing Loaded Resin

When the resin in the glovebox 31A ion exchange columns have been loaded to a level that they will no longer reduce the decon solutions to LSA levels, the resin shall be removed for disposal and replaced with new preconditioned resin.

GLOVEBOX 25

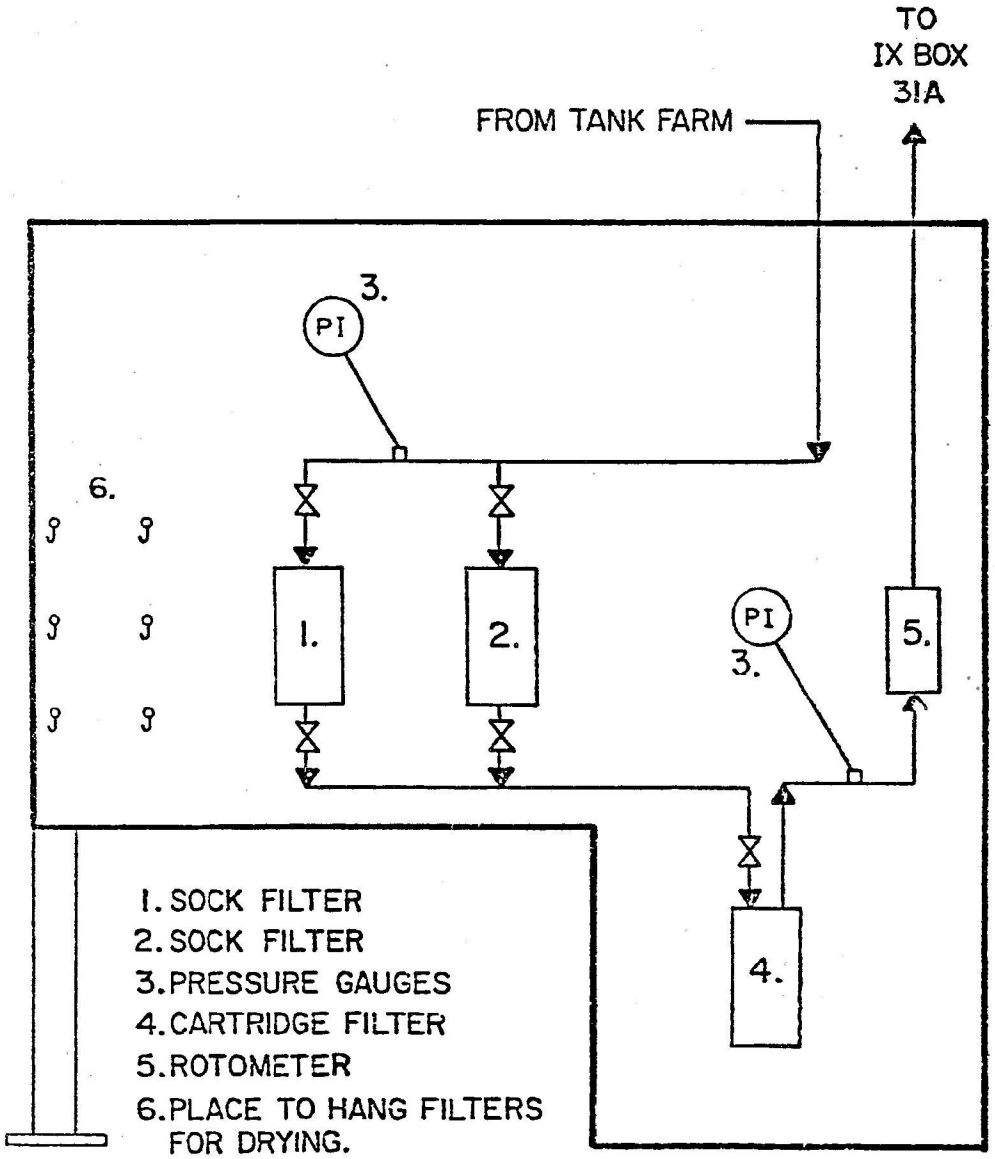


Figure 1

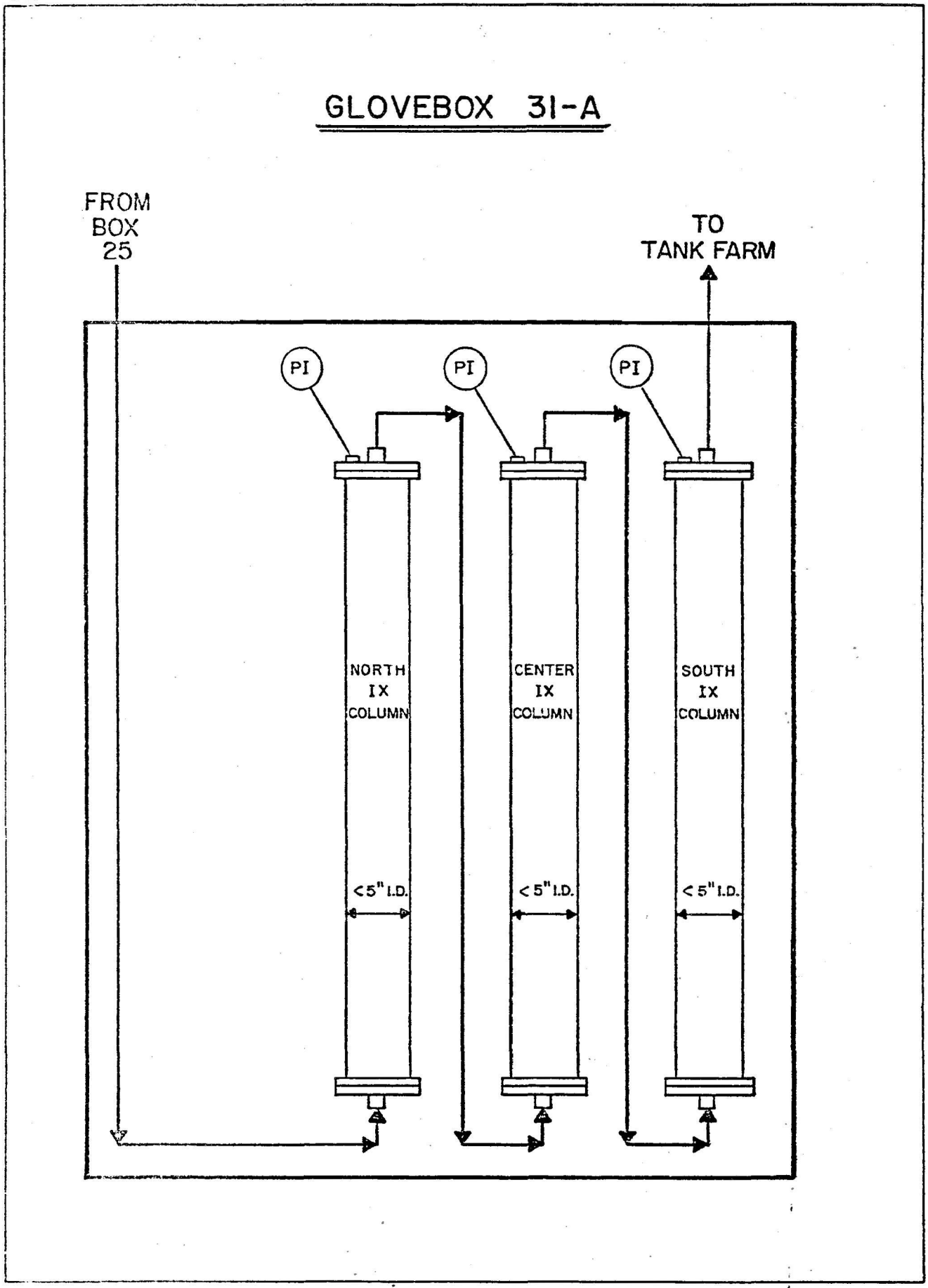

GLOVEBOX 31-A
FROM BOX 25
TO TANK FARM
PI
PI
PI
NORTH IX COLUMN
CENTER IX COLUMN
SOUTH IX COLUMN
< 5" I.D.
< 5" I.D.
< 5" I.D.

Figure 2

Normally, a resin change will result in changing the resin in two of the three columns. The vacuum system in glovebox 40 will be used to vacuum the resin out of the columns in glovebox 31A.

4.1 With the inlet valves (bottom valves) closed on the first two IX columns (first in flow series), remove the flanges from the top of the columns.

4.2 Using glovebox 40 feed tank slurp line, vacuum the resin and liquid from the glovebox 31A columns through the glovebox 40 sock filter to catch the resin with the liquid going to glovebox 40 feed tanks.

