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Waste Calcining Facility Remote Inspection Report

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**Westinghouse Idaho
Nuclear Company, Inc.**

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EXECUTIVE SUMMARY

The purpose of the Waste Calcining Facility (WCF) remote inspections was to evaluate areas in the facility which are difficult to access due to high radiation fields. The areas inspected were the ventilation exhaust duct, waste hold cell, adsorber manifold cell, off-gas cell, calciner cell and calciner vessel.

The WCF solidified acidic, high-level mixed waste generated during nuclear fuel reprocessing. Solidification was accomplished through high temperature oxidation and evaporation. Since its shutdown in 1981, the WCF's vessels, piping systems, pumps, off-gas blowers and process cells have remained contaminated. Access to the below-grade areas is limited due to contamination and high radiation fields.

Below grade, CPP-633 is constructed of re-enforced concrete to a depth of 49 feet. Above grade, CPP-633 is constructed of steel framing and cinder blocks. Waste processing was conducted below-grade in concrete-shielded cells. Processing cells are located on the west and east sides of the building, separated by the operating corridor and underlying access corridor.

The WCF remote inspections were conducted from March to June of 1994. Each inspection technique was tested with a mock-up in a radiologically clean area before the equipment was taken to the WCF for the actual inspection. During the inspections, essential information was obtained regarding the cleanliness, structural integrity, in-leakage of ground water, indications of process leaks, indications of corrosion, radiation levels and the general condition of the cells and equipment.

In general, the cells contain a great deal of dust and debris, as well as hand tools, piping and miscellaneous equipment. Although the building appears to be structurally sound, the paint is peeling to some degree in all of the cells. Cracking and spalling of the concrete walls is evident in every cell, although the east wall of the off-gas cell is the worst.

Groundwater in-leakage through the joints in the ventilation exhaust duct has run down the ventilation exhaust ports into the cells, but is probably not a major source of in-leakage to the facility. Cracks in the exterior walls, especially the east wall of the off-gas cell, are more likely the major sources of groundwater in-leakage.

All of the cells show signs of some process leakage, although signs of leakage in the waste hold cell are minimal. Process leaks into the calcine cell left residue and stains on the piping and cell liner where the highest recorded radiation levels were observed. Radiation levels as high as 270 β - γ :55 γ rem/hour were recorded on-contact with stains on the cell liner. General body fields (GBFs) in the calciner cell reached levels as high as 42 β - γ :6 γ rem/hour, whereas general body fields in the adsorber manifold cell ranged from 25 β - γ :20 γ rem/hour to 50 β - γ :35 γ rem/hour.

The internal inspection of the calciner vessel was aborted because the dolomite addition line used for access was found severed. The radiation levels in the ventilation exhaust duct were not recorded because radio contact was lost with the radiation monitoring equipment early in the inspection.

Several lessons were learned from the inspections which will improve future remote work at the WCF. Simulations, mock-ups and dry runs to test remote designs proved invaluable during the inspections. The original designs for both the waste hold cell and the calciner vessel were modified to correct deficiencies identified during the simulations. Access to hard-to-reach places should be a focal point during the design of the inspection equipment. Size and flexibility of the equipment should be of primary concern, as well as camera placement and capability. Minimization of exposure for the personnel operating the remote equipment should be a key consideration during planning. Fairly significant exposures are possible even though operating personnel remain in areas with relatively low radiation fields.

The results of the completed inspections and lessons learned will be used to plan future activities for stabilization and deactivation of the facility. Remote clean-up of loose piping, hand tools, and miscellaneous debris can start immediately while information from the inspections is factored into the conceptual design for deactivating the facility.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	iii
TABLE OF CONTENTS	vii
PURPOSE	1
HISTORICAL BACKGROUND	1
PROCESS DESCRIPTION	2
PHYSICAL DESCRIPTION	4
Waste Hold Tanks and Cell	5
Calciner Vessel and Cell	5
Off-Gas Quench System, Feed Evaporator and Off-Gas Cell	5
Ruthenium Adsorbers	6
Off-Gas Filters and Blowers	7
Ventilation	7
Hot Sump Tank	8
REMOTE INSPECTIONS	8
Ventilation Exhaust Duct Inspection	8
Description of Inspection	8
Inspection Results	8
Conclusions and Planned Course of Action	9
Waste Hold Cell Inspection	9
Description of Inspection	9
Inspection Results	9
Conclusions and Planned Course of Action	10
Adsorber Manifold Cell Inspection	11
Description of Inspection	11
Inspection Results	11
Conclusions and Planned Course of Action	12
Off-Gas Cell	12
Description of Inspection	12
Inspection Results	13
Conclusions and Planned Course of Action	14
Calciner Cell	14
Description of Inspection	14
Inspection Results	14
Conclusions and Planned Course of Action	15
WC-102 Calciner Vessel	16
Description of Inspection	16
Inspection Results	16
Conclusions and Planned Course of Action	16
LESSONS LEARNED	17
SUMMARY	17

PURPOSE

The purpose of the Waste Calcining Facility (WCF) remote inspections was to evaluate areas in the facility which are difficult to access due to high radiation fields. Although the list is not all-inclusive, the areas were inspected for:

- cleanliness
- structural integrity
- in-leakage of ground water
- indications of process leaks
- indications of corrosion
- radiation levels
- general condition

The results of the inspections will be used to plan future activities for stabilization and deactivation of the facility.

