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SIEMENS

January 13, 1997
JBE:97:005

U.S. Nuclear Regulatory Commission
Attn: Michael F. Weber, Chief
Licensing Branch
Division of Fuel Cycle Safety and Safeguards, NMSS
Washington, DC 20555

Dear Mr. Weber:

Enclosed for your information and to include in Chapter 15 of Siemens Power Corporation's (SPC) license application are two copies each of pages 15-23a through 15-23e and 15-30a through 15-30g. These pages provide summaries of criticality safety analyses for the Line 2 ADU Process and the Line 2 UO_2 Powder Production System.

If you require additional information, please call me at 509-375-8663.

Very truly yours,

J.B. Edgar

James B. Edgar
Staff Engineer, Licensing

/pg

Enclosures

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15.1.6.4.3 Fire Protection

The UO_2 building is rated as noncombustible. Monthly inspections confirm that fire loading is kept to a minimum. Fire extinguishers, alarm pull boxes, and heat detectors are strategically placed throughout the conversion areas. Where moderation control is in place, water exclusion signs are posted to alert local fire fighters of areas where water is not to be introduced. In these areas, high expansion foam, dry chemical or CO_2 would be used to combat a fire.

There are two high temperature unit operations in the conversion area: the hot oil dryers which operate at a maximum temperature of 575°F; and the rotary kilns or calciners which operate in the range of 1100°F to 1600°F.

For the hot oil dryers, high temperature silicon oil that is not flammable at process operating temperatures is used. Automatic high temperature shutdowns are used to minimize the potential for overheating.

Hydrogen concentration in the calciner is maintained above the upper explosive limit. A continuous purge of nitrogen is maintained on the double rotary air locks to prevent room air from entering the calciner and causing the accumulation of an explosive mixture in the calciner. Hydrogen detectors are installed above the calciners to provide indications of and alarms for hydrogen leaks.

15.1.6.4.4 Environmental Safety

Hazardous materials are contained to prevent their introduction into the environment. All unit operations are served by POG vent lines or by hoods. Hoods are maintained at a negative pressure and vented to the POG system. Floors are sealed and have no drains.

The POG system treats and removes fumes and particulates from the exhaust air using scrubbers, dryers and two stages of high efficiency filtration (HEPA).

All room and building air is processed through the heating, ventilation, and air conditioning system and then HEPA filtered to remove particulates.

Certain chemically hazardous solid wastes such as solvent contaminated rags from the controlled area are disposed of in special containers distributed throughout the conversion area. The rags are treated as hazardous mixed hazardous waste as appropriate and periodically transferred to a secured storage area for future disposal.

15.1.6.5 Line 2 ADU Process

The Line-2 ADU process begins at the hydrolysis tank and ends at the discharge of the ADU dryer. The major pieces of equipment comprising the system are the hydrolysis tank and heat exchanger, the ADU precipitation tank and heat exchanger, the flocculation tank, the ADU centrifuges, and the dryer. In the ADU process, the UF_6 gas is contacted with water in a contactor and the resultant UO_2F_2 solution is collected in a safe geometry cylindrical hydrolysis tank. A ventilated containment hood is provided for the hydrolysis tank to protect against small UF_6 gas leaks. The uranyl fluoride produced in the hydrolysis tank is transferred to a precipitation tank where it is mixed with ammonium hydroxide to produce ADU. The precipitation tank is critically safe by virtue of geometry and is vented to the POG system to prevent release of ammonia vapors to the operating area.

Continuous centrifuges are used to separate solid ADU from the liquid stream. The solids are dried in a ventilated, oil heated dryer, and the ammonia and water vapors are removed from the offgas stream by scrubbing in the POG system. The high temperature silicone oil, used in the dryer as a heat exchange medium, is stable and not flammable at the ADU dryer operating temperatures. Dryer temperatures are automatically controlled and provision is made to protect against overheating of the oil by electrical shutdown of the oil heating system.

15.1.6.5.1 Criticality Safety

Criticality safety in the Line 2 ADU process is assured by geometry, uranium concentration, and enrichment control. The enrichment is limited to 5 wt%^{235}U. All tanks and vessels are geometrically safe for uranium compounds with a uranium density of less than 5.53 gU/cm^3. The only U compound produced at SPC with a density greater than 5.53 gU/cm^3 is either compacted or sintered UO_2 and no failure mechanism which could result in such material entering this system has been identified. The only possible sources of significant quantities of UO_2 entering the Line 2 ADU system are the calciner offgas (COG) scrubber system and the calciner process offgas (POG) system via the ADU dryer. Both of these offgas scrubber systems are designed to prevent significant quantities of UO_2 from entering the ADU system.

- Hydrolysis Tank and Heat Exchanger, ADU Precipitation Tank and Heat Exchanger, and Flocculation Tank

Criticality safety for the hydrolysis, precipitation, and flocculation tanks and associated heat exchangers is assured by controlling the enrichment, the uranium concentration and the geometry of the vessels.

Summary of Accident Conditions

As described earlier, the Line-2 ADU tanks are favorable geometry tanks for ADU. Only the addition of UO_x-H_2O at concentrations greater than 1150 g U/l (which has the consistency of putty) in the tanks will exceed the allowed k_{eff} of 0.97 for abnormal conditions. The only tank in this processing system that has a pathway to get UO_x-H_2O is the flocculation tank. This tank is a nominal 10 inch diameter tank which is favorable geometry even for UO_x-H_2O.

The hydrolysis, precipitation, and flocculation tanks each receive dilute nitric acid (DNA) from the DNA tank. The DNA tank has a diameter of 10.75 inches. Tanks up to 11 inches I.D. have been shown to have a $k_{eff} \leq 0.97$ when filled with an optimum ADU-H_2O mixture. The DNA tank does not normally contain U compounds. In addition, if ADU were accidentally transferred to the DNA tank, the ADU would be converted to UNH due to the nitric acid present. The DNA tank is only 61% of the minimum critical cylinder diameter for 5.0 wt.% enriched UNH.

The hydrolysis tank also connects to the DNA and deionized water (DIW) lines which could have the potential for backflow of U solutions into the DNA and DIW supplies. These supplies do not normally contain U compounds. Also, the DNA and DIW tanks will have a k_{eff} less than 0.97 for any U bearing material that can credibly back flow into them. Back flow at these locations would be dependent on line pressure, valve alignment and pipe resistance. This line has a spring-loaded valve which is a design feature to prevent backflow should the valve be misaligned when the supply pump is not functioning. The Aqua Ammonia (AA) system is designed with a vented, favorable geometry supply tank which prevents backflow to the unfavorable geometry bulk storage tank.

The hood around the hydrolysis tank is an unfavorable geometry vessel; therefore, a criticality drain installed in the hood is sized to prevent the accumulation of greater than a safe slab depth of liquid inside the hood.

The polyhall flocculent is added through a funnel, thereby providing an air gap which isolates the flocculent system from the Line-2 ADU system.

- ADU Centrifuge and Dryer

Criticality safety for the ADU centrifuge and dryer is assured for optimum ADU concentrations by the geometries of the dryer and centrifuge.

Summary of Accident Conditions

Criticality safety of the dryer system is maintained by limiting the depth of ADU in the dryer by design of the dryer lid, by excluding significant amounts of UO_2, and by neutron absorption of the steel in the flight screws. ADU slurry is pumped from the precipitation tank to the ADU centrifuge and wet ADU goes from the centrifuge through a chute into the dryer.

The introduction of significant amounts of UO_2 (controlled by the process) upstream of the dryer that could also potentially lead to unsafe conditions has been reviewed. The solution from the calciner off gas scrubber (COG) is recycled to the flocculation tank which discharges to the P600 centrifuges and on to the ADU dryer. The gas flows in the calciner are low enough that very little UO_x is carried over to COG. Also, the liquid flow rates from the COG are only about 3-5% of the total flow to the P600 centrifuges. In the event that the COG solution becomes the only feed stream to the flocculation tank, which would happen if feed to the calciner was shut off, it would take approximately 1.5-3.0 hours before the calciner would be empty of material, eliminating the source of UO_x to the flocculation tank. During this time at most only a few kg of material could be recycled to the flocculation tank and into the dryer. The amount of UO_2 available for introduction into the ADU feed stream is normally less than 5 kg at any one time and is considered insignificant when mixed with the typical ADU feed stream.