4.3 Dump the dewatered resin out of the sock filter into a 1.5 liter geometrically safe poly bottle with enough absorbal to absorb at least twice the amount of moisture remaining in the resin (1/2 liter of Oil Dri to 1 liter of resin).

4.4 Bag out each container of resin before starting to fill the second container with resin.

4.5 After replacing the resin with new resin, switch the IX column flex lines so that the column with the old resin is first in the flow series before resuming the ion exchange operation.

R_3 I. INTRODUCTION

Contamination and exposure control dictates the need for thorough solution cleaning of wet process gloveboxes prior to sectioning for transfer to glovebox cut up operations for volume reduction.

The necessity of assuring that no waste packaged for disposal is acidic resulted in adopting a strong alkaline detergent steam cleaning process using solutions of a Turco product called "Powr-steam" and soda ash.

The clean up of the decon solutions for disposal is done primarily by filtration prior to contacting the solutions with the anionic Dow 21-K ion exchange resin for the removal of the remaining collodial suspended particles (<0.75 micron size) and a very small percent as complexes of plutonium and uranium with sodium carbonate.

The glovebox 40 vacuum receiver, filtration and ion exchange system is used to prepare feed solutions for the glovebox 31A ion exchange system where the glovebox decon solutions are cleaned down to a level that can be solidified and disposed of as Class A LSA waste.

The ion exchange resin will be preconditioned before it is put into the columns. When a column has reached its loading capacity, as determined by radiometric analysis of the ion exchange effluent, the resin will be removed for disposal and replaced with a new resin.

II. HEALTH AND SAFETY

1. The vacuum pump exhaust and air supply in glovebox 40 both have the potential of pressurizing the glovebox; therefore, the low glovebox negative alarm switch has been wired to shut off the vacuum pump and to close the air supply solenoid valve when the glovebox negative gets below 0.25" of water.

   CAUTION: The vacuum pump can still be operated by holding the start button in - the pump will stop as soon as you take your finger off the button if the low glovebox negative alarm is tripped.

2. The air supply line is equipped with a 1/8" orifice and each resin column is equipped with a rupture disc rated at 43 psi. The vents for releasing feed tank air pressure must also have 1/8" orifices to prevent pressurization of the glovebox.

3. The air regulator should normally be set to hold a pressure of 20 psi and should never be set to maintain a pressure greater than 30 psi.

4. Care must be taken to avoid introducing sharp edged objects into the box. Pliers and channel-locks must be used to handle the metal fabric sheathed flex lines to prevent puncture wounds.

5. Constant attendance is required during operation.

III. NUCLEAR SAFETY

1. General

1.1 Tanks, columns and filter canisters are to be geometrically safe.

1.2 Liquid level in bottom of glovebox is limited to less than one inch. The liquid alarm must be maintained to alarm at $\leq$1.0".

2. Operational (Except Resin Removal)

2.1 Glovebox 40 is limited to two used filters (cartridge and/or sock filter) at a time. Glovebox 40 is illustrated in Figure 1.

