START ENGINEERING CHANGE NOTICE

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Page 1 of 2

1. ECN 117856

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date
Supplemental ☒ Direct Revision ☐ Change ECN ☐ Temporary ☐ Supersedure ☐ Discovery ☐ Cancel/Void ☐	D. K. Oestreich, Safety Hazards Analysis Section		1/03/90
	5. Project Title/No./Work Order No. B-590 Neptunium Oxide Glovebox	6. Bldg./Sys./Fac. No. 202-A	7. Impact Level 3
	8. Document Number Affected (include rev. and sheet no.) SD-HS-SAR-001, Rev 5	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package Doc. No.	11c. Complete Installation Work	11d. Complete Restoration (Temp. ECN only)
☐ Yes (fill out Blk. 11b) ☒ No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

This ECN ~~is a change to ECN 117855 which transmitted a~~ TRANSMITS THE Preliminary Safety Analysis Report on PUREX Project B-590-Neptunium Oxide Glovebox ~~to reviewers for functional review. The document has been revised and reviewer comments resolved. The document is again transmitted~~ for approval ~~and sign-offs~~. Please add the attached PSAR as a temporary appendix to the PUREX FSAR document. (NOTE: Project has been placed on hold.) ~~Do not attach this doc. to the SAR until the project has been restarted.)~~ JRC

~~apprv cc~~ JRC

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13a. Justification (mark one)	13b. Justification Details
Criteria Change ☐ Design Improvement ☐ Environmental ☐ As-Found ☐ Facilitate Const. ☒ Const. Error/Omission ☐ Design Error/Omission ☐	Project B-590 will result in the installation of a glovebox to be used in converting neptunium solutions to neptunium oxide.

14. Distribution (include name, MSIN, and no. of copies)

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A-7900-013 (11/88)

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 117856

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
☐ Yes	Additional ☐	$ N/A	Additional ☐	$ N/A	Improvement ☐	N/A
☒ No	Savings ☐	$ N/A	Savings ☐	$ N/A	Delay ☐	N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☒	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☒	ICRS Procedure	☐
FSAR/SAR	☒	IEFD Drawing	☒	Process Control Manual/Plan	☒
Safety Equipment List	☒	Cell Arrangement Drawing	☒	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☐		☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
	WHC-CM-5-24	

20. Approvals

OPERATIONS AND ENGINEERING	Signature	Date
Cog./Project Engineer	D. K. Deutrich	1/3/90
Cog./Project Engr. Mgr.	[illegible]	1/4/90
QA	ST Smith	3/1/90
Safety	[illegible]	2/9/90
Security		
Proj.Prog./Dept. Mgr.		
Def. React. Div.		
Chem. Proc. Div.	~~RL McCormack~~	2-1-90
Def. Wst. Mgmt. Div.		
Adv. React. Dev. Div.		
Proj. Dept.	JD Condron	2/28/90
Environ. Div.		
IRM Dept.		
Facility Rep. (Ops)		
Other	AUTHORIZING MGR DL CHASE	
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ARCHITECT-ENGINEER	Signature	Date
PE		
QA		
Safety		
Design		
Other		
DEPARTMENT OF ENERGY		
	NA	
ADDITIONAL		
	Unclassified - George Reddy	3/1/90

A-7900-013R (11/88)

PRELIMINARY SAFETY ANALYSIS REPORT - NEPTUNIUM OXIDE GLOVEBOX
PROJECT B-590

Temporary Appendix to SD-HS-SAR-001, Rev 5
PUREX Plant FSAR

DK Oestreich

Westinghouse Hanford Company

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PRELIMINARY SAFETY ANALYSIS REPORT - NEPTUNIUM OXIDE GLOVEBOX

1.0 OVERALL PURPOSE

This document is intended to provide a preliminary safety analysis of a PUREX plant modification which will result in the installation in Q-Cell of a glovebox and processing equipment to be used for the purpose of converting neptunium nitrate solution to neptunium oxide powder. This plant modification is being conducted under Project B-590 which was described in Conceptual Design Report SD-590-CDR-001, Rev 0.