HISTORICAL BACKGROUND

The Idaho Chemical Processing Plant (ICPP), located within the Idaho National Engineering Laboratory (INEL) site, reprocessed nuclear fuel for defense applications. Reprocessing produced liquid, high-level mixed waste which was stored in underground storage tanks prior to solidification. Solidification was accomplished through the calcination process at the WCF.

The WCF was designed for contact maintenance which required decontamination to low radioactivity levels prior to conducting maintenance on process equipment. Over the operating history of the facility, process and decontamination solutions corroded metal surfaces and insoluble residues built-up in areas that were hard to access. Subsequent decontamination of equipment became increasingly difficult and radiation levels progressively rose. Consequent aggressive decontamination techniques contributed to equipment aging, resulting in the increased frequency and severity of corrosion-related leaks and failures.

Early calciner operations used a heated sodium-potassium eutectic alloy to provide heat to the fluidized bed during processing. In 1970 the calciner was converted to an in-bed kerosene combustion system to sustain bed temperatures. The conversion improved the process efficiency, but released hydrocarbon residue in the off-gas which deposited on the ruthenium adsorbers. Further, the change caused ruthenium compounds to form as particulates in the off-gas stream which deposited in the calciner piping and off-gas cell.

The WCF was designed and originally operated as a demonstration plant, and then placed in operation for production in 1963. From 1963 to 1981, the facility completed a series of 9 processing campaigns, converting over 4,000,000 gallons (535,000 ft³) of liquid waste to approximately 77,000 cubic feet of solids. The WCF was replaced by the New Waste Calcining Facility (NWCF) following the WCF's final campaign in 1981, although the WC-114 evaporator unit continued to operate until 1986. The WCF tanks were emptied and some were flushed with water, but none of the tanks were thoroughly decontaminated. This was customary practice for process shutdowns at that time.

Since its shutdown, the WCF's vessels, piping systems, pumps, off-gas blowers and process cells have remained contaminated. Moderate to high levels of radioactivity remain in the below-grade areas of the WCF which limits access to these areas. Asbestos abatement was completed for the above-grade portions of the WCF in 1993 and these areas are readily accessible.

PROCESS DESCRIPTION

Liquid waste was fed from the ICPP tank farm to the calcining process which used high temperature oxidation and evaporation to solidify the waste. The feed was an acidic, radioactive liquid waste which contained a high percentage of dissolved and undissolved solids, including salts, radio-nuclides, process additives and neutron poisons. After calcination, the solid waste was pneumatically transferred to underground storage in solids storage bins.

A simplified flow diagram of the calcination process is shown in Figure 1, which presents the major equipment of concern for stabilization and deactivation. As presented in Figure 1, liquid waste entering the WCF from the tank farm was blended and held in the waste hold tanks (WC-100 and -101) until it was fed to the calciner vessel (WC-102) or the feed evaporator (WC-114). Additionally, WC-100 and -101 provided a return path to the tank farm for the WC-114 evaporator bottoms.

Liquid waste from WC-100 and -101 was air-lifted to an intermediate tank, which provided constant head pressure, and then fed to the calciner vessel, WC-102. The liquid waste was evaporated and oxidized at approximately 500°C in WC-102 to produce calcine (salts and oxides produced from dissolved metals and fission products). The solid calcine was then pneumatically transferred to underground storage in the solids storage bins.

WASTE CALCINING FACILITY (WCF)

Figure 1

The scrub solution surge tank, WC-108, supplied scrub solution to the off-gas quench tower, WC-107, where it sprayed into the off-gas stream through silicon carbide nozzles. The scrub solution in WC-107 removed calcine particles and moisture, and cooled the calciner vessel off-gas. The off-gas leaving WC-107 was directed to the silica gel adsorbers (WC-110 and -111 or WC-112 and -113) by the adsorber manifold. WC-110, -111, -112, and -113 each contain an amorphous silica gel which removed volatile ruthenium from the off-gas. After leaving the silica gel adsorbers, the off-gas passed through a series of HEPA filters and then out of the WCF to the ICPP Main Stack.

The feed evaporator, WC-114, originally stored adsorber wash solutions for return to the waste hold tanks. Later, it concentrated high level waste from the tank farm via WC-100 and -101 and the concentrated solution was sent back to the tank farm. The condenser overheads from WC-114 were sent to WC-119.