2.2 Glovebox 40 is limited to one portable geometrically safe two liter container.

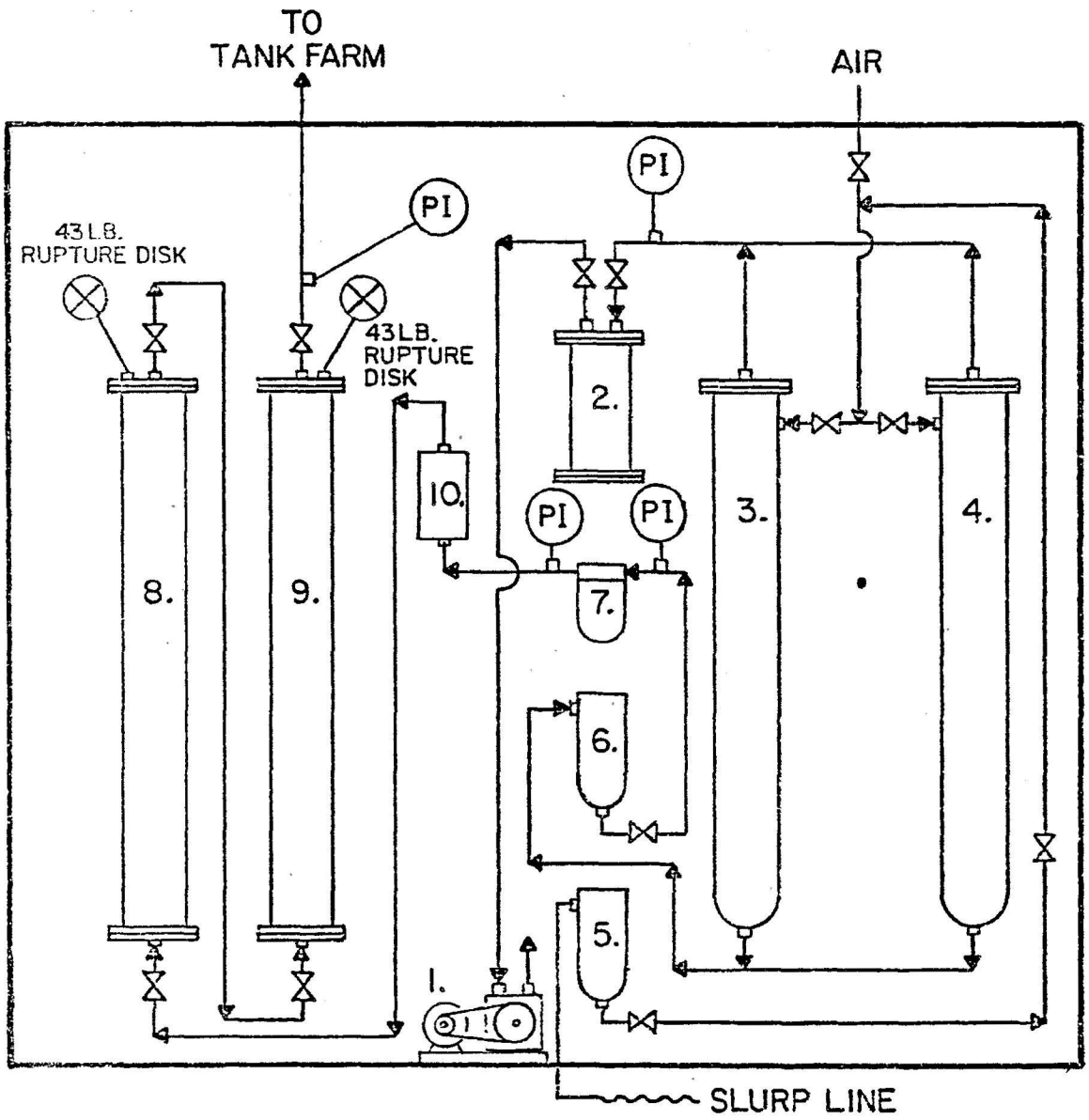
2.3 All filters and portable containers are to be kept spaced 12" from columns and feed tanks.

3. Resin Removal

3.1 There may be no used filters outside of filter canisters in glovebox 40.

3.2 Glovebox 40 is limited to one filled portable two liter container (resin or liquid).

GLOVEBOX 40



1. VACUUM PUMP
2. GLASS VACUUM TANK
3. VACUUM RECEIVER FEED TANK
4. VACUUM RECEIVER FEED TANK
5. SOCK FILTER
6. SOCK FILTER
7. CARTRIDGE FILTER
8. ION-EXCHANGE COLUMN
9. ION-EXCHANGE COLUMN
10. ROTOMETER

Figure 1

IV. PROCEDURE

1. Conditioning New Resin

As purchased, new Dowex 21-K resin does not come ready to use. The resin will be conditioned at the U-plant by the following procedure before it is placed in the glovebox 40 columns.

For each cubic foot of resin:

1.1 Prepare 24 gallons of 4% NaOH (200 lbs. of potable water plus 8 pounds of flake sodium hydroxide).

1.2 Pump the solution through the resin at the rate of 0.5 gallon per minute.

1.3 Follow with a resin rinse of 40 gallons (334 pounds) of potable water at the same flow rate.

1.4 Prepare 24 gallons of 10% NaCl (200 pounds potable water plus 20 pounds of salt).

1.5 Pump the solution through the resin at the rate of 0.5 gallon per minute.

1.6 Follow with a resin rinse of 40 gallons (334 pounds) of potable water at the flow rate of 0.5 gallon per minute.

1.7 The resin is now ready to be put into the resin columns in glovebox 40 ($\sim$1 ft.^{3}/column).

2. Filling Feed Tanks

The feed tanks will be filled by slurping liquids from the bottom of gloveboxes being steam cleaned through the glovebox 40 slurp line.