The physical location of the glovebox within the Q-Cell loadout lobby is shown in sheet 1 of drawing # H-2-98720 and equipment installation within the glovebox is shown in sheet 2 of this drawing. The process flow diagram for processing within the glovebox is given in Drawing H-2-98743.

2.0 SUMMARY SAFETY ANALYSIS

An evaluation of the facility and process involved in production of neptunium oxide from neptunium nitrate solution has led to the conclusion that no accidents have been identified relative to this process which could provide the motive force for the breaching of protective barriers and the dispersal of radionuclides to the environment.

The accident scenarios examined in chapter 9 include the breaking of a one inch compressed air line in the glovebox, and a potential pressure transient created by accidental mixture and rapid chemical reaction between nitric acid and hydrazine. While the compressed air leak scenario may be capable of causing a radiological release from the glovebox into Q-Cell, neither scenario would be expected to damage HEPA filters on the PR Room ventilation system and result in an environmental release of radionuclides. Consequently, no accident has been identified which could result in radiological dose consequences which exceed the risk acceptability criteria given in WHC-CM-4-46.

3.0 SITE CHARACTERISTICS

Please refer to the PUREX FSAR, SD-HS-SAR-001, for a discussion of site characteristics.

4.0 PRINCIPAL DESIGN CRITERIA

Details of the functional design criteria for this plant modification are provided in the FDC document, SD-590-FDC-001, as well as in the Conceptual Design Report, SD-590-CDR-001, Rev 0. Please refer to the above two documents

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for a detailed discussion of the functional design criteria for this plant modification.

This plant modification can be shown to be appropriately classified as Safety Class 3. The PSAR has established that any accidents which might occur relative to operation of the neptunium oxide line would only have impact on occupational safety. Guidance given in Management Requirements and Procedures MRP 5.46 indicates that items for which failure could be expected to result only in occupational safety impacts should be classified as Safety Class 3. MRP 5.43 indicates that documents which relate only to equipment failures limited to occupational safety impacts should be classified as Impact Level 3. It is concluded that the equipment involved in neptunium oxide production should be classified as Safety Class 3 and Impact Level 3.

5.0 FACILITY DESCRIPTION - NEPTUNIUM PURIFICATION PROCESS

The neptunium purification system, also known as Q-Cell is located at the storage gallery level of Building 202-A, the PUREX Plant, between the west end of the PIV room and the PR room. As shown in Figure 5-11 of the PUREX FSAR, Q-Cell includes a control room, a load-out room, an AMU level, a maintenance room and shielded maintenance hood, and a shielded hot cell. The AMU is located above the control room. Access to Q-Cell is obtained through the SWP lobby or, in emergencies, through the PIV room. Potential access to the PR corridor also exists but the door is presently sealed.

The installation of the neptunium glovebox in the load-out room of Q-Cell will require some changes to the present cell configuration. It will be necessary to demolish the existing six inch concrete wall which is located between rooms 28 and 28A, and install a stainless steel floor liner. The existing load out hood and decontamination/repair hoods will be removed as well as TK-Q11 and pumps P-Q11-1 and -2 will be removed to make room for the glovebox. Piping to TK-Q11 will be re-routed to TK-Q46.

Q-Cell was installed in the building along with the neptunium recovery and decontamination facility in J-Cell, to provide for further purification of the neptunium recovered in J-Cell prior to shipment offsite. The Q-Cell purification system was designed for batch operation. The J-Cell package is currently in operation recovering Np from back-cycle waste.

Nuclear criticality safety for Q-Cell is dependent upon vessel geometry and upstream plutonium mass control. The vessels which are not of geometrically favorable design, including the 3 inch annular 3XF Tank are preceded by vessels Q1 and Q2 which are of geometrically favorable design. Since safe geometry control is not available for all vessels in Q-Cell, administrative control of mass limits must be depended upon to prevent criticality.

Multiple samples are taken of the recirculating solvent extraction product stream in Tank J2 and are analyzed to insure low plutonium content prior to transferring this solution to Q-Cell. The maximum concentration of plutonium allowed in solutions in J-Cell is 6 grams per liter because of the presence of the J-Cell sump and the SJ2 deep sump which are not geometrically

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favorable for criticality safety. The maximum amount of plutonium which is permitted in concentrator E-Q2 is 450 grams.

Neptunium is not itself of concern with respect to criticality because the minimum critical mass for the metal is about 70 kg. The neptunium oxide product has a density of approximately 3 grams/cubic centimeter as compared to a density of 19 grams/cubic centimeter for the metal. Consequently the minimum critical mass for neptunium oxide would be on the order of 200 kg. Thus, with a maximum normal glovebox inventory of less than three kilograms of neptunium, there is no likelihood that enough neptunium could be in the Q-Cell glovebox to cause a criticality.

5.1 Supporting Utilities and Facilities

Most of the energy requirements of processing in the Q-Cell glovebox will be provided with electricity. The major operations requiring substantial electricity are the drying oven and the calcination furnace. Steam will be provided for the heating coils in the precipitator vessel and some other tanks as well as to provide steam jets for use in transferring liquids in the process.

Cooling water is supplied for the E-Q17 Reflux Condenser and for cooling coils in the Oxalate Decomposition Tank, TK-Q16.

Compressed air at 100 psi is provided in the Q-Cell glovebox for use in operating diaphragm operated valves and for air sparging of tanks to provide good solution mixing.

Supply air to GB-Q1 and GB-Q2 which comes from the load-out room is HEPA filtered to prevent contamination of the room resulting from any potential flow reversals from the glovebox to the room. The exhaust air from GB-Q1 and GB-Q2, the wet and dry sides of the glovebox, will be filtered individually by HEPA filters which can be isolated using butterfly valves for filter changeout. The filters are sized for 100 ft^3/minute capacity. Exhaust ductwork (304L stainless steel welded construction) carries the glovebox exhaust to the PR room exhaust system as shown in Drawing H-2-98776. The exhaust system will maintain air pressure within the glovebox at -0.10 to -1.0 inch water gauge with respect to the Np loadout room. Q-Cell room air from both the maintenance room and the hot corridor is combined with exhaust air from the neptunium loadout room and passed through a HEPA filter into plenum No. 4. where it combines with PR room hood exhaust air. The combined air stream is passed through two more HEPA filters before exiting from exhaust stack 296-A-1.

The vessels within the glovebox will have their own vessel vent system which is shown on drawings H-2-98747 and H-2-98745. The system consists of an off-gas collection manifold which exhausts through drop-out pot TK-Q45 through vacuum pump VP-Q45-1 through E-Q9 vent jet condenser and through VT-Q10 vent trap to the PUREX air tunnel. The vacuum pump will be physically located in the sample gallery in order to keep the noise out of Q-Cell.

The Oxalate Decomposition Tank, TK-Q16 can be expected to produce carbon dioxide gas as a decomposition product. Although pressurization of the tank would not be expected on the basis of experience with the same process in N-Cell, any pressurization would receive adequate relief through Line QA-17 which is 0.75 inches in diameter. This line ultimately goes into a two inch vessel vent line.

The fire protection system provided for the neptunium oxide glovebox uses an automatic, limited water supply wet pipe sprinkler system along with frangible bulb type sprinklers. This system will provide an "improved risk" level of fire protection as defined in DOE Order 5480.1a, Chapter X.

6.0 PRODUCTION PROCESS FOR NEPTUNIUM OXIDE

The conversion of neptunium nitrate solution to neptunium oxide takes place in the neptunium glovebox, GB-Q1 and GB-Q2. This glove box was added to Q-Cell as a process modification carried out under Project B-590.

The new back-end process used to convert neptunium nitrate solution to neptunium oxide solid is very similar to what is done in N-Cell to make plutonium oxide. Neptunium nitrate solution is eluted from the 3X column (TK-Q4) and collected in the 65 liter receiver tank (TK-Q14). Tank Q14 is the new feed head tank which replaces old TK-Q6 which has been removed. (Tanks Q14 and Q4 are not located in the new neptunium glove box, but are in the hot cell within Q-Cell.) The eluate from TK-Q4 is 0.35 molar nitric acid. Solution chemistry is adjusted to the required processing range by adding feed adjustment chemicals. Chemicals added include sufficient 12 M HNO_3 to bring the feed concentration to 2 M HNO_3. Also added is 0.26 liters of 11.3 M hydrazine to reduce and hold the neptunium oxidation state at +4. The 10 liter feed metering tank (TK-Q40, which is inside of the glovebox) receives pretreated feed solution from TK-Q14 and then vacuum transfers measured quantities of feed to the precipitator vessel, TK-Q42 (10 liter capacity) which is also in glovebox GB-Q1. Oxalic acid solution is added from TK-Q41, the oxalic acid metering tank. If a holding reductant is needed to maintain the neptunium in the (IV) oxidation state, ascorbic acid is added from the metering flask. Neptunium (IV) Oxalate is precipitated in TK-Q42 and filtered through a 10 micron sintered metal filter (F-Q44) or an equivalent paper filter. The filtrate which contains excess oxalic acid is transferred back out of the glovebox to tank TK-Q15, the filtrate collection tank.

The filtered neptunium oxalate is transferred into an Inconel combustion boat which receives approximately 0.5 Kg of wet neptunium oxalate by a combination of pouring and scraping from the filter. The boat will be placed in a drying oven which is vented to the vessel vent system in order to remove nitric acid vapor evolved from the boat during the drying operation. After drying, the combustion boat is transferred to the calcination furnace where neptunium oxalate is oxidized to neptunium oxide.

Filtrate waste is transferred from TK-Q15 to tank TK-Q16 which is the oxalate decomposition tank. This tank is heated by steam coils to boiling and the

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oxalic acid is converted to carbon dioxide and water. The main reason for conducting the oxalate destruction operation is to eliminate any possibility that oxalate could later pose a criticality problem in solvent extraction tanks or in the F10 Concentrator due to precipitation of plutonium by the oxalate. Concentration of plutonium by precipitation, could potentially pose a criticality threat. This issue is discussed further in the safety analysis section.

The Inconel combustion boat which contains the dried neptunium oxalate precipitate is transferred to the dry side of the glovebox and placed into the calcination furnace where 0.44 Kg of dry neptunium oxalate is converted to 0.23 Kg of dry neptunium oxide. The furnace off-gasses are collected and sent to the vessel vent system. The condensate returns to TK-Q16 while the carbon dioxide is sent to the vessel vent system.

The neptunium oxide is transferred into a vibratory tumbler to produce a homogenous powder for loading out into slip top containers which also serve as weighing dishes. A ten gram product sample is weighed to establish loss on ignition (LOI). Filled slip-top containers are weighed on a second, larger balance. The LOI determination is used to establish that conversion of neptunium oxalate to neptunium oxide has been quantitative.

The glovebox also contains a rework dissolver for use on neptunium oxide which does not meet product purity specifications. The rework dissolver is also used as a catch vessel for scrap neptunium resulting from cleaning the neptunium oxalate filter.

7.0 WASTE CONFINEMENT AND MANAGEMENT

Please refer to the PUREX FSAR, SD-HS-SAR-001, for a discussion of waste confinement and management.

8.0 RADIATION PROTECTION

The Non-Reactor Facility Safety Analysis Manual, WHC-CM-4-46, does not require consideration of facility worker radiation exposure relative to the risk acceptability criteria given for nuclear facilities. The manual generally only requires consideration of radiation exposure of non-facility workers or off-site persons as the "protected" population. Facility worker radiation protection is provided under the ALARA Program which is normally described in chapter 8 of a facilities' FSAR. It will be necessary to expand the discussion of ALARA relative to Q-Cell operations in Chapter 8 of the FSAR prior to operation of the facility. Production of a solid product rather than a solution as the final product will probably result in more worker exposure because the operation is more complex and requires more handing of radioactive materials. It is also true that the solid product would not be expected to provide as much self-shielding that a solution would be expected to provide.

The major part of the direct radiation dose will be provided by the ^{233}Pa daughter rather than by neptunium. This is true because the Pa decays by

beta ray and gamma ray while the neptunium decays by non-penetrating alpha ray. (The opposite is true of the internal inhalation dose where high energy alpha rays do the most damage.) According to Paragraph 8.3.2.3 of the PUREX Technical Manual, the equilibrium concentration of Pa in neptunium is 696 microcuries per gram of neptunium. Figure 8.2 of the PUREX Technical Manual shows the growth with time of the Pa daughter into freshly purified neptunium. If one assumes that only freshly purified neptunium is introduced into the new glovebox, and that the residence time in the glovebox is no more than three days, then concentration of ^{233}Pa in the neptunium should be no more than 80 microcuries per gram of neptunium.

Benecke has calculated that the dose rate for a one kilogram sphere of neptunium oxide would be 3.35 REM/hour at a distance of one centimeter from the surface for neptunium which is in equilibrium with its Pa daughter. Three day old neptunium would only have a fraction of this dose rate because it is not yet in equilibrium.

$$(80/696)(3.35) = 0.38 \text{ REM/hour per Kg } NpO_2$$

The 2 kilogram maximum neptunium inventory of the glove box would provide twice this dose or 0.76 REM/hour at one centimeter.

Thus the potential for considerable radiation exposure to the hands does exist, and use of appropriate shielding and work practices should be employed to minimize this dose.

In addition to the Q-Cell worker hazard from direct radiation which is discussed above, there is also the potential for considerable inhalation of radionuclides in the event that an accidental airborne release of neptunium from the glovebox to the Q-Cell atmosphere takes place. Exposure of facility workers is not a consideration with respect to risk acceptance criteria given in the safety manual, but such exposure is considered to be administratively controlled by the ALARA program. Sufficient neptunium inventory exists in the glove box that worker exposures in excess of radiological doses permissible under ALARA guidelines could occur.

9.0 SAFETY ANALYSIS

As is discussed below, a Preliminary Safety Evaluation has been done with respect to Project B-590, and it has been concluded that no credible accident scenarios involving this process modification have been identified which would be expected to result in unacceptable chemical or radiological releases to the environment. (Risk acceptability is defined in terms of the risk acceptability criteria provided in WHC-CM-4-46.)

The scenario of a broken one inch air line in the glovebox was examined, and it was concluded that a release of radionuclides from the glovebox to Q-Cell could possibly take place, but that the released material would be stopped by the HEPA filters in the ventilation system.

A scenario involving energy release from rapid chemical reaction was also examined, but it was concluded that reaction rates would be expected to be too slow to generate pressure transients sufficiently large to threaten protective barriers.

9.1 POTENTIAL ENERGY SOURCES

The breaching of protective barriers and/or the dispersal of radioactive or toxic materials normally require a release of energy such as that provided by a fire or explosion in order to take place. A small amount (260 milliliters) of 36.2% hydrazine hydrate (11.3 M) is added to TK-Q14 to stabilize the oxidation state of the neptunium. Hydrazine can potentially react violently with the 12 M nitric acid which is added to this vessel. (Material Safety Data Sheet for Hydrazine) In reality, the nitric acid is first added to Q14 to adjust the acid concentration of the IX column eluate to 2.0 M, thus the direct addition of 12 M nitric acid to hydrazine would be a procedure violation.