The hot sump tank (WC-119) collected all of the radioactive waste solutions from the WCF equipment and cell floor drains through jets, pumps or gravity drains. This vessel provided temporary storage for process or decontamination waste and still provides storage for steam condensation and groundwater in-leakage.

RCRA Part A permitted equipment is indicated by an asterisk (*) in Figure 1. Plan views and sections of CPP-633, which show equipment locations and arrangements, are presented in Appendix A.

PHYSICAL DESCRIPTION

Below grade, CPP-633 is constructed of 2 to 7 foot thick reinforced concrete to a depth of 49 feet. Above grade, CPP-633 is constructed of steel framing and cinder blocks. Including the below grade portion, the overall dimensions of the structure are 110 feet long, 70 feet wide and approximately 80 feet deep. Plan views and sections of CPP-633 are presented in Appendix A.

Waste processing was conducted below-grade in concrete-shielded cells. Processing cells are located on the west and east sides, separated by the operating corridor and underlying access corridor. The operating corridor is 15 feet wide, 77 feet long and 11 feet high. An instrument control panel runs down the middle of the operating corridor, although much of the instrumentation is no longer in service. The access corridor is located immediately below the operating corridor and measures 15 feet wide, 59 feet long and 21 feet high. Entry to most of the main process cells is from: 1) the access corridor through labyrinths, or 2) at grade level through overhead hatches and concrete hatch covers.

Waste Hold Tanks and Cell

The waste hold tanks, WC-100 and -101, are vertically mounted, 6 foot diameter, stainless steel tanks with a design volume of 2,090 gallons each. WC-100 and -101 are located in the waste hold cell and were last used in 1988 as a return route to the tank farm from WC-114. When use of WC-100 and -101 was discontinued, they were jetted to the minimum heel.

The waste hold cell is 12 feet wide, 21 feet long and 17.5 feet high with a sump located in the floor between the tanks. The cell has a stainless steel liner covering the floor and sump and extending 7 inches up the wall. The unlined wall and ceiling are covered with 3 coats of paint. Access to the waste hold cell is through a 21 inch-square opening in the access corridor or through two overhead hatches.

Calciner Vessel and Cell

The calciner vessel consists of a stainless steel vertical cylinder with a hemispherical head and conical bottom. The vessel's overall length is 20.5 feet and its maximum diameter is 4 feet. During operation, the calciner vessel contained approximately 55 cubic feet (5000 pounds) of calcine material. WC-102 was last used in 1981 and then shutdown. Shutdown consisted of opening the bottom drain to remove solids, "dusting" with fluidizing air to remove the fines, and then flooding and backflushing the calciner vessel with water.

The calciner cell is 15 feet wide, 21 feet long and 29.5 feet high. The cell floor and walls are completely lined with stainless steel while the ceiling is covered with three coats of paint. Access to the calciner cell is through a labyrinth in the access corridor or through an overhead cell hatch on the east side of the building. Process solution leaks and leakage of calciner solids occurred in the calciner cell. Historically, residual chemicals from process leaks and calcine solids were removed by dissolution with decontamination chemicals.

Off-Gas Quench System, Feed Evaporator and Off-Gas Cell

The off-gas quench system consists mainly of the quench tower, WC-107, and the scrub solution make-up tank, WC-108. WC-107 is 5.5 feet in diameter and 9 feet tall. WC-108 is 5 feet in diameter, 12 feet long, and holds 1800 gallons. Both vessels are constructed of stainless steel, although the spray nozzles in WC-107 are made of silicon carbide. WC-107 and WC-108 were last used in 1981 and then shutdown by jetting WC-108 empty.

Process solution leakage from failed valves or pipes occurred during operation. Further, ruthenium deposits are suspected to have accumulated in the off-gas piping

The feed evaporator, WC-114 is made of stainless steel and has a capacity of 5400 gallons. The evaporator vessel is a horizontally mounted, cylindrical tank that is approximately 17.5 feet long with a 7 foot diameter. The feed evaporator was last used in 1986 to concentrate high level liquid waste and return it to the tank farm via WC-100 and -101.

WC-107, WC-108 and WC-114 are all located in the off-gas cell. The off-gas cell is constructed of concrete and measures 21 feet wide, 35 feet long and 30 feet high. The cell floor is lined with stainless steel which extends 7 inches up the walls. Three coats of paint cover the remaining wall surfaces and ceiling. The off-gas cell can be accessed through the overhead cell hatch on the east side of CPP-633 or through a labyrinth in the access corridor.

Ruthenium Adsorbers

After quenching, the off-gases were piped across the access corridor to the adsorber manifold cell. The adsorber manifold cell houses the valves and piping (including the adsorber manifold) that routed process off-gases to and from the ruthenium adsorbers. The adsorber manifold consists of a U-shaped section of pipe which follows the North, West and South walls of the cell with valved branches to the ruthenium adsorbers.

The adsorber manifold cell is 17 feet wide, 22 feet long, and 21 feet high. The floor and lower 7 inches of the cell are lined with stainless steel. The remainder of the walls and the ceiling are painted with three coats of paint. Access to the adsorber manifold cell is through an overhead cell hatch west of the building or through a labyrinth entered from a landing between the access and operating corridors.

The ruthenium adsorbers, WC-110, -111, -112 and -113, are 7 foot diameter, 16.5 feet high, stainless steel vessels which taper towards the bottom. Each is loaded with 6,000 pounds of silica gel for collection of radioactive ruthenium. An adsorber cell is located on either side of the adsorber manifold cell, each containing two adsorber vessels. Each cell is 11 feet wide, 21 feet long, and 21 feet high. Both cells' floors are lined with stainless steel which runs 7 inches up the walls. The remainder of the walls and the ceiling are coated with three layers of paint. Access to the adsorber cells is from overhead cell hatches west of the building or through knock-outs (filled with lead bricks) in the adsorber manifold cell walls.

The ruthenium adsorbers are believed to be the source of high radiation levels and RCRA-listed hazardous constituents. In-bed combustion of kerosene inside the calciner vessel is believed to have caused the build-up of unburned hydrocarbons in the silica gel, resulting in the collection of ruthenium and mercury. The WCF adsorber systems were designed to pneumatically transport spent silica gel to the Solids Storage Bins, but plugged piping in the transport system and high radiation levels necessitated removal of part of the piping. The remaining pipe ends are capped in the off-gas cell.

Off-Gas Filters and Blowers

Process off-gases were filtered to remove fine particles in three removable off-gas filter units located in the off-gas filter cell, which is 10 feet wide, 18.5 feet long and 8.5 feet high. The filter units are separated by walls constructed of steel plate. Stainless steel lines the cell floors and concrete walls while the ceiling is coated with three layers of paint. Access to each filter unit is through a concrete hatch cover at grade level.

Filtered process off-gases were drawn through two off-gas blowers located in the off-gas blower cell, which is 24 feet wide, 26 feet long and 9 feet high. Stainless steel lines the floor and the bottom 6 inches of the walls. The remainder of the walls and ceiling are coated with three layers of paint. Two concrete ceiling hatches are installed in the cell for grade-level access. From the exhaust of the blowers, the off-gases left the building for discharge up the ICPP stack.

Ventilation

Ventilation within the WCF was maintained by a central supply fan on the main floor level and an exhaust blower located in the blower pit outside the north end of the WCF. This system is still operational and running to maintain air flow from the areas of lowest contamination to the areas of highest contamination. Air flow is from the main floor level to the operating and access corridors, out through the cells to a buried tile duct which surrounds the WCF perimeter. The tile duct is exhausted through the exhaust blower pit, then filtered, and finally discharged to the ICPP stack.

Hot Sump Tank

The hot sump tank, WC-119, is constructed of stainless steel and has a 5000 gallon capacity. The tank is 17.5 feet long with a 7 foot diameter. WC-119 is located below the access corridor in a cell which is 9.5 feet wide, 25 feet long and approximately 11 feet high. The cell floor and lower 6 inches of the walls are lined with stainless steel. The remainder of the cell is coated with three layers of paint. The cell can be accessed through a 2 foot-square hatch in the access corridor floor. Although still in use to collect steam condensate, WC-119 was last used to collect process solutions (hazardous waste) in 1986.

REMOTE INSPECTIONS

The WCF remote inspections were conducted from March to June of 1994. Each inspection technique was tested with a mock-up in a radiologically clean area before the equipment was taken to the WCF for the actual inspection. The cell inspections were performed with remotely operated vehicles equipped with detectors to monitor radiation fields and cameras for visual observations. Internal inspections also employed radiation detectors and cameras.

The intent of each cell inspection was to determine the general body fields and hot spots in the cells. In addition, process leaks and in-leakage from outside the cells were identified during the inspections. The general condition of the stainless steel liners, paint and concrete was also examined. Finally, the condition of the vessels, associated equipment, piping and equipment mounts in each cell was observed. Internal inspections were intended to determine the radiological and general conditions of the inspected equipment. Conditions particular to each cell or equipment were also noted.

Ventilation Exhaust Duct Inspection

Description of Inspection

The ventilation exhaust duct was internally inspected for general status and radiological conditions on March 7, 1994 with a Mini-Track robot. The robot was equipped with lights and a camera, and Merlin-Gerin β - γ : γ radiation detectors.

Inspection Results

The Merlin-Gerin β - γ : γ radiation detectors failed shortly after the inspection started and no useful radiation levels were obtained.