When filling the feed tanks with decon solutions from a glovebox, leave $\sim$ one foot of tank space for feed adjustment.

2.1 Close the air supply valve, feed tank outlet filter valves, rotometer valve, and feed tank slurp inlet valve.

2.2 Open the feed tank vent valve to release all air pressure and then reclose the vent valve.

2.3 Open the valves on the vacuum line from the vacuum pump to the feed tanks.

2.4 Start the vacuum pump.

2.5 With the slurp line in the liquid to be transferred, open the slurp line valves.

2.6 When the feed tanks are filled, remove the slurp line from the liquid being transferred and allow the vacuum to remove all of the liquid from the slurp line.

2.7 Stop the vacuum pump, close the vacuum line valves, and close the slurp line valves.

3. Feed Adjustment

The feed solution must have a pH of 11.0 to 12.0.

The solution used for steam cleaning gloveboxes should normally contain 0.1 pound of Turco and 0.1 pound of soda ash per gallon of water. An excess of plasma arc smoke plated out in plasma arc cutting gloveboxes may require as much as 0.25 pound of Turco/gallon for proper cleaning. R3

The Turco contains sodium hydroxide. The feed solution from gloveboxes should not require a pH adjustment except when a significant amount of acid residue has been encountered in a glovebox or in piping.

3.1 After filling the feed tanks with glovebox or pipe decon solutions, open feed tank vent valves to release the vacuum and reclose the vent valve.

3.2 Open sample valve and check pH of feed solution to assure a pH of 11.0 to 12.0.

3.3 Slurp sodium hydroxide solution into feed tanks as necessary to adjust pH to 11.0 to 12.0. The sodium hydroxide solution used for pH adjustment should be made by dissolving one pound of sodium hydroxide in a gallon of water.

4. Ion Exchange Loading

4.1 With vacuum line valves and slurp line valves closed, open the valve on the air line to the feed tanks and pressurize the feed tanks with the air regulator set to hold 20 psi.

4.2 With the filter valves, IX column valves, and tank farm valves open, open and adjust the rotometer valve to establish a flow of 0.5 gallon per minute.

4.3 The flex lines should be connected to the IX columns to load from bottom up (columns will be loaded in series).

R3 4.4 Occasionally a 3 to 5 mil sample should be taken where the flex line is connected to the bottom of the primary IX column for a gross alpha count for comparison to the gross alpha count results from the tank farm batch sample to determine if the resin is loaded.

4.5 Continue repeating the steps in Section IV, 2, IV. 3, and IV. 4 until six of the tank farm tanks in Room 127 are filled to within about 2' of the top of the tanks.

4.6 When 6 of 8 tank farm tanks are full, the operations must be shut down.

4.7 When the operation is shut down, vent the air pressure off the feed tanks and clean up the glovebox.

NOTE: Be absolutely sure that the air and rotameter are shut off and restarted in the proper sequence each time it is necessary to refill the feed tanks. The proper sequence is to shut off the rotameter and then shut off the air. When starting back up, turn the air on and then slowly open the rotameter. This prevents air surging into the resin bed and rolling the resin.

5. Changing Loaded Resin

Sample each tank farm batch (two full tanks, 25 to 30 gallons). Submit 50 to 75 mil samples to Health Physics for a gross alpha count and pH measurement. If the gross alpha count results of the tank farm batch sample taken prior to circulation through the glovebox 31-A resin columns does not show a reduction in the level shown by the occasional glovebox 40 sample (see Step IV 4.4) the glovebox 40 resin must be changed. R3

Normally, a resin change will result in changing the resin in only one of the two columns (the first column in the flow series).

5.1 With the inlet valve (bottom) closed on the first IX column (first in flow series), remove the flange from the top of the column.

5.2 Using the feed tank slurp line, vacuum the resin and liquid from the IX column back through the slurp line sock filter to catch the resin with the liquid going back to the feed tanks.

5.3 Dump the dewatered resin out of the sock filter into a 1 to 2 liter geometrically safe poly bottle with enough absorbal to absorb at least twice the amount of moisture remaining in the resin (1/2 liter of oil dry to 1 liter of resin).

5.4 Bag out each container of resin before starting to fill the second container with resin.

CAUTION: All bagouts from ion exchange gloveboxes must use the "horse-tail" method. Bag sealers are not allowed.

5.5 After replacing the resin with new resin, switch the IX column flex lines so that the column with the new resin is second in the flow series before resuming the ion exchange operation.