Karraker (1984) shows in his paper that the gas generation rate from the reaction between nitric acid and hydrazine ranges between 0.5 and 0.9 moles of gas produced per mole of hydrazine. Thus it can be shown that the 260 milliliters of hydrazine solution added to Q14 will provide 2.9 moles of hydrazine which could generate as much as 2.6 moles of gas which would occupy 63.4 liters at 25°C. In a sealed system with a nominal volume of 65 liters, this release of gas would double the systems pressure to 2 atmospheres or 29.4 psia. Since the vessel vent system includes a vacuum pump, the actual system pressure would be expected to be much less.

It was also shown in the paper by Karraker that the reaction between 6 M nitric acid and hydrazine is not a rapid reaction. The fastest reaction half-time at 80°C with 0.1 M ferric ion present as a catalyst was 33 minutes. Since it was also shown that reaction rate was first order with respect to nitric acid concentration, doubling the HNO_3 concentration to 12 M would have the effect of cutting the reaction half-time by a factor of two, lowering it to 16 minutes. It is still much too slow a reaction to generate any dangerous pressure transients. It is concluded that there is very little likelihood that a violent chemical reaction will take place in Q14. Note also that the concentration of the hydrazine is below 40% which is the lower limit of flammability given for flash point in the Material Safety Data Sheet.

Other than from violent chemical reaction, the only potential source of energy which could act to overcome barriers and disperse radiological materials is a compressed air leak in the Q-Cell glovebox. With a normal pressure of 100 psi, a full break in one inch line would deliver about 212 cubic feet of air per minute. It can be shown that a pipe break of one minute duration would cause the pressure in the glovebox to approximately double to about 15 psig versus the atmosphere. Such a pressure transient would be expected to cause contamination of Q-Cell, but would not be expected to cause loss of HEPA's on the PR Room ventilation system or otherwise cause a radiological release to the environment. It should be pointed out that the

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probability of a full one inch pipe break is quite small compared to the probability of a small air leak around an air line fitting.

9.2 Dose Calculation

An examination of the proposed neptunium oxide precipitation process reveals no apparent equipment failures or other accident scenarios which would release enough energy to overcome protective barriers and disperse radioactive materials. Even considering this, it is still instructive to assume a release scenario and calculate the radiological dose, in order to place the danger posed by this plant modification into proper perspective.

An accident scenario is proposed in which an explosion of unknown origin takes place on the dry side of the neptunium oxide glovebox. The total inventory of neptunium is estimated to be 2000 grams of neptunium contained in dry neptunium oxide powder. It is estimated that when the gloves are blown off the glovebox by the explosion that approximately one percent of the total or 20 grams of neptunium becomes airborne in the Q-Cell room and makes it all the way to the PR Room exhaust system.

The PR Room exhaust is filtered through two separate HEPA filters before being exhausted into stack 296-A-1. Note that this exhaust is equipped with an automatic damper which isolates the exhaust stream from the environment if the radiation CAM on the stack trips.

Each of the two HEPA filters is rated at 99.95% efficiency, thus the combination of two HEPA's can be expected to allow passage of only 2.5×10^{-7} of the total activity challenging the pair of filters. Thus the maximum amount of neptunium which would be expected to go out stack 296-A-1 would be:

$$(2.5 \times 10^{-7})(20) = 5 \times 10^{-6} \text{ grams}$$

Since it takes 1418 grams of Neptunium-237 to make one Curie, the maximum stack release is predicted to be 3.5×10^{-9} Curies. This value is considered to be the maximum source term because a number of other protective devices such as the automatic dampers have not been taken credit for.

Dose calculations were done with the GENII code using the above source term of 3.5×10^{-9} Curies. The nearest on-site individual at MO-405 was shown to receive a maximum predicted dose of only 6×10^{-16} or for all practical purposes zero REM. The off-site maximum doses were expected to be too low to calculate.

It can be seen from the above calculations that even if one of the two series HEPA filters on the PR room ventilation system were to fail, the resulting radiological doses would still meet the risk acceptance criteria defined in WHC-CM-4-46.

9.3 Risk Analysis Criticality Considerations

Criticality prevention specifications for the PUREX Plant are given in CPS-P-465-40000. Criticality specifications are only given for plutonium because the minimum critical mass for neptunium is so much larger than the amount of neptunium actually expected to be present in Q-Cell at any one time that neptunium itself is not of any importance relative to criticality.

The maximum concentration of plutonium permitted in feed transferred from TK-J2 to concentrator E-Q2 (the initial Q-Cell operation) is 6 grams per liter. (PUREX Process Control Manual, Table 12.14.3) The normal total amount of plutonium expected to be in tank E-Q2 is only 2.4 grams in a batch feed volume of 910 liters.

The precipitation of neptunium in Q-Cell is very similar to the operation used to precipitate plutonium in N-Cell. Oxalate filtrate in N-Cell, after being subjected to destruction by elevated temperature for a four hour period, is analyzed for residual oxalate. Criticality Prevention Specification CPS-P-465-40000 defines a limiting condition for operation (LCO) pertaining to N-Cell which requires that oxalate concentration in Tank E6 be maintained at $<1.6 \times 10^{-3}$ M for recycling of Pu when Pu concentrations > 6 g/l.

The plutonium concentration going into Q-Cell is only expected to be on the order of 2.6×10^{-3} grams/liter but there is still a concern that residual oxalate ion could precipitate plutonium in Concentrator F10 which is downstream from Q-Cell. It is appropriate to apply the above oxalate concentration requirement limit to Q-Cell. (Note that high oxalate concentrations do not pose a criticality danger to Q-Cell itself, but only to F10 Concentrator.)

The addition of the Q-Cell glovebox for neptunium oxide production is not expected to add any appreciable risk to the overall Q-Cell operation. Any accidents which might possibly occur relative to Q-Cell production of neptunium oxide would be expected to only affect Q-Cell workers. No accidents have been identified which would provide sufficient energy to provide the motive force for a radiological release affecting the nearest non-facility onsite worker or nearest offsite individual.

10.0 CONDUCT OF OPERATIONS

Please refer to the PUREX FSAR, SD-HS-SAR-001, for a discussion of contractor organizational structure and management control system.

11.0 OPERATIONAL SAFETY REQUIREMENTS

A criticality prevention specification should be considered for Q-Cell which requires that oxalate concentration in the effluent from Tank Q16 be maintained at $<1.6 \times 10^{-3}$ M whenever the plutonium inventory in Concentrator F10 exceeds 500 grams. Concentrator F10 receives Pu bearing waste from sources other than Q-Cell. The plutonium concentration going into Q-Cell is only expected to be on the order of 2.6×10^{-3} grams/liter which makes the probability of a criticality occurring in Q-Cell very low. Specifications call for the Pu concentration in the 2PN stream going into Q-Cell to be less

than 0.01 grams/gallon (0.038 grams/liter). Operation of the E-Q2 Stripper-Concentrator in Q-Cell can at most, provide a concentration increase which is a factor of nine. This would limit Pu concentration in Q-Cell solutions to less than 0.34 grams/liter.

There is, however, a concern that residual oxalate ion could precipitate plutonium from other sources in the F10 Concentrator which ultimately receives the effluent from Tank Q16. It is recommended that the new criticality specification be equivalent to CPS-P-465-40000, Mod G/2, Paragraph 13c pages 36-37. The new CPS would call for limiting the oxalate ion concentration in TK-Q16 such that the oxalate concentration in Concentrator F10 which receives this waste should not exceed 1.6×10^{-3} M.

12.0 QUALITY ASSURANCE

Please refer to the PUREX FSAR, SD-HS-SAR-001, for a discussion of quality assurance requirements.

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