Oil in the heating jacket under the dryer is a potential source to increase the effective height of ADU in the dryer should ADU leak into the jacket. The only source identified for ADU to leak into the jacket is by structural failure of the dryer (significant crack). If such a failure were to occur, the oil is pressurized and would, therefore, leak into the dryer rather than the ADU leaking into the oil. Oil leakage would result in the formation of formaldehyde gas which is readily recognized or contaminated powder which would be detected in the downstream processes. Oil in the ADU is not a criticality concern because, as noted earlier, the analysis assumes fully moderated ADU.

Covers are installed over the insulating bats that cover the exterior of the dryer at locations where ADU could leak from the dryer. This prevents gradual buildup of ADU in the insulation.

15.1.6.5.2 Radiation Protection

Conversion of UF_6 to UO_2 is performed in a limited access radiation controlled area. Personnel entering the area, who require monitoring under 10 CFR 20.1502(a), are required to wear radiation monitoring devices and protective clothing/equipment appropriate for the work to be performed. Personnel are required to survey themselves prior to exiting the controlled area. Equipment leaving the controlled area must be

released by Radiological Safety personnel. All personnel also receive initial and yearly refresher training on radiation protection principles and requirements.

Airborne uranium contamination is controlled by extensive use of hoods which are maintained at negative pressure and ventilated to the POG system. Examples of such hood locations are vaporization chests, hydrolysis tanks, centrifuge cleanouts, and hot oil dryers.

Routine surveys are performed and housekeeping practices are enforced to minimize surface and airborne contamination in the conversion areas. Air is continuously sampled and periodically analyzed to detect any airborne contamination.

Urine sample analyses and lung counts are periodically performed for personnel who work in the controlled access area. The frequencies of such testing are described in Chapter 3.

15.1.6.5.3 Fire Protection

The UO_2 building is rated as noncombustible. Monthly inspections confirm that fire loading is kept to a minimum. Fire extinguishers, alarm pull boxes, and heat detectors are strategically placed throughout the conversion areas. Where moderation control is in place, water exclusion signs are posted to alert local fire fighters of areas where water is not to be introduced. In these areas, high expansion foam, dry chemical or CO_2 would be used to combat a fire.

There are two high temperature unit operations in the conversion area: the hot oil dryers which operate at a maximum temperature of 575°F; and the rotary kilns or calciners which operate in the range of 1100°F to 1600°F.

For the hot oil dryers, high temperature silicon oil that is not flammable at process operating temperatures is used. Automatic high temperature shutdowns are used to minimize the potential for overheating.

Hydrogen concentration in the calciner is maintained above the upper explosive limit. A continuous purge of nitrogen is maintained on the double rotary air locks to prevent room air from entering the calciner and causing the accumulation of an explosive mixture in the calciner. Hydrogen detectors are installed above the calciners to provide indications of and alarms for hydrogen leaks both at SPC and the Richland Fire Department.

15.1.6.5.4 Environmental Safety

Hazardous materials are contained to prevent their introduction into the environment. All unit operations are served by POG vent lines or by hoods. Hoods are maintained at a negative pressure and vented to the POG system. Floors are sealed and have no drains.

The POG system treats and removes fumes and particulates from the exhaust air using scrubbers, dryers and two stages of high efficiency filtration (HEPA).

All room and building air is processed through the heating, ventilation, and air conditioning system and then HEPA filtered to remove particulates.

Certain chemically hazardous solid wastes such as solvent contaminated rags from the controlled area are disposed of in special containers distributed throughout the conversion area. The rags are treated as hazardous mixed hazardous waste as appropriate and periodically transferred to a secured storage area for future disposal. Liquid chemical wastes are typically routed to the surface impoundment system which is appropriately designed, constructed, and operated to provide safe and effective storage/treatment of these effluents.