PROCEDURE

DATE December 14, 1984 NO. KM-NP-36-19, Revision 0

SUBJECT

SEQUOYAH FUELS CORPORATION

MOP WATER IX SYSTEM OPERATION

CIMARRON FACILITY

I. INTRODUCTION

The radioactivity level in the plutonium-uranium contaminated solutions (mop water) generated from decontamination of building surfaces and equipment exterior to the gloveboxes will normally be reduced to releaseable levels by filtration and ion exchange. The clean up of the decon solutions for disposal is done primarily by filtration. A strong basic anionic ion exchange resin (DOW 21-K) is used to absorb the non-filterable collodial suspended particles (< 0.75 micron size) and a small percent as complexes of plutonium and uranium with sodium carbonate.

The mop water ion exchange system consists of one 5" I.D. column $\sim$ 8' long mounted on the north wall of Room 127. A pump, sock filter and cartridge filter mounted on a portable cart is used to pump the decon solution to an overhead 55 gallon drum which is located on a work platform above the column for gravity feed through the column to a 55 gallon drum located under the column. The ion exchange resin will be preconditioned before it is put into the column. When the resin has been loaded to a level that it will no longer reduce the decon solutions to releasable levels, it shall be removed for disposal and replaced with new preconditioned resin. See Figure 1 for illustration.

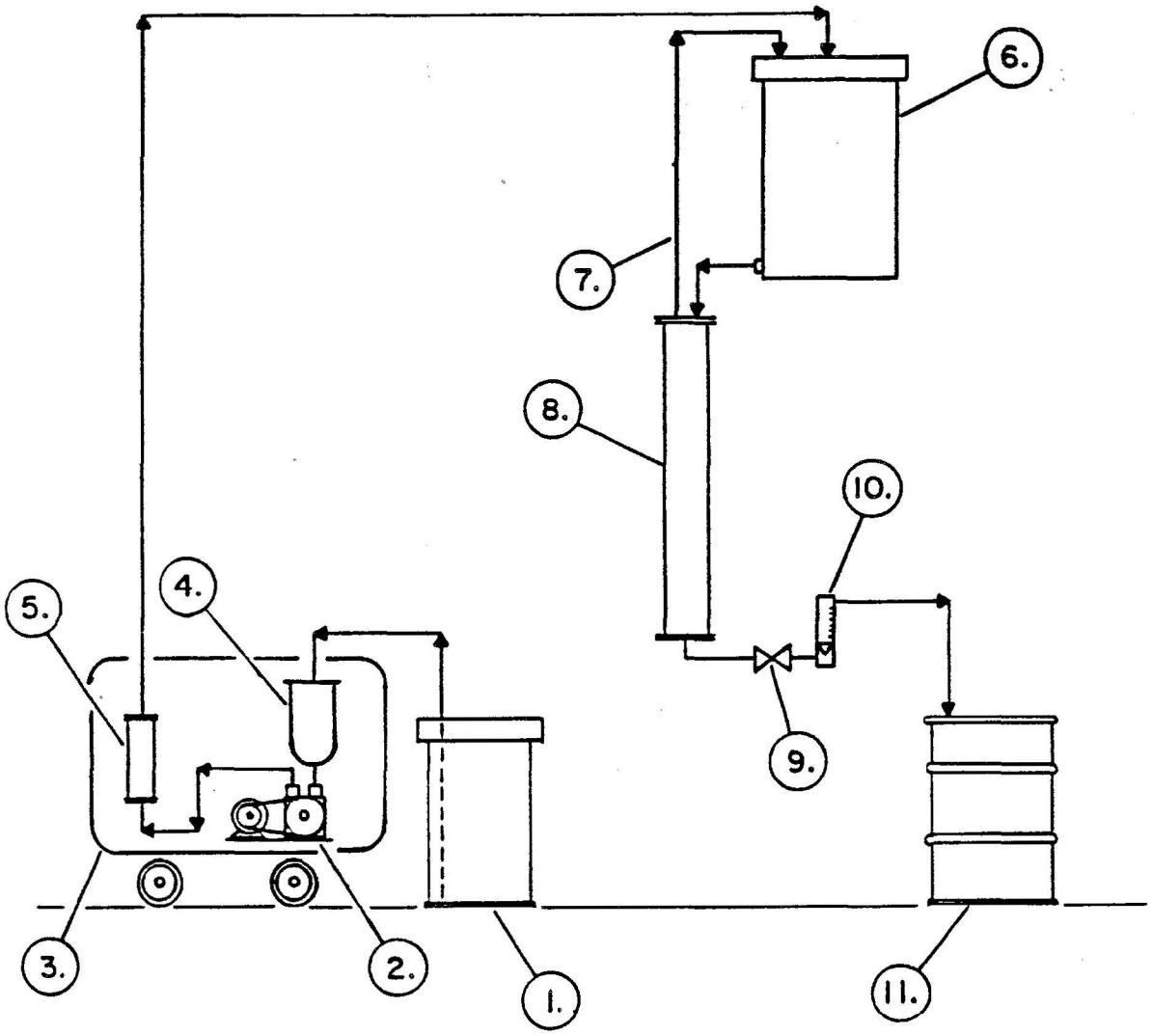
The liquid effluent from the ion exchange system shall meet 0.1 MPC (4.0×10^{-7} μci alpha/ml) release limits for release to the sanitary lagoons. Liquids that cannot be reduced to $\leq$ 0.1 MPC release limits shall be cemented for burial as LSA Class A waste.

Decon operations requiring significant quantities of detergents and/or sequestering agents for removal of contamination from porous surfaces will probably result in decon solutions which cannot be reduced to 0.1 MPC with the ion exchange system.

II. HEALTH AND SAFETY

1. A lapel air sampler shall be worn by the operator performing the work.

ION EXCHANGE CLEANUP OF MOP WATER



1. FEED TANK
2. VANTON PUMP
3. PORTABLE CART
4. SOCK FILTER
5. CARTRIDGE FILTER
6. HOLDING TANK
7. VENT LINE
8. I.X. COLUMN
9. CONTROL VALVE
10. FLOW METER
11. SHIPPING DRUM

NOTE: PLUMBED WITH TYGON TUBING.

Figure - 1 -

2. A constant air monitor with an alarm shall be required in the room.

3. The work area is to be kept clean and orderly at all times. Spills must be cleaned up promptly.

4. Avoid creating and breathing dust clouds when handling the soda ash powder.

5. The industrial strength hydrogen peroxide used for pre-treating solutions for the ion exchange operation is a strong oxidant and will burn your skin. Wear rubber gloves to protect your hands, goggles to protect your eyes, and a face shield to protect your face when using the peroxide.

6. Surgeons gloves are to be worn when performing any operation which will bring the hands into contact with any chemicals or decon solutions.

7. Always be aware of the location of the eye wash-safety shower station so that you could locate it with your eyes closed.

III. NUCLEAR SAFETY

Any contamination clean up exterior to a glovebox requires a Special Work Permit which will specify the safety equipment required for the situation.

Solutions generated from routine floor mopping and from steam cleaning of walls and other surfaces exterior to the gloveboxes are picked up with a wet vacuum mounted on a 55 gallon drum. The decon solutions have historically averaged $\sim$2,000 dpm/ml with 46,947 dpm/ml being the maximum experienced during the clean up of a spill during the D & D of the plant.

1. All drums of mop water shall be sampled and analyzed for gross alpha activity prior to filtering and prior to pre-treating for ion exchange. Mop water that is less than 40,000 dpm alpha/ml may be introduced into this ion exchange system for clean up. Solutions of 40,000 dpm/ml or greater will be processed through the glovebox 40-31A ion exchange system.

   NOTE: 40,000 dpm alpha/ml represents 0.1 miligram of FFTF Pu per liter or 20.8 miligrams of FFTF Pu per gallon.

2. The ion exchange column is geometrically safe. Even though experience has shown that the maximum loading on the Dow 21-K resin column ($\sim$1 ft.^{3} of resin) is 5 grams of Pu when the resin is loaded to a level that it will no longer reduce the decon solutions to $<$0.1 MPC release levels, the loaded resin will be removed and dewatered by slurping to safe geometry sock filters in glovebox 40 for contamination control.

3. An SOL sign will be maintained on the wet vacuum system limiting the drum to $<$15 grams of Pu.

IV. PROCEDURE

1. Conditioning New Resin

As purchased, new Dowex 21-K resin does not come ready to use. The resin will be conditioned at the U-plant by the following procedure before it is placed in the resin column.