The visual inspection revealed that the ventilation exhaust duct is in generally good condition. There was no sign of serious structural failure, although there was some indication of in-leakage from ground water (run-off). The flanged joints of the pipe were sealed with concrete when the line was installed and discoloration at the joints indicates that this is the source of the in-leakage. There is additional discoloration where the in-leakage has run along the bottom of the pipe. Further, there is a small amount of fine debris along the bottom of the pipe.

Conclusions and Planned Course of Action

Radiation readings are still required in the ventilation exhaust duct. The duct will be inspected using remote equipment with better clearances and more durable radiation detectors.

Waste Hold Cell Inspection

Description of Inspection

The waste hold cell was inspected June 1, 1994 with a Genie hoist mounted in the 21 inch-square opening in the access corridor. A Genie hoist is a pneumatically-driven, telescoping arm with 6 foot segments capable of extending to total length of 28 feet. The hoist was operated from just outside the opening by a technician in contact with personnel monitoring the remote indications. The height of the hoist was controlled by adjusting the mount in the 21 inch-square opening.

A camera and light capable of tilting in the vertical plane and rotating 360° in the horizontal plane was mounted on the end of the hoist, along with Merlin-Gerin detectors to measure β - γ : γ radiation levels. The camera's monitor and the Merlin-Gerin read-out were remotely displayed above-grade in the WCF health and safety office.

Inspection Results

Radiation levels in the cell varied from approximately 1 to 7 rem/hour β - γ : γ and 0.5 to 4 rem/hour γ . The highest readings were generally observed towards the east wall, north of WC-101, although variations in radiation levels were seldom more than approximately 2 rem/hour throughout the cell. The lowest readings were observed just inside the 21 inch-square opening, but reached the average reading of (3 to 5) β - γ : (1 to 2) γ rem/hour within several feet of the opening.

The major source of radiation was the dust-like debris on the floor as indicated by the 1 to 2 β - γ rem/hour rise in radiation readings when the hoist was angled down toward the floor. No significant hot spots were noted and readings taken approximately 1½ inches from WC-100 and WC-101 were essentially the same as the general body fields (GBFs) in the cell.

An approximately ¼" layer of dust-like debris, with occasional larger pieces, covers the entire floor. There is a badly deteriorated aluminum ladder and several hand tools in the cell. Also, there is tubing, piping and miscellaneous pieces of trash scattered throughout the cell.

The cell's liner appears to be intact and in fairly good condition, although much of it is obscured by the dust-like debris. Further, the piping, tanks, and tank mounts are in good condition with minimal surface corrosion. The piping shows minimal staining which indicates that there has been limited process leakage in the cell. It should be noted that restricted access under WC-100 and WC-101 prohibited a good view of the cell sump, which might be expected to have higher radiation levels and show more wear and corrosion.

The paint on the cell walls is in fair condition, with the exceptions of stains which run down the walls from the ventilation exhaust ports. In some areas the paint has etched away under the stains and the concrete is showing. Cracking of the concrete walls appears to be on the surface only. No definite source of groundwater in-leakage was observed on the north or east walls. However, the south wall, east of WC-101, is badly stained from approximately 10 feet above the floor to the lip of the cell liner. This appears to be the result of solution flowing from the calciner cell. Presumably, flow is through a crack in the wall between the cells although no definite source for the leakage could be identified.

Conclusions and Planned Course of Action

The on-contact radiation readings from WC-100 and WC-101 indicate that the vessels are empty, with possible dry residuals remaining in the tanks. Any heel left in the tank should have resulted in on-contact radiation readings significantly higher than the GBFs, which was not the case.

Relatively low radiation fields will ease an initial clean-up of the dust, debris and tools in the cell with little development of new remote techniques required. It is anticipated that the remote vacuuming and gathering of miscellaneous items, followed by spraying down the floor, will reduce the radiation fields and allow manned entry into the cell.

Adsorber Manifold Cell Inspection

Description of Inspection

The adsorber manifold cell was inspected June 7, 1994, using a ANDROS robot equipped with an electric automotive radio antenna. The ANDROS robot runs on three sets of treads, which allow it to negotiate stairs and climb over many obstacles. It also has a three-jointed arm which can be moved in all three directions. Attached to the end of the arm is a simple hand which rotates and tilts.

The ANDROS robot entered the adsorber manifold cell through a labyrinth accessed from the landing in the south stairwell between the access corridor and the operating corridor. Control of the robot was accomplished by means of cables connecting the robot to the controls in the access corridor.

Merlin-Gerin β - γ : γ radiation detectors were attached to the arm and the electric antenna to monitor β - γ : γ levels in the cell. The detectors on the arm allowed the unit to take on-contact readings on the floor and against piping and tanks. The detectors on the electric antenna allowed the unit to monitor GBFs approximately 4 to 7 feet off the floor. Limited on-contact readings were possible with the arm, depending on the degree of interference from ancillary piping and equipment.

A camera and light capable of tilting vertically and rotating 360° horizontally was mounted on the end of the ANDROS arm. The camera's monitor and the Merlin-Gerin read-outs were remotely displayed above-grade in the WCF health and safety office.

Inspection Results

Radiation levels in the adsorber manifold cell rose from a low of approximately 7 β - γ :5 γ rem/hour at the top of the stairs entering the cell to approximately 38 β - γ :33 γ rem/hour at the bottom of the stairs. GBFs were generally in the range of (25 to 50) β - γ :(20 to 35) γ rem/hour range.

The highest on-contact reading from the floor was 176 β - γ :150 γ rem/hour from a stain in the southwest quarter of the cell. Two radiation readings of similar magnitude were observed 12" above the cell sump and 6" above the deteriorated pieces of an aluminum ladder. Multiple radiation readings taken at 6" from the manifold piping were in the (25 to 50) β - γ :(15 to 30) γ rem/hour range.

The condition of the stainless steel liner could not be determined due to the amount of material on the floor. The material on the floor was apparently wetted and dried, because it

has solidified and lost the dust-like consistency observed in the other cells. The hardened layer has subsequently cracked into pieces approximately 1" to 3" across.

There are many pieces of instrument tubing, pipes and unidentifiable pieces of debris on the floor. The cell also contains a hand cart, buckets, and three ladders. One of the ladders broke into multiple pieces when it was moved by the ANDROS robot.

Several of the valves on the branch lines to the ruthenium adsorbers show signs of significant pitting and corrosion from process leaks. In general, the rest of the piping is in fair condition with limited surface corrosion and minimal staining. The piping mounts which were observed are also in fairly good condition, although a good view of the mounts under the major piping was not possible because they were not accessible with the ANDROS' arm. There is no indication of groundwater in-leakage in the cell.

Conclusions and Planned Course of Action

The adsorber manifold poses several problems for future cleaning and decontamination. The radiation levels necessitate that initial efforts be performed remotely. However, the material on the floor will be difficult to vacuum due to its size. Furthermore, the equipment in the cell has deteriorated and become brittle due to the high flux in the cell. As observed during the remote inspection, moving the equipment may cause it to break into pieces which are large enough to preclude vacuuming, but small enough to make remote gathering very time consuming.

Plans for the cell include removal of the equipment, tubing and debris. Following this effort, the crust on the floor and any small debris generated by removing the equipment will be removed. A method for this has not yet been determined.

Off-Gas Cell

Description of Inspection

The off-gas cell was inspected June 10, 1994, using the ANDROS robot with a Genie hoist mounted on top of it. Both the arm of the ANDROS and the Genie hoist were equipped with Merlin-Gerin radiation detectors to monitor β - γ radiation levels. A camera and light were also mounted on the arm and hoist. The cameras' monitor and the Merlin-Gerin read-outs were remotely displayed above-grade in the WCF health and safety office. The off-gas cell was accessed through the labyrinth in the access corridor.

The cell was inspected on June 22, 1994 with the ANDROS robot, but with the Genie hoist removed. This allowed better access between and under the vessels in the cell. Only β - γ radiation readings were obtained during this entry, and any radiation readings from this cell which do not include a γ radiation reading are from the second entry.

Inspection Results

Radiation levels in the cell varied from a low of approximately 0.4 β - γ :0.3 γ rem/hour just inside the cell door to high readings of approximately 10 β - γ :6 γ rem/hour between WC-108 and the east wall of the cell. GBFs were generally in the range of (2 to 6) β - γ :(0.6 to 5.0) γ rem/hour range. The highest GBFs were measured between WC-108 and the east wall whereas the lowest readings were taken in the south-east corner of the cell and against the north wall.

The highest on-contact readings from the floor were taken above a stain at the south end of WC-108, which read 77 β - γ rem/hour. On-contact readings on the floor between WC-108 and WC-114 steadily dropped from a high of 21 β - γ rem/hour at the south end of the vessels to a low of 8.6 β - γ rem/hour at the north end of the vessels.

On-contact radiation readings on WC-108 varied from 6 to 12 β - γ rem/hour, and on-contact readings for WC-114 varied from 6 to 8 β - γ rem/hour. On-contact readings taken on WC-107 by extending the Genie hoist were approximately 2 β - γ :1 γ rem/hour, indicating that there is no significant source of radioactivity inside WC-107.

The condition of the piping, equipment and mounts varied from good to badly corroded. The equipment mounts along the east wall show signs of minor corrosion and there is evidence of process leaks on some of the instrument piping. The flanges of the pump mounted on the south end of WC-108 show signs of extensive leakage and subsequent corrosion.

The stainless steel liner is stained below WC-108 and WC-114 from process leaks. The source of the leaks is apparently the process and instrument pipe connections to the vessels. Aside from the stains, the liner appeared to be in good condition, although the build-up of dust-like debris towards the walls obscured the outer portions of the liner. The debris reached a maximum depth of approximately 4 inches next to the wall. There are also several hand tools and larger pieces of debris in the cell.

Large areas (some as large as 5 or 6 feet in diameter) of spalling and flaking on the walls appear to be the source of the dust-like debris. The spalling is worst east of WC-108 and in the cell's southeast corner. Further, there is considerable cracking of the concrete in the spalled areas. Staining below the cracks indicates that there has been some in-leakage of groundwater.

Conclusions and Planned Course of Action

The cracking and spalling of the exterior walls are not considered an immediate structural problem, but the resulting in-leakage of groundwater requires that stabilization of the cell be given a high priority. The process leaks around the vessels must be addressed before the process lines and equipment can be flushed.

Plans for the cell include removal of the equipment, tubing and debris. The dust-like debris along the exterior walls and any larger debris will be removed. Removal will likely be accomplished by remote HEPA vacuuming.

Calciner Cell

Description of Inspection

The calciner cell was inspected June 14, 1994, using the ANDROS robot with a mounted Genie hoist. Both the arm of the ANDROS and the Genie hoist were equipped with Merlin-Gerin radiation detectors to monitor β - γ radiation levels. A camera and light were also mounted on the arm and hoist. The cameras' monitor and the Merlin-Gerin read-outs were remotely displayed above-grade in the WCF health and safety office. The calciner cell was accessed through the labyrinth in the access corridor. The cell was inspected a second time on June 20, 1994 with the ANDROS robot, but with the Genie hoist removed, to allow better access under WC-102.

Inspection Results

GBFs in the cell varied from a low of approximately 10 β - γ :4 γ rem/hour in the south-west corner of the cell to a high of 42 β - γ :6 γ rem/hour next to WC-102. GBFs fluctuated widely in the cell, depending on the instruments' proximity to WC-102 and the process stains on the floor.

The highest on-contact readings from the floor were taken under WC-102 and read 270 β - γ :55 γ rem/hour. Several process stains on the floor around WC-102 had on-contact readings of similar

magnitude. On-contact readings against the bottom of WC-102 were 51 β - γ :17 γ . The fluidizing air lines against the east cell wall read 19 β - γ :9 γ rem/hour, although the on-contact readings for piping along the west wall were generally less than 10 β - γ :3 γ rem/hour.

The stainless steel liner is badly stained from process leaks, especially around and under WC-102. The condition of the floor lining could not be determined due to the approximately $\frac{1}{4}$ inch layer of dust-like debris. The lining on the walls was stained in several places, although the source of the stains could not be determined due to the complexity and amount of piping in the cell. The equipment mounts and platform grating also exhibit more signs of corrosion and deterioration than was observed in the other cells.

Process leaks have stained some of the piping, flanges and valves, and there is considerable localized damage on several sections of pipe. One line, approximately 10 feet from the bottom and connected to the south side of WC-102, has been severed approximately 5 feet from the vessel. Several instrument lines are also broken high on the north side of WC-102.

There is a considerable amount of instrument tubing, hand tools, miscellaneous metal pieces and general debris spread throughout the cell. A remote inspection conducted in 1992 ended when the robot (the robot was developed by the ICPP remote inspections group) failed. The failed robot is still in the cell.

Conclusions and Planned Course of Action

Originally, it was planned to use on-contact radiation readings against WC-102 at varying heights to determine if there is any calcine material concentrated in WC-102. The complexity and amount of piping and equipment next to the vessel prevented raising the Genie hoist higher than 6 or 8 feet next to the vessel. Thus, another method of evaluating WC-102 for the build-up of calcine material must be determined.

Plans for the cell include removal of the failed robot, hand tools, miscellaneous equipment, tubing and debris. The radiation levels necessitate that initial clean-up efforts be performed remotely. Additionally, the process stains will require decontamination which must also be performed remotely.

WC-102 Calciner Vessel

Description of Inspection

Inspection of the WC-102 calciner vessel was attempted June 24, 1994, with an Elmo (Model #EM-401) camera fitted with a 7½ mm lens. The camera was mounted inside a circular array of lights and inserted into WC-102's dolomite addition line. The 1½ inch, schedule 80 pipe was opened at a flange connection in the operating corridor to insert the camera. The camera's monitor was remotely located in the WCF health and safety office.

Inspection Results

The camera was inserted approximately 30 feet down the dolomite addition line where it was discovered that the line had been severed. The centerlines of the separated sections of pipe were offset approximately 4 inches. The camera could not be inserted in the downstream section of pipe and the inspection was terminated.

Conclusions and Planned Course of Action

It was concluded that the dolomite addition line is the severed line observed on the south side of WC-102 during the calciner cell inspection. Further evaluation has eliminated the possibility of connecting the pipes or inserting a camera from the calciner cell into the pipe. Three options for a future inspection are currently being considered:

- Inspect the vessel through a smaller pipe with a smaller, much more expensive camera unit.
- Lift the overhead cell hatch. Lift the mancover or drill through the top of WC-102 and insert an Elmo camera. This approach would result in the most personnel exposure and the camera would need to negotiate through a baffle plate inside WC-102.
- Drill a hole through the side of WC-102 and insert an Elmo camera. This approach would require remote development to negotiate the maze of piping around WC-102 and remotely drill a hole. Personnel access to drill the hole is prohibited due to the high radiation fields in the cell.

An inspection option will be selected by Aug 31, 1994 and a plan developed for the remote inspection of WC-102.

LESSONS LEARNED

Simulations, mock-ups and dry runs to test remote designs proved invaluable during the inspections. The first design for inspecting the waste hold cell was rejected entirely after the equipment was found to be too heavy and hard to operate during mock-up testing. The original camera and light design for the calciner vessel inspection was too large to pass through the bends of the pipe. Re-designing the mount for the lights allowed the assembly to pass easily through the dolomite addition line during the actual inspection.

Access to hard-to-reach places should be a focal point during the design of the inspection equipment. Size and flexibility of the equipment should be of primary concern, as well as camera placement and capability. Due to the number and complexity of the pipes surrounding many vessels, such as WC-102, critical observations may be lost due to the remote equipment's inability to negotiate the piping.

Exposure for the personnel operating the remote equipment should be reduced to the greatest extent possible. Total personnel exposure for the adsorber manifold cell inspection was approximately 500 mrem. Due to difficulties accessing the cell, opening and closing the labyrinth door accounted for over 300 mrem of the total exposure. Generally, the time that personnel are exposed to high radiation levels is confined to the period of time that they are getting the equipment into the cells. However, any difficulty or delay with the equipment can result in significant increases in exposure.

SUMMARY

The WCF inspections were generally successful, although not all objectives were fully met. Essential information was obtained regarding the cleanliness, structural integrity, in-leakage of ground water, indications of process leaks, indications of corrosion, radiation levels and the general condition of the waste hold cell, off-gas cell, calciner cell and adsorber manifold cell.

The cells in general contain a great deal of dust, debris, hand tools and miscellaneous piping. Although the building appears to be structurally sound, the paint is peeling to some degree in all of the cells. Cracking and spalling of the concrete walls is evident in every cell, although the east wall of the off-gas cell the worst.

Groundwater in-leakage through the ventilation exhaust duct joints has run back down ventilation exhaust ports in the cells, but is probably not a major source of in-leakage in the WCF. Cracks in the exterior walls, especially the east wall of the off-gas cell, are more likely the major sources of groundwater in-leakage.

All of the cells show signs of some process leakage, although leakage in the waste hold cell is minimal. Process leaks in the calciner cell created hot spots on the piping and cell liners where the highest recorded radiation levels were observed. The equipment mounts throughout CPP-633 are in generally good condition, showing only signs of relatively minor surface corrosion. Equipment and piping corrosion is exclusively associated with process leaks.

The highest reading hot spots and GBFs were found in the calciner cell. The adsorber manifold cell also had high GBFs. It was determined that no heel exists in WC-100 and WC-101 based on the radiation readings next to the vessels. No determination of whether calcine material had concentrated in WC-102 could be made because the Genie hoist could not be positioned to extend up through the maze of piping next to WC-102.

The internal inspection of the calciner vessel was aborted because the dolomite addition line was severed. The radiation levels in the ventilation exhaust duct were not recorded due to losing contact with the radiation monitoring equipment early in the inspection. Re-inspection of the calciner vessel and ventilation exhaust duct using slightly different methods is anticipated to obtain more complete radiation readings.

The results of the completed inspections will be used to plan future activities for stabilization and deactivation of the facility. Remote clean-up of loose piping, hand tools, and miscellaneous debris can start immediately while information from the inspections is factored into the conceptual design for deactivating the facility.

APPENDIX A

EQUIPMENT ARRANGEMENTS, ELEVATIONS AND PLAN VIEWS

A-3

Equipment Arrangement
(Looking West)

Equipment Arrangement
(Looking North)

OPERATING CORRIDOR
ELEV. 1-112' 4" TO ELEV. 0'-0"

ELEVATION LOOKING WEST

SCALE: $\frac{3}{32}$ " = 1' - 0"

ACCESS CORRIDOR
 ELEV. (-) 34' - 2 $\frac{3}{4}$ " TO
 ELEV. (-) 22' - 7 $\frac{1}{4}$ "

SCALE: $\frac{3}{32}$ " = 1' - 0"

HOT SUMP FLOOR
 ELEV. (-)49'-0" TO
 ELEV. (-)34'-2 $\frac{3}{4}$ "

SCALE: $\frac{1}{32}'' = 1' - 0''$

DATE

FILMED

10/17/94

END