15.1.7 Powder Production

15.1.7.1 Line 1 UO_2 Powder Production System

The UO_2 powder production system starts at the output of the ADU dryer and ends at the discharge of the powder storage slab hoppers. The major pieces of equipment comprising the system are the feed hopper, the calciner, the calciner download hood and powder transfer system, the slab hoppers, and the calciner offgas scrubber.

Dry ADU is fed via the feed hopper from the hot oil dryer or powder recycle system to the feedscrew assembly of the calciner (a rotary kiln) where it reacts with a reducing atmosphere of hydrogen or ammonia to produce uranium dioxide (UO_2) powder. Steam is added to the calciner to remove residual fluoride from the ADU powder. Steam and excess nitrogen, hydrogen, or ammonia, ammonium fluoride, and ammonium nitrate (which, at the pressure in the calciner, is not explosive) exit the calciner via the calciner off-gas duct located near the ADU feed end. These exhaust gases are scrubbed with water to cool them, remove water soluble gases, and to remove entrained powder. Entrained uranium is recycled to the conversion line at the recycle tank.

UO_2 powder is passed through a rotary air lock at the discharge end of the calciner. An in-line moisture analyzer is installed at the discharge end of calciner as a method of monitoring the calciner operation for the production of dry powder. The powder can also be sampled by the autosampler below the rotary air lock as it drops to the diverter valve. The autosampler periodically samples the powder being discharged from the calciner and drops it via a 1 1/2-inch I.D. hose into a catch pan at the calciner discharge hood. The diverter valve can direct the powder flow either to the calciner bucket drop or the Vac-U-Max™ transfer line in the calciner discharge hood. The Vac-U-Max™ transfer line transports the powder to slab hoppers or to the poisoned 45 gallon drum loadout station. Powder in the hoppers is sampled and the samples are analyzed for moisture. Only when the powder is verified to be dry (< 10,000 ppm moisture) may the powder be transferred to a blender.

15.1.7.1.1 Criticality Safety

Criticality safety in the Line 1 UO_2 powder production system is assured through controls on enrichment, moderator concentration, geometry, and the calciner construction materials.

- Line 1 Feed Hopper

Criticality safety in the feed hopper is assured by the favorable geometry of the hopper. A bounding model was used for the feed hopper which was considered to conservatively

model any potential changes and interactions. The ECN system prevents modifications to the safe geometry of the hopper without review and approval from Criticality Safety.

Summary of Accident Conditions

Two accident scenarios were pc 'ed which could affect the feed hopper geometry. These were bulging as a result of pressurization and bulging due to thermal expansion from powder burnback. The feed hopper is not designed as a pressure system and has multiple pathways to release pressure. Significant bulging due to thermal expansion is prevented by design and by the limited volume to contain recycle powder available for burnback.

Powder spills out of the feed hopper inspection port due to pressurization were analyzed as a means of accumulating more than a safe batch of moderated uranium material in an unsafe configuration. Significant spills of ADU from the calciner feed hopper inspection port are not credible due to the hopper design and gravity.

- Line 2 Calciner

Criticality safety in the calciner is assured by passive engineered features, specifically, the materials of construction (the inconel HP/HX alloy which acts as a poison) and geometry (for this alloy the 10 inch inside diameter is safe).

Summary of Accident Conditions

Due to the large quantity of material in the calciner, the potential for significant powder spills was reviewed. No credible means was found by which significant amounts of powder could be released from the calciner.

The calciner ha. been shown to be safe when filled with optimally moderated UO_2 due to materials of construction and geometry. Therefore, the introduction of moderators into the calciner is not a criticality concern for the calciner itself.

The auto-lubrication system for the calciner injects grease at the grease seal on the downstream end. In order for grease to get into the powder, the grease seal must fail, allowing excessive amounts to enter the space between the bellows and the calciner. The carbon packing for the grease seal is required to be inspected every six months. The space between the bellows and the calciner can accommodate up to 21.6 Kg of grease before it reaches the discharge end of the calciner where it can come into contact with the powder. The grease reservoir for the lubrication system has a capacity of 12 lbs. (5.45 Kg). The grease consumption rate is required to be verified not to be excessive each time the grease reservoir is filled. Such monitoring provides a means to detect a failure of the

15.1.7.2 Line 2 UO_2 Powder Production System

The UO_2 powder production system starts at the output of the ADU dryer and ends at the discharge of the Lines 2 and 3 powder storage slab hoppers which provide UO_2 powder for the Lines 2 and 3 powder preparation systems. The major pieces of equipment comprising the system are the feed hopper, the calciner, the calciner download hood and powder transfer system, the slab hoppers, and the calciner offgas scrubber.

Dry ADU is fed via the feed hopper from the hot oil dryer or powder recycle system to the feedscrew assembly of the calciner (a rotary kiln) where it reacts with a reducing atmosphere of hydrogen or ammonia to produce uranium dioxide (UO_2) powder. Steam is added to the calciner to remove residual fluoride from the ADU powder. Steam and excess nitrogen, hydrogen, or ammonia, ammonium fluoride, and ammonium nitrate (which, at the pressure in the calciner, is not explosive) exit the calciner via the calciner off-gas duct located near the ADU feed end. These exhaust gases are scrubbed with water to cool them and to remove water soluble gases and entrained uranium powder. Entrained uranium is recycled to the conversion line at the geometrically favorable flocculation/recycle tank, which is part of the Line 2 ADU system.

UO_2 powder is passed through a rotary air lock at the discharge end of the calciner. An in-line moisture analyzer is installed at the discharge end of calciner as a method of monitoring the calciner operation for the production of dry powder. The powder can also be sampled by the autosampler below the rotary air lock as it drops to the diverter valve. The autosampler periodically samples the powder being discharged from the calciner and drops it via a 1 1/2-inch I.D. hose into a catch pan at the calciner discharge hood. The diverter valve can direct the powder flow either to the calciner bucket drop or the Vac-U-Max™ transfer line in the calciner discharge hood. The Vac-U-Max™ transfer line transports the powder to slab hoppers or to the poisoned 45 gallon drum loadout station. Powder in the hoppers is sampled and the samples are analyzed for moisture. Only when the powder is verified to be dry (< 10,000 ppm moisture) may the powder be transferred to a blender.

15.1.7.2.1 Criticality Safety

Criticality safety in the Line 2 UO_2 powder production system is assured through controls on enrichment, moderator concentration, geometry, and the calciner construction materials.

- Line 2 Feed Hopper

Criticality safety in the feed hopper is assured by the favorable geometry of the hopper. A bounding model was used for the feed hopper which was considered to conservatively

grease seal. The grease seal inspection and monitoring the grease consumption provide multiple barriers which will prevent significant quantities of grease from entering the powder in a short period of time.

During normal operation of the calciner system, the discharge material from the calciner has been shown by test to be less than 0.17 wt.% moisture. There are two conditions of calciner operation which conceivably could result in UO_2 produced in the calciner exceeding 1% water content. These conditions are: (1) increasing the amount of ADU feed into the calciner to an amount that surpasses the calciner's ability to dry it; and (2) by somehow adding or condensing moisture at the discharge end of the calciner. These conditions are prevented, detected and/or mitigated by the in-line real time moisture analyzer or periodic sampling, by maintaining N_2 flow through the rotary air locks, and by controlling and monitoring calciner pressure, temperature, and feed rate.

Experimental data have been collected to determine the actual conditions under which the calciner would generate certified dry (≤ 1% water) powder. The following set of conditions has been developed to assure that the calciner discharges dry powder:

1) Conduct real time measurement of moisture content of powder at the discharge end of calciner.

2) Maintain cover gas on the discharge end of calciner to prevent steam from condensing on cold surfaces and contaminating dry material.

3) Maintain calciner temperature and pressure within prequalified ranges such that any water added will be turned to steam and removed by the POG system.

- Line-2 Calciner Download and Powder Transfer System

Criticality safety in the calciner download and powder transfer system is assured by enrichment control and piping geometry in the transfer system and by volume control in buckets and the presence of poison in storage drums, respectively.

UO_2 powder is passed through the rotary air lock at the discharge end of the calciner. The powder may be sampled (as it drops to the diverter valve) by an autosampler located above the rotary air lock. Use of the autosampler is not required, but is used as a backup for the in-line moisture analyzer. The autosampler periodically samples the powder being discharged from the calciner and drops it via a 1 1/2-inch ID hose into a catch pan at the calciner discharge hood. The diverter valve can direct the powder flow either to a 5-gallon bucket or a Vac-U-Max™ transfer line, each located in the calciner discharge hood. In summary, the Line 2 calciner download hood provides locations to perform the following operations;

1) Download calciner powder to volume controlled buckets.

2) Autosample the calcined powder into a catch pan in a separate hood.

3) Transfer powder to the slab hoppers or poisoned 45 gallon drums via the Vac-U-Max™ system.

Summary of Accident Conditions

The only potential for a spill inside the hood which could result in an accumulation of a significant amount of material is at the bucket download station. Such spills are prevented by the use of a through-beam sensor which is interlocked to the rotary air lock to prevent powder transfer if a bucket is not in the proper position.

Introduction of moderator to powder resulting in powder with greater than 1.0 wt.% moisture being transferred to slab hoppers or 45-gallon poisoned drums could occur due to failure of friction connections and/or rubber boots or lines in the transfer system. This potential accident requires simultaneous leaks in both a water source and the powder transfer equipment. The powder transfer lines from the diverter valve below the calciner to the slab hoppers are designed and operated to prevent the undetected introduction of moisture to the slab hoppers. Specifically, the following conditions are met:

1) All connections provide a positive seal such that water spraying on the transfer lines will not leak into the powder.

2) Opening or reconfiguring powder transfer lines requires Criticality Safety approval and approved procedures to prevent introduction of moderators during and following the opening of the system.

3) Spray shields are in place where appropriate to provide a barrier between known sources of moderators and potential leak sites in the powder transfer system (wear points, connectors etc.)

4) An operator who is continually present during equipment operation and whose only responsibility is to watch for and prevent the intrusion of moderators into the powder transfer lines may be substituted for requirements 1 through 3 above.

Additional assurance that moderator has not entered the powder during transfer is also provided by moisture analyses which are performed at the powder's destination (slab hoppers or 45-gallon poisoned drums).

Overbatching containers at the Line-2 calciner bucket drop station is prevented by limiting the volume of the container such that the container cannot hold more than a safe batch of powder.

- Lines 2 and 3 Slab Hoppers

The Lines 2 and 3 slab hoppers store "potentially moderated powder". "Potentially moderated powder" has at least one assurance that the powder is dry. After the powder is certified dry by lab analysis, it is then transferred to blenders for additional processing. Criticality safety is assured in the slab hoppers by enrichment and geometry control.

Summary of Accident Conditions

The Lines 2 and 3 slab hoppers will maintain a $k_{eff} \leq 0.95$ under normal conditions as long as the internal slab hopper thickness is ≤ 4.7 inches, including any deflections. The Lines 2 and 3 slab hoppers are designed, with a minimum 0.15 inch wall thickness, to maintain a maximum slab thickness of 4.25 inches under design basis loading, which includes a maximum 3.5 psig internal pressure and 225°F wall temperature. The wall and slab thicknesses are verified semi-annually. The pressure relief valve and temperature alarm are also checked for proper operation semi-annually.

The powder, which is stored in the slab hoppers, is required to have at least one assurance that the powder is dry. This requirement makes the introduction of moderating material an unlikely event. Both significant addition of moderator and significant changes in geometry are required before the slab hoppers could exceed a k_{eff} of 0.97 during accident conditions.

The Vac-U-Max™ filter bag at the top of each slab hopper lid consists of a 17-inch diameter lid which extends 1 1/2 inches beyond the hopper envelope. This 1 1/2-inch extension in the lid could result in a slab thickness greater than the 4.7 inches allowed. Calculations have been performed with the lid assembly and up to three side-by-side slab hoppers filled with an optimum UO_2/H_2O mixture. With a single filter housing filled, the maximum k_{eff} is .94001 ± 0.00452. These calculational results bound the Vac-U-Max™ filter hoppers which use a single filter and are bounded within the assumed design features.

- Calciner Offgas Scrubber

Criticality safety in the calciner offgas (COG) scrubber is assured by enrichment control and geometry.

The COG scrubber tank receives deionized water and discharges scrubber solution to the recycle tank. The non-condensable gases discharged from the calciner to the COG scrubber are discharged from the offgas scrubber to the plant POG system.

Summary of Accident Conditions

There is potential for moderator to back flow from the COG system to the calciner. To prevent such an occurrence the calciner pressure monitor is alarmed to indicate if significant amounts of water have entered the calciner so that mitigating action may be taken. In addition, the in-line moisture analyzer will indicate if the powder being discharged by the calciner contains excess moisture. The minimum temperature and pressure requirements for the calciner will assure that water entering the calciner will be discharged as steam.

The possible migration of uranium to other systems is controlled by seal pots and COG scrubber tank criticality drains.

15.1.7.2.2 Radiation Protection

UO_2 powder production is performed in a limited access radiation controlled area. Personnel entering the area, who require monitoring under 10 CFR 20.1502(a) are required to wear radiation monitoring devices and protective clothing/equipment appropriate for the work to be performed. Personnel are required to survey themselves prior to exiting the controlled area. Equipment leaving the controlled area must be released by Radiological Safety personnel. All personnel also receive initial and yearly refresher training on radiation protection principles and requirements.

Airborne uranium contamination is controlled by extensive use of hoods and other equipment (e.g. the calciner) which are maintained at negative pressure and ventilated to the process offgas (POG) system.

Routine surveys are performed and housekeeping practices are enforced to minimize surface and airborne contamination in the conversion areas. Air is continuously sampled and periodically analyzed to detect any airborne contamination.

Urine sample analyses and lung counts are periodically performed for personnel who work in the controlled access area. The frequencies of such testing are described in Chapter 3.

15.1.7.2.3 Fire Protection

The UO_2 building is rated as noncombustible. Fire loading is kept to a minimum through monthly inspections. Fire extinguishers, alarm pull boxes, and heat detectors are strategically placed throughout the conversion areas. Where moderation control is in place, water exclusion signs are posted to alert local fire fighters of areas where water is not to be introduced. In these areas, high expansion foam, dry chemical or CO_2 would be used to combat a fire.

There are two high temperature unit operations in the powder production area: the hot oil dryers which operate at a maximum temperature of 575°F; and the rotary kilns or calciners which operate in the range of 1100°F to 1600°F.

For the hot oil dryers, high temperature silicon oil that is not flammable at process operating temperatures is used. Automatic high temperature shutdowns are used to minimize the potential for overheating.

Hydrogen concentration in the calciner is maintained above the upper explosive limit. A continuous purge of nitrogen is maintained on the double rotary air locks to prevent room air from entering the calciner and causing the accumulation of an explosive mixture in the calciner. Hydrogen detectors are installed above the calciners to provide indications of and alarms for hydrogen leaks.

15.1.7.2.4 Environmental Safety

Hazardous materials are contained to prevent their introduction into the environment. All unit operations are served by POG vent lines or by hoods. Hoods are maintained at a negative pressure and vented to the POG system. Floors are sealed and have no drains.

The POG system treats and removes fumes and particulates from the exhaust air using scrubbers, dryers and two stages of high efficiency filtration (HEPA).

All room and building air is processed through the heating, ventilation, and air conditioning system and then HEPA filtered to remove particulates.

Solvent contaminated rags from the controlled area are disposed of in special containers distributed throughout the conversion area. The rags are treated as mixed hazardous waste and stored in a secured area for future disposal.