For each cubic foot of resin:

1.1 Prepare 24 gallons of 4% NaOH (200 lbs of potable water plus 8 pounds of flake sodium hydroxide).

1.2 Pump the solution through the resin at the rate of 0.5 gallon per minute.

1.3 Follow with a resin rinse of 40 gallons (334 pounds) of potable water at the same flow rate.

1.4 Prepare 24 gallons of 10% NaCl (200 lbs. of potable water plus 20 pounds of salt).

1.5 Pump the salt solution through the resin at the rate of 0.5 gallon per minute.

1.6 Follow with a resin rinse of 80 gallons (668 pounds) of potable water at the flow rate of 0.5 gallon per minute.

1.7 The resin is now ready to be put into the resin column.

2. Pretreatment of IX Feed Solution

There is a significant difference in the various feed solutions for the mop water IX system; therefore, the pre-treatment is quite variable. The feed solutions consist primarily of: 1) water generated from routine mopping of the production area corridors with a pH of 6.0 to 7.0, 2) oxalic acid steam cleaning solutions with a pH of 2.0, and 3) highly alkaline detergent (Turco) steam cleaning solutions with a pH of 12.0.

NOTE: Turco steam cleaning solutions containing as much as 0.1 lb. of Turco per gallon of water cannot be cleaned below 3 to 10 dpm/ml (1 to 3 MPC) with this IX system. In addition, Turco steam cleaning solutions of this strength leave a powdery residue on the cleaned surfaces. For steam cleaning surfaces exterior to gloveboxes, add only enough Turco to raise the pH of the solution to 12.0. Cleaning compounds containing chlorine, clorides, and sulfates must be avoided because chlorides and sulfates will strip the U-Pu-sodium carbonates off the resin.

2.1 Prior to any pre-treatment, sample the solution in the barrel. Submit a 3 to 5 ml sample to Health Physics for a gross alpha count.

2.2 After determining that the gross alpha activity is less than 40,000 dpm/ml, decant the liquid through the sock filter to a clean drum. Cement the solids remaining in the bottom of the drum.

2.3 Add industrial strength hydrogen peroxide at the rate of 2 ml/gallon of the filtered mop water and Turco steam cleaning solutions, stir thoroughly, and let age for at least two hours. Do not add hydrogen peroxide to oxalic acid steam cleaning solutions.

2.4 Add soda ash at the rate of 0.1 lb./gallon of the aged solution as well as to the filtered oxalic steam cleaning solution. Stir thoroughly and sample the solution. Submit a 50 to 75 ml sample to Health Physics to determine the pH of the treated solution. Add sodium hydroxide solution as necessary to adjust the pH of the solution to 11.0 to 12.0 so that any plutonium will form a precipitate to be filtered out.

NOTE: The sodium hydroxide solution used for pH adjustment should be made by dissolving one pound of sodium hydroxide in a gallon of water.

2.5 After adjusting the pH of the solution, let the solution age and settle for a minimum of 36 hours.

3. ION Exchange Loading

3.1 Decant the treated and aged solutions by slurping through the sock and inline filter to the overhead IX feed storage drum. Cement the precipitate remaining in the bottom of the drum.

3.2 Place an empty clean drum under the IX column outlet line and adjust the feed valve to give a gravity flow of $\sim$ 2 gallon/hour.

NOTE: Since the receiver drum and feed drum are the same size and the system uses gravity flow, the system shall be allowed to flow on the backshifts without an operator on duty.

3.3 After the batch has percolated through the resin column, submit a 3 to 5 ml sample to Health Physics for gross alpha analysis.

3.4 Repeat steps 3.1, 3.2 and 3.3 until the alpha activity in the solution meets the 0.1 MPC limits of $< 4.0 \times 10^{-7}$ μci/ml.

3.5 Dump the released solution to the 10,000 gallon hold up tanks.

4. Changing Loaded Resin

When the resin in the ion exchange column has been loaded to a level that it will no longer reduce the decon solutions to releasable levels, the resin shall be removed for disposal and replaced with new preconditioned resin.

4.1 Remove the flange from the top of the column.

4.2 Using the glovebox 40 feed slurp line, vacuum the resin from the column through the glovebox 40 sock filter to catch the resin.

4.3 Dump the dewatered resin out of the sock filter into a 1.5 liter geometrically safe poly bottle with enough Oil Dri to absorb at least twice the amount of moisture remaining in the resin (normally 1/2 liter of Oil Dri to 1 liter of resin).

4.4 Bag out each container of resin for NDA before starting to fill the next container with resin. Repeat until all of the resin has been removed from the column.