HAER No. WA-128-A

Plutonium Finishing Plant,
Waste Incinerator Facility (Building 232-Z)
200 West Area, Hanford Site
Richland Vicinity
Benton County
Washington



**PHOTOGRAPHS**

**WRITTEN HISTORICAL AND DESCRIPTIVE DATA**

**Historic American Engineering Record**
**National Park Service**
**Western Region**
**Department of the Interior**
**San Francisco, California 94107**

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# HISTORIC AMERICAN ENGINEERING RECORD

## PLUTONIUM FINISHING PLANT, WASTE INCINERATOR FACILITY (Building 232-Z)

**HAER NO. WA-128-A**

Location: 200 West Area, Hanford Site, 20 miles north of Richland, Benton County, Washington.

USGS Riverland Quadrangle, Washington, 1986, 7.5 Minute Series Section 1, Township 12 North, Range 25 East of the Willamette Meridian.

UTM Coordinates: Zone 11, Easting 298200, Northing 5158300.

Date of Construction: 1961

Engineer: Unknown

Builder: General Electric Company

Present Owner: U. S. Department of Energy, Washington D.C.

Present Use: Building abandoned; in process of deactivation for removal of hazardous substances.

Significance: Building 232-Z, a waste incinerator facility, was constructed to recover plutonium from miscellaneous solid wastes produced by the adjacent Plutonium Finishing Plant (PFP), the Plutonium Isolation Facility and the REDOX and PUREX plants in the 200 Areas on the Hanford Site. Known officially as the Contaminated Waste Recovery Process Facility, the 232-Z incinerator was determined eligible for listing in the National Register of Historic Places because it was a prototype for the incineration of contaminated wastes. 232-Z was unique for its equipment design and first-of-a-kind method of automating and executing the incineration of plutonium-bearing wastes. From 1961 to its closure in 1972, 232-Z recovered significant amounts of plutonium through the incineration of contaminated combustible scrap material.

Report Prepared By:
David W. Harvey
Battelle, Pacific Northwest Laboratory
Richland, Washington

Michele S. Gerber, Ph. D.
Westinghouse Hanford Co.
Richland, Washington

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## *HANFORD SITE - MISSION*

In 1943 the Manhattan Engineer District (MED) of the U. S. Army Corps of Engineers chose Hanford, Washington as the site of the world's first plutonium production facilities. The development of atomic power on the Hanford Site represented a significant national event that profoundly shaped and defined military strategies and wartime events during the 1940's. The efforts in research and development expended during the Manhattan Project (1943-1946) through the Cold War period influenced national developments in energy production, medical breakthroughs and plutonium production for national defense.

The mission today is one of environmental remediation, restoration, and waste management. N- Reactor, the last plutonium production reactor in operation, closed in 1987. In 1989, the Hanford Federal Facility Agreement and Consent Order (the Tri-Party Agreement) was signed. The three signatories, State of Washington, the U. S. Environmental Protection Agency, and the U. S. Department of Energy, agreed to a clean-up of the Hanford Site.

## 200 WEST AREA, PLUTONIUM PRODUCTION FACILITY, AND 232-Z

The plutonium production process at Hanford involved three essential steps: uranium fuel elements were fabricated and jacketed in the 300 Area, irradiated in the 100 Areas, and chemically dissolved and separated into plutonium, uncoverted uranium and various fission byproducts in the 200 Areas. Initially constructed during the Manhattan Project era, the 200 Areas at Hanford were the locations of the chemical separations ("processing") plants and their numerous ancillary and support facilities. One of the more important facilities in the 200 West Area was the Plutonium Finishing Plant (PFP). From its beginning in 1951 to the closure of its production processes in 1989, PFP (Building 234-5Z) processed plutonium-bearing chemical solutions and converted them into metal and oxide. The 232-Z Building was constructed in 1961 to recover plutonium through an incineration process from solid wastes produced mainly by PFP.

## *HISTORICAL BACKGROUND*

### GENESIS AND NEED

In the Spring of 1958, the Chemical Processing Department at the Hanford Works (HW)[0] expressed an interest in building an incineration facility. The purpose was to recover plutonium (Pu) from "various miscellaneous solid wastes" produced by the Plutonium Finishing Plant (PFP, or the 234-5 Building) and the Plutonium Isolation Facility (the 231 Building).[1] Additional solid combustible materials to be fed into the incinerator could be generated by the cleanup of "inadvertent spills" at Hanford's two operating radiochemical plants, the REDOX (reduction-oxidation) and PUREX (plutonium-uranium extraction) facilities. Candidate wastes would include cartons, filters, rags, paper, gloves, clothing, tools and small equipment components. Plutonium-bearing materials first would be hand-sorted into burnable or leachable fractions. The combustible materials would be incinerated, and then the product (Pu) would be recovered by a wet leaching of the ash. Non-combustible materials would be leached in heated nitric acid and then water-rinsed. The leachate and rinse solutions then were transferred to the Plutonium Reclamation Facility (PRF) for solvent extraction refining.

At that time the new project was proposed, some leaching of Pu from highly contaminated wastes was being performed in Room 227 of the PFP. However, the equipment being used in that room was not designed for a leaching function, and it could not process nearly as much material as was available. At that time, Hanford scientists estimated that six kilograms (kg) of Pu per year were discarded with contaminated materials. The national demand for, and economic value of, plutonium was high, so recovery of the costs of incinerator construction was expected within 15 months of startup. Further, there was a desire to limit the contamination of "real estate" (waste burial grounds on the Hanford Site) and to assure long-term radiological safety of the area by not continuing to place highly contaminated wastes in the ground.[2]

Consequently, as of June 1, 1958, HW operators began to store, rather than bury, highly contaminated solid wastes of the type expected to be candidate feed for an incinerator. A preliminary project proposal was generated that same month, with the request that the endeavor be approved quickly because considerable accumulation of feed was expected and "these materials will present hazards of fire and contamination spread." The new facility, as first envisioned, was to consist of a building with primary and auxiliary equipment and services for burning combustible, Pu-bearing wastes, for preparing the resultant product in suitable form for re-reprocessing, and for leaching non-combustible Pu-bearing wastes. The final re-processing steps were to be conducted in the RECUPLEX (recovery of uranium and plutonium through extraction) facility, a part of the PFP complex.[3]

DESIGN AND DEVELOPMENT

In July, HW and Atomic Energy Commission (AEC) scientists were sent to the AEC's Rocky Flats Site in Colorado to examine a plutonium-burning incinerator being designed there. They learned that the Rocky Flats incinerator was to be a manual, batch-type device, operated on a campaign basis. It consisted of a conventional, industrial incinerator that had been altered by lining it with a stainless steel sheet and substituting a stainless steel grate. This unit was enclosed in a glove box located below a standard dry box with an air-lock for the introduction of combustible materials, and a canning and bag-out facility for removing the ashes. The single glove box also served as the sorting (feed preparation) and ash collection area. The incinerator was manually fed and the fire was lighted by a match. Later, an auxiliary gas-firing feature was added. During burning, the lid of the incinerator was open about four inches, to permit the addition of more materials as needed to maintain a robust fire. Observations as to when to add materials were made through a glove box panel. During operation, the pressure and air balances were controlled manually by operating a bleed valve that supplied forced air. For most materials, ordinary air was supplied, but oxygen was added when plastic materials were being burned, in order to reduce the amount of soot formation. The off-gases from incineration were treated with a caustic scrub, but no subsequent attempt was made to recover Pu from the scrub solutions. The dry ashes, along with hood sweepings and leach concentrate underwent Pu recovery by dissolving in nitric acid, followed by standard extraction using tri-butyl phosphate (TBP). It was estimated that 100-500 grams (g) of Pu per day thus were recovered at Rocky Flats.[4]

Soon after their trip to Colorado Hanford scientists had prepared a process design document that detailed an incineration facility very similar to that at the Rocky Flats. By the time design scoping was completed for the Hanford facility, it was estimated that 2.5 cubic feet (cu/ft) of solid candidate wastes were being accumulated per day at Hanford, and a sense of urgency was expressed about the project.[5]

On December 17, 1958, a key meeting was held at HW for the purpose of comparing the merits of the simple box-type incinerator with that of an externally heated, tunnel-type incinerator. While it was recognized that the box-type incinerator had fewer mechanical parts and "probably would require less maintenance," the majority of the attendees "preferred the tunnel-type incinerator from the standpoint of safety and operability."[6] By January 1959, considerable design revisions were underway, including the use of electrical heating, a continuous wire-mesh belt feed system, a muffle-type incinerator, a mechanical feed chopper, increased building ventilation, and a more complex off-gas scrubber and filtration system. These changes were undertaken to "improve operability of the proposed plant and to minimize nuclear safety problems."[7]

In the Spring of 1959, project revisions, work specifications and work authorizations were issued to proceed with construction of the continuous-feed (conveyor-belt) incinerator, a prototype design in plutonium-burning incinerators. At this time, a destructive distillation unit (DDU) and a circular, single-chamber gas-fired incinerator were in use at the Oak Ridge Site in Tennessee, but only for burning uranium-bearing wastes. Another radioactive waste incinerator, located at the General Electric Company's Atomic Power Equipment Department at San Jose, California, was still in the construction stage, and it burned only thorium and uranium-bearing wastes. The joint AEC-NDL (Nuclear Defense Laboratory - part of the Department of Defense) prototype incinerator project at the Edgewood Arsenal in Maryland would not start up until 1965-66, nor would other prototype incinerators at the Harvard Air Cleaning Laboratory and elsewhere. Previous incinerators for contaminated wastes that had operated at various AEC sites were small, simple, batch-type operations.[8]

At Hanford, a bank of High Efficiency Particulate Air (HEPA or "absolute") filters were added as back-up to the glass pad filters that originally were to have formed the primary barrier. In order to reduce fire danger and provide corrosion resistance, many materials now considered hazardous and dangerous were incorporated. Such materials included asbestos cement underground ducts and piping, asbestos cement floor filter boxes, glass asbestos fiber membranes in the HEPA filters, lead alkyd base paints for the filter frames, and many other substances now regulated by the Environmental Protection Agency. By April, 125 boxes (totaling 560 cu/ft) of candidate wastes for the incinerator were being stored in the World War II "magazine" vaults (the 213-J&K Vaults) in the southeast end of Gable Mountain, and predictions estimated 400 boxes (totaling 1,800 cu/ft) by mid-1960. The rising economic value of plutonium, combined with the increased efficiency expected out of the new type of incinerator, then was expected to enable the facility to pay for itself within 10 months of operation.[9]

Throughout the two years beginning in the Summer of 1959, various aspects and attributes of the incinerator system were studied and debated by Hanford personnel assigned to the project. One such aspect was the off-gas scrubber system. In September 1959, the Rocky Flats Site designed a new dry scrubbing system, to replace the caustic and water scrubber system that had formed the basis for the Hanford design. The Rocky Flats decision was based on continual plugging problems as salt from the off-gases built up on the scrubber components. However, after much discussion, Hanford engineers decided to modify rather than replace their wet scrubber apparatus. They substituted a diaphragm or bellows-type valve, added control valves in several locations, substituted various types of gaskets (including adding more asbestos-based gaskets to minimize leakage), and included many other modifications to the flow lines of the system.[10]

Still, pre-start tests conducted in 1961 in a 300-Area research building at Hanford showed disappointing results for the wet Peabody[11] scrubber. Without the regular use of in-place filter cleaning practices, it was estimated that the 232-Z scrubber would require weekly filter replacement, even to maintain a 90-95% absorption rate for nitric acid vapors.[12] A regular filter cleaning schedule was put in place. However, further steps that would have filtered the scrubber solution through paper pulp to remove fly-ash and other suspended particulates, recycled (burned) the filter cake through the incinerator itself, and then sent the clarified scrubber solution through an ion exchange process in the PFP's Waste Treatment Facility (the 242-Z Building) for plutonium recovery were not implemented.[13]

Another aspect of overall 232-Z operation that received much attention previous to startup was that of the neutron monitoring devices that would be used. In September 1960, specifications were drawn up for a prototype instrument, to be built distinctly for the Hanford incinerator project. It was a borontrifluoride ($BF_3$) tube with at least 200 feet of co-axial cable, without pulse transformers of pre-amplifiers, that would display a linear count rate with a variable base line or discriminator level. These neutron counters were to be provided for the chopper, the feed bin, the leaching hood, and for the (used) scrubber solution tank (in a moderator under the tank). An additional, portable $BF_3$ instrument was to be provided for the entire facility, in order to check build-up of Pu-bearing deposits anywhere at any time. Such instruments were procured and tested successfully in August 1961.[14] Material balance and accountability for the 232-Z facility was maintained by surveying the feed waste boxes with a "package" neutron counter located in Room 161 of the 234-5 Building, and then surveying the dry, canned ash that existed at the end of the incineration process with another package neutron counter.[15]

Other design changes were made in the two years prior to startup, in the interest of criticality safety, fire protection, cost savings, and other considerations. For example, spacers were installed in the bellows-type expansion joints at both the feed and discharge ends of the incinerator tube itself, to prevent the bellows from filling with too much dry plutonium oxide powder. Specific inspection and cleanout and bagging procedures were established for the housing around the chopper feed mechanism, due to the potential of Pu buildup. Hood sizes and locations were changed, as was the ash hopper slide valving. Spacing of shelves for the storage of waste cartons was re-configured, and the sumps for the three leaching pots in the leach hood were double-walled so that their effective diameter could not be increased by a leak through a single wall. Thirteen heat-detecting fire alarm devices were placed throughout the 232-Z Building, and an oscillating safety saw of the type used by surgeons to remove casts was procured to open boxes and cut up material in the chopper. This precaution was taken to assure that rubber gloves and/or operators' hands could not be cut inadvertently by this instrument. Standard room air monitors were provide throughout the facility, and pressure and liquid level alarms were installed in various parts of the scrubber liquid circulation system.[16]

## START-UP AND MECHANICAL PROBLEMS

Throughout the Summer and Autumn of 1961, as an unusually high number of pre-start acceptance tests and modifications of the 232-Z incinerator went forward, the prototypical nature of the unit was emphasized many times by Hanford scientists and engineers. The "endless traveling belt" feed system was perhaps most unique. It was mounted on two stainless steel pulleys, one that served as a friction drive and one that served as an automatic tightener.[17] Made

of HN (high nickel), high temperature cast 314 stainless steel mesh, this conveyor belt was described as not having "gone through the normal prototype development stage, so some of the operating conditions are hard to define."[18] Additional testing funds were secured because "it was recognized that start-up funds would be required for equipment testing and modification...due to the prototypical nature of the continuous incinerator and its greater complexity...Normally such equipment would be designed, developed and tested as a prototype prior to [industrial] design and fabrication...Experience during initial start-up and current testing has continued to reveal the complexity of the continuous incinerator operation."[19] After only a few days of testing, the belt showed "rapid deterioration...apparently the result of increased operating temperatures (1000 to 1090 C) [Centigrade]." It was quickly recommended that the maximum continuous operation temperature of the primary combustion chamber be kept below 820 C (1650 F - Fahrenheit), and that of the secondary combustion chamber be kept below 900 C (1650 F).[20] Further, the incinerator backfired at slow belt speeds, the vibrator chute that was supposed to deliver chopped feed to the belt did not deliver it, the feed bin chain was not sturdy enough, the feed mechanism itself did not seal the inlet of the chopper, and various valves, jets, insulation sections, and other components needed modifications.[21]

Finally on January 8, 1962, full-scale operations with actual waste materials began at the 232-Z Building. Due to personnel limitations, the facility operated only one shift per day, and only 42 cartons of waste were incinerated during the first three months. Leaching operations proceeded smoothly, with plastic and rubber gloves, along with miscellaneous metal parts, being washed in nitric acid and ANN (aluminum nitrate nonahydrate), rinsed, and then the leach solution removed from the 232-Z Building for further processing and plutonium recovery. At the incinerator itself, however, the interwoven wires of the 314 stainless steel conveyor belt began to fail within just two months of startup. It was believed that thermal cycling had caused corrosion and an accumulation of scale on the belt. Furthermore, it continually jammed or slipped and needed tightening, and the chopper blades also needed frequent replacement. "Tramp" metal in the chopper also threw sparks into the feed bin, causing fires.

The cumulative effect of these problems was that operational time ranged from zero to a maximum of 12 hours per week. Hanford engineers were already writing specifications for new belt materials and drive mechanisms, when the one of the most significant accidents in Hanford Site history occurred in the RECUPLEX operation of the PFP. On April 7, 1962, a nuclear excursion occurred in a tank holding plutonium-bearing solutions at RECUPLEX. The resulting contamination closed that facility permanently, and caused a re-evaluation of criticality controls at other Hanford facilities.[22]

As a result, many additional checks were made on the sampling and analytical procedures used in 232-Z operations, and the Post Acceptance Report for the facility was postponed from mid-1962 into early 1963. Operations in the building were closed for the last three weeks of April, two weeks in May, and again for three weeks in June. Almost as soon as incineration resumed in late June, the scrubber cell pump failed and spread contamination throughout the facility. The cleanup from this event shut down operations for nearly two more weeks. Again, belt jamming shut down activities for a week in August, and operations throughout the rest of the year were spotty, never achieving more than 17 hours per week of operating time.[23]

As re-evaluation of incinerator operations, safety and criticality prevention measures took place throughout 1962, the prototypical nature of the 232-Z incinerator was emphasized. "This project provided facilities for processing plutonium wastes with practically no previous development work," wrote one high-ranking Hanford official.[24] By late 1962, with the final acceptance documents still not approved, additional engineering funds were requested to solve problems with the "feed belt, bearings, alignment and the back-firing of the feed at the entrance to the incinerator."[25] Additionally, new and more sophisticated leaching equipment that would use an ultrasonic process for agitating the Pu-bearing materials in a recirculating stream of chemicals was recommended. Mechanical agitation of bulk materials bearing plutonium contamination was recognized as less safe, and the capacity of the three existing, six-inch leach pots was inadequate to handle the volume of non-combustible wastes awaiting processing.[26] Yet, despite all of the problems and inadequacies, the 232-Z Facility did recover enough plutonium to achieve economic pay-back of its costs within the first operating year.[27]

CONTINUAL MECHANICAL DIFFICULTIES

On January 25, 1963, a routine radiation survey of the incinerator glove box revealed loose contamination on an electrical junction box for the furnace heater elements. Subsequent investigation revealed that the vertical furnace flues were cracked at the points where they were welded to the burning chamber. It was believed that the temperature cycles to which the materials had been subjected had caused thermal expansion of the chamber to a degree that the expansion bellows could not withstand. Further, the actual design of two horizontal combustion chambers was deemed faulty, in that each of the four rigid vertical flues welded to them was found to be supporting the weight of much of the fire brick around it. Two repair alternatives were proposed: complete replacement of the existing combustion chambers with new units, or the simpler re-welding of the vertical furnace flues along with re-design of the expansion bellows, removal of additional structural restraints on expansion (involving re-design of the fire brick arrangement and of some piping), and re-insulation without a cementing mortar.[28]

Due to the high need and demand for the facility, the latter alternative was chosen. By early Spring of 1963, combustible plutonium-bearing waste was being accumulated at the rate of approximately 50 cartons (boxes) per month, and about 1,535 boxes currently existed as a backlog. Prolonged storage of this waste, then being stored in various locations including the electrical gallery of Hanford's inoperative B-Plant, was considered undesirable.[29] Repairs and contamination cleanout went forward throughout the Spring and Summer, with approximately 260 grams of Pu removed from the incinerator chambers and nearly 35 grams per foot removed from the front portions of the exhaust line leading from the incinerator to the scrubber.[30] The incinerator returned to full service on September 17, 1963. Due to continual problems however, the 314 stainless steel mesh conveyor belt was replaced on October 22, 1963, with a belt made of Nichrome V[31] (an alloy containing 80 percent nickel and 20 percent chromium). This belt in turn was replaced with an Inconel 600[32] belt on February 11, 1964. Inconel 600 is a nickel alloy that contains chrome, iron and trace amounts of other metals. The new belt became brittle and failed on April 20. It was replaced with a stainless steel belt from spare parts, which in turn was replaced with another Nichrome V belt on July 14, 1964, and changed again on December 16.[33]

Throughout late 1963 (after restart) and all of 1964, incinerator operations in the 232-Z facility in fact were plagued with numerous interruptions due to various mechanical problems.

Additionally, scrubber filters plugged, the rotating drum chopper bound up and jammed, chopper blades wore out, temperature differentials in the combustion chambers curtailed operations, and miscellaneous other difficulties were experienced. By far the largest number of problems were encountered with the incinerator itself, however. Repeatedly, smoke issued from the combustion chambers, metallic couplings failed, numerous shut-downs occurred to remove soot buildup from the chambers and the flues, and the belt needed to be shortened and/or freed from jams on many occasions. Sometimes the conveyance moved jerkily or stopped altogether, and frequent clean-outs of the housing at the feed or discharge ends were necessary.[34]

In November 1963, one weekly report stated: "Incinerator operation...was accomplished only with a great deal of effort at keeping the belt moving." The following month, another report confirmed that operation was "erratic due to a number of problems."[35] On December 17, a fire in the chopper hood burned up the rubber conveyor belt and transition bellows, and stopped burning for the rest of the year. (As a result, a water-fog spray fire extinguishing system was installed in the chopper glove box during 1964.) Pressurization of the ash discharge part of the primary combustion chamber became a problem in August 1964, when ashes and "clinkers" that still were burning were discharged into the ash can and onto the glove box floor at "considerable velocity." It was not unusual to find biweekly reports reading: "Incinerator operation during this period was very erratic due to problems with the incinerator belt, the feed belt, and other miscellaneous items."[36] Finally, the suggestion of a millwright to cut a hole in the belt's drive drum housing to allow for inspection and cleanout of foreign matter proved to be an effective idea.

In view of the numerous difficulties, fewer than 100 boxes of waste were processed through the incinerator during CY 1963, and 974 boxes were processed through CY 1964.[37] Explaining the low throughput and continual problems, Hanford management reiterated the prototypical nature of the Site's incinerator and stated that the attempt to build and operate this facility so early may have been "overly optimistic."[38]

By contrast, the performance of the leaching facility within the 232-Z Building was fair during 1963 and excellent during 1964, as a new leach hood for washing used anion exchange resins was placed into service on January 30, 1964. Together with the original leach hood, the new equipment processed almost continually throughout that year. Rubber gloves, metal objects, plastic sheets solutions from Hanford laboratories, and materials from the cleanup of a large, late 1963 fire at the REDOX facility were processed successfully.[39]

Incinerator operations during the first half of 1965 progressed in unusually smooth fashion, with approximately 700 boxes of waste being processed through the first week of July. The backlog was reduced to just under 400 cartons of waste. Smoking, backfiring, and temperature differentials within the incinerator itself continued as occasional problems, along with jamming of the chopper feed belt, the frequent need to replace chopper blades, and difficulties with the pumps, filters and valves of the scrubber off-gas system.[40]

However, on July 10, a heating element failed and the incinerator was shut down for repairs. While repairs were going forward, maintenance workers noted that the vertical flues were "broken loose" from the burning chambers. Further inspection inside a temporary greenhouse revealed the virtually complete separation of the four flues from the chambers, with large and destabilizing cracks that necessitated complete replacement of the furnace. Concluding that the 314

stainless steel "alloy for the furnace...had insufficient ductility to relieve stresses within the furnace configuration," Hanford scientists decided to replace the entire unit with a new one made of Incoloy 800[41], an iron alloy containing 30-35 percent nickel, 19-23 percent chromium, and small amounts of other elements. Further, a new furnace design would "permit freedom of movement between the component parts...[and would be] free of external restraints." The all-welded construction was replaced with ball and socket joints and slip joints at the top and bottom of each flue tube riser. With waste cartons being generated at the rate of 30-40 per month, and then being stored inside seven abandoned ammunition igloos west of the 200-West Area (part of the former Camp Hanford anti-aircraft defenses), the replacement project was pursued on an urgent basis.[42]

By the time the 232-Z incinerator failed in July 1965, it had recovered 157 kg of plutonium (or the contents of 2,400 ash cans). In view of these favorable results, and of the unfavorable waste carton storage conditions, quick repair was desired. However, the fabrication with the Incoloy 800 material to Hanford's tight specifications was more difficult than expected, and the new incinerator was not available for startup until October 17, 1966. In the meanwhile, leaching operations in the 232-Z facility went forward with efficiency.[43]

At the startup of the Incoloy furnace in the 232-Z facility, it was decided to operate at slightly lower temperatures (below 820 C, or 1500 F) than had been used with the 314 stainless steel furnace, in order to prolong operating life. However, problems soon surfaced again. Abnormal air rates, difficulties with the ash distribution mechanisms, soot buildup, and plutonium accumulation in the scrubber components all manifested themselves during late 1966.[44] On July 18, 1967, the new incinerator failed, due to thermal fatigue and embrittlement, especially in the upper (secondary) combustion chamber. As an expedient, 321 stainless steel was used to fabricate a new upper combustion chamber, as fabrication with Incoloy 800 was a specialized and time-consuming process. Further, the broken primary cyclone was replaced, the upper and lower chambers were welded together, much insulation was replaced, and temperature sensors formerly located on the outer wall of the incinerator were placed directly in the off-gas. Operations resumed on October 6, 1967, with maximum temperature guidelines of 800 C.[45]

The combination Incoloy 800 and 321 stainless steel furnace then operated for over two years until it failed and was re-built again in early and mid-1970. During those two years, problems with the off-gas scrubber system were the most frequent, with other temporary shutdowns caused one major fire in the HEPA filter and by localized fires in the chopper and in the feed end of the incinerator glove box itself. Additionally, the wire mesh conveyor belts continued to need tightening, spot welding and periodic changeouts, and the lack of good air flow control remained as a basic design flaw.[46]

## FINAL YEARS AND CLOSURE

Following the 1970 rebuilding and re-start, the 232-Z incinerator operated for approximately three years, when it was shut down as part of an overall PFP review of "interfaces with the environment." Fire protection improvements were added to the 232-Z facility in 1972. During the 1970-73 period, fires and other interruptions were minimized by the use of the temperature thermocouple that was located in the off-gas stream. However, the high frequency in alarm activations, and subsequent shut downs, caused a relatively low throughput rate, and the incinerator averaged only two hours per shift in actual burning time. The alarm was set to trip whenever a temperature spike occurred, no matter how short in duration. In practice, this meant a

shut down every time a piece of fly ash contacted the thermocouple, followed by a complete inspection of the incinerator. Additionally, plugging of various parts of the scrubber system remained as a constant problem, along with corrosion failure of scrubber components due to contact with the strong sodium hydroxide-urea scrubber solution. Ten replacements of major scrubber parts proved necessary in the two years previous to the 1973 shut down.[47]

Although many suggestions for the improvement of incinerator operations were made throughout the 1974-76 period, the 232-Z facility never was re-started.[48] In 1988, a monitoring enhancement plan was developed for the facility, and a remediation project management plan was issued in 1989. As characterization studies proceeded throughout 1989, Hanford Site managers determined that the old facility did not meet modern seismic requirements, and a specific source term reduction plan was developed in 1990.[49]Instrument and filtration modifications and upgrades, multiple surveillances, and other activities have taken place since that time. Plutonium source term reduction work currently is proceeding under interim action status, pending completion of a full Environmental Assessment for the facility.

## *PHYSICAL DESCRIPTION*

### ORIGINAL PLANS AND CONSTRUCTION

Completed in 1961, the Contaminated Waste Recovery Process Facility, known as the 232-Z Building, is a rectangular, single story facility constructed of lightly reinforced concrete blocks situated on a reinforced concrete grade beam foundation. The building, approximately 2100 square feet, measures 37 feet wide (E-W) by 57 feet in length (N-S); one story high (15 feet) over the process and storage areas, and two stories high (19 feet) over the service areas at the north end.

The interior is divided into several rooms, the largest of which is the process room that originally housed several pieces of equipment, including the incinerator and several glove and filter boxes. Other rooms include the scrubber cell room, a storage room, a change room, a chemical preparation room, and rooms for ventilation and electrical equipment.

The facility consisted of five hoods (glove boxes), for sorting and drying contaminated materials, leaching or washing non-combustible materials, incinerating combustible materials and canning the ashes, and providing contamination barriers around the scrubbers (filters) and around the blowers. The incinerator had both primary and secondary combustion chambers. Simple caustic and water scrubber filtration was provided, along with a bank of glass wool filters. An automatic carbon dioxide fire suppression system was provided for the waste carton storage room.

The exhaust system tied into the main 234-5 exhaust stack for final filtration, and the building process wastes likewise were linked to the 234-5 facility waste holding tanks (D-6 tanks) via a buried, three-inch 304 stainless steel line. Condensate and cooling water from the 232-Z facility were combined with similar streams from the PFP, and routed to the 216-Z-19 ditch for surface (crib) disposal.

### MECHANICAL EQUIPMENT AND PROCESSES

The incinerator was the first of its kind when it opened in 1962. It was a "prototype" in design and function for plutonium-burning incinerators because of its conveyor-belt automation system. Scrap material was conveyed from one process to another by a "traveling belt" feed system that fed the contaminated material into the incinerator. The material was reduced to small

pieces in the chop-hood and incinerated in the furnace where the resultant ash was collected in ash-cans and transported to an adjacent facility where the ash was leached to recover plutonium. Off-gases produced from combustion were routed to scrubber equipment and a filter system located in the scrubber cell.

## EXISTING CONDITIONS

### Modifications/Additions

**Interior**

Structurally 232-Z has not been subjected to incompatible modifications or changes to its original plan.. During its years of operations there were minimal modifications to the facility's features. Numerous engineering functions, however, were replaced and/or changed as mechanical problems plagued incinerator operations from the beginning. In the space of a year (1963-64) the conveyor belt was replaced on five different occasions. Off-gas heaters, the electrical incinerator heating elements, bellows, the rubber feed belt from the chopping bin, temperature indicators, scrubber circulation pumps, and other soft components burned out and had to be replaced. In 1965 the furnace for the incinerator had to be replaced. With waste cartons being generated at 30-40 per month it was urgent that the furnace be activated at the earliest date possible. When the incinerator failed later that year it did not start up again until October of 1966. During the repair period, the fire brick and heating elements also were replaced, and the inside of the incinerator glove box was painted with a strong polyvinyl-chloride contamination fixant.

The problems with the incinerator and furnace did not end. In July 1967 the incinerator failed again. The upper and lower chambers of the incinerator were welded together, and insulation was replaced. In early 1970 the incinerator failed again and was re-built. Fire protection improvements were added in 1972. Ten replacements of major scrubber parts proved necessary in the two years prior to the final shutdown in 1973. The wall-mounted, combustible gas analyzer was removed in 1982, and several other steps were taken during 1983 to achieve "terminal cleanout." Certain glove box assemblies were disassembled, electrical service was disconnected, and the panels were replaced on the leaching hood.

In 1983 partial decontamination and decommissioning activities resulted in the removal of the chop (sorting) hood and leach hoods 1 & 2. While the feed system/conveyor belt framework is still intact, the chutes into the incinerator were closed (Mincey 1994). The incinerator hood, scrubber cell, ash canning hood, glove and filter boxes and associated process piping remain intact (Carter 1994).

Further steps were taken during 1984, including installation of sheet metal blanks on the sorting and leaching hoods, extension of heat detector and fire alarm coverage, and relocation of Continuous Air Monitors (CAMs) to preferred locations within the facility. Wiring modifications, and additional CAM relocations and fire protection improvements were made during 1985 and 1988. The ventilation system was upgraded in 1990 to provide the facility with separate HEPA filtration.

**Exterior**

232-Z has retained its original plan/configuration, concrete construction, built-up roof, original doors and concrete foundation.

The elevation with the most exterior modifications is the east facade. While the fascia band and metal flashing along the roof line have been retained, the metal flashing and a metal roof extension over one of the doors has been removed. In 1990 HEPA ventilation equipment was installed along this facade. The original ventilation louver, however, has been retained. Changes to this facade have been mainly cosmetic rather than structural.

On the front (south) facade a corrugated metal addition/shelter has been added between the two doors. The metal doors are original, and the metal gutters above the doors have been retained. While the fascia band and metal flashing have been retained along the roof line, similar bands between the doorway and the roof line have been removed.

The fascia band and metal flashing along the roof line of the west facade have been retained, along with all other original features.

While the original doors are intact on the rear (north) facade, the metal gutters over the doors have been removed. The fascia band and metal flashing along the roof line has been retained.

***PROJECT INFORMATION***

Due to public health and safety concerns, the U. S. Department of Energy, Richland Operations Office (DOE-RL) is planning to demolish the 232-Z Waste Incinerator Facility. The DOE-RL determined that the excessive levels of plutonium concentration in the facility, and the risk of potential release, was not acceptable. The proposed action in the draft EA/FONSI addresses plutonium inventory removal and building demolition. The decommissioning activity would consist of the dismantling, decontamination and removal of all interior equipment and features, followed by the total disassembly, packaging and disposal of the building.

The State Historic Preservation Office (SHPO) concurred with DOE-RL's recommendation that 232-Z is eligible for listing in the National Register of Historic Places. Although less than fifty years old, the building is associated with the nationally significant Cold War Era, is located within a potential National Register Historic District, and is individually significant for its equipment design and prototype method of automating and executing the incineration of plutonium-bearing wastes. Thus, DOE-RL concluded that the above undertaking will have an adverse effect upon the National Register eligibility of 232-Z.

Section 106 of the National Historic Preservation Act of 1966 (P.L. 86-665, as amended) requires all federal agencies to take into account the effects of their undertakings on properties listed in or eligible for the Register, and afford the Advisory Council on Historic Preservation an opportunity to comment on the proposed undertaking. As required by Section 106, DOE-RL entered into a consultation process with the SHPO and the Advisory Council to negotiate a Memorandum of Agreement (MOA) on means to avoid or mitigate the adverse effects of the proposed undertaking. The MOA stipulated that DOE-RL mitigate the adverse effects by documenting the building to Historic American Engineering Record (HAER) standards. The stipulations in the MOA include a HAER narrative report, archival-quality photographic documentation, and photographic copies of original construction/engineering drawings.

## BIBLIOGRAPHY

"Atomic Incinerator Operates at San Jose," in G.E. News (Richland, WA: G.E. Hanford Co., September 30, 1960), #25, p. 1.

Borgeson, M.E., Letter to Gentlemen (Vendors) (Richland, WA: G.E. Hanford Co., March 14, 1962).

Borgeson, M.E., "Chopper Glove Box Fire Protection Equipment - 232-Z Building," Memo to D.W. Corbell (Richland, WA: G.E. Hanford Co., September 4, 1964).

Borgeson, M.E., "Furnace Conveyor Belt," Memo to J.W. Fillmore (Richland, WA: G.E. Hanford Co., December 31, 1964).

Borgeson, M.E., "Trip Report, Radioactive Waste Incineration" (Richland, WA: G.E. Hanford Co., October 27, 1965).

Borgeson, M.E., "Recommended Temperature for Incinerator Operation," Memo to D.W. Corbell (Richland, WA: Isochem, Inc., October 7, 1966).

Bradway, A., "Project CGC-813, Plutonium Recovery From Contaminated Materials," Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., September 15, 1959).

Bradway, A., "Contingency Maintenance Request MA-41" (Richland, WA: G.E. Hanford Co., March 27, 1963).

Browne, W.G., "CGC-813 - Plutonium Recovery From Contaminated Materials," Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., January 12, 1959).

Browne, W.G., "Project CGC-813 - Plutonium Recovery from Contaminated Materials - 234-5 Bldg., Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., November 21, 1960).

Browne, W.G., "Neutron Counters for Project CGC-813," Memo to D.W. Corbell (Richland, WA: G.E. Hanford Co., March 10, 1961).

Browne, W.G., "Nuclear Safety of the Chopper Feed Hopper on the Incinerator -234-5 Building," Memo to L.M. Meeker (Richland, WA: G.E. Hanford Co., August 31, 1961).

Bruns, L.E., "Flowsheet and Bases for Equipment Specifications, New Leach Hood," HW-75675 (Richland, WA: G.E. Hanford Co., December 3, 1962).

Bruns, L.E., and Lyon, R.Y., and Unzicker, W.F., "Z Plant Weekly Report; Recuplex, Incinerator, & Task I - II," HW-72224 RD (Richland, WA: G.E. Hanford Co., January 2, 1963).

Conner, E.L., Jr., and Crocker, H.W., "Filtration of Incinerator Scrubber Solution," HW-70932 (Richland, WA: G.E. Hanford Co., September 6, 1961).

Corbell, D.W., "Fire Protection Equipment, 232-Z Building" (Richland, WA: G.E. Hanford Co., April 19, 1961).

Corbell, D.W., "Request for Appropriation No. 66008" (Richland, WA: G.E. Hanford Co., July 29, 1965).

Courtney, J.J., "Project CGC-813, Pu Recovery from Contaminated Material, Exceptions - Post Acceptance Papers," memo to D.R. Gustavson (Richland, WA: G.E. Hanford Co., October 29, 1962).

Doud, E., "Plutonium Recovery From Miscellaneous Wastes: Incineration and Leaching," Letter to J.T. Christy (Richland, WA: G.E. Hanford Co., May 27, 1958).

Doud, E., "Recovery of Pu From Miscellaneous Wastes; Report on Trip to Rocky Flats, Colorado," Memo to J.B. Fecht (Richland, WA: G.E. Hanford Co, July 21, 1958).

Doud, E., "Plutonium Recovery from Contaminated Materials (Project CGC-813) Process Design," HW-57288 (Richland, WA: G.E. Hanford Co., August 27, 1958).

Engineers of Plutonium Processing Engineering, "Z Plant Report, Task I-II & Recovery Operations, January 1, 1965, through December 31, 1965," ISO-57 RD (Richland, WA: Isochem, Inc., January 1, 1967).

Engler, A.E., "Construction Specifications for Phase I, 232-Z Building," HWS-6495 (Richland, WA: G.E. Hanford Co., May 12, 1959).

Felt, R.E., "Incinerator Operations Analysis," Memo to G.A. Nicholson (Richland, WA: Atlantic Richfield Hanford Co., November 8, 1974).

Fillmore, J.W., "Apparent Incinerator Furnace Failure, Building 232-Z, July 12, 1965," Memo to Distribution (Richland, WA: G.E. Hanford Co., July 13, 1965).

Fillmore, J.W., "Status of Incinerator Furnace Building, 232-Z," Rough Draft (Richland, WA: G.E. Hanford Co., July 30, 1965).

Fillmore, J.W., Lyon, R.Y., Teal, J.A., and Upington, G.W., "Hazards Review for Start-Up of Repaired incinerator, 232-Z Building," ISO-506 (Richland, WA: Isochem, Inc., September 27, 1966).

Fisk, P.B., "Determination of Plutonium Content in Incinerator Ash, Plutonium Reclamation Facility," RL-SEP-350 (Richland, WA: G.E. Hanford Co., March 4, 1965).

Gifford, A.T., "Plutonium Waste Incineration," Letter to P.H. Reinker (Richland, WA: U.S. Atomic Energy Commission, May 11, 1964).

Gustavson, D.R., "Project CGC-813; Plutonium Recovery From Contaminated Materials, Design Instructions," Memo to H.D. Tibbals (Richland, WA: G.E. Hanford Co., November 21, 1958).

Gustavson, D.R., "Project Planning Meeting; Plutonium Recovery From Contaminated Materials, Project CGC-813," Memo to File (Richland, WA: G.E. Hanford Co., December 22, 1958).

Gustavson, D.R., "Project CGC-813; Plutonium Recovery From Contaminated Materials, Design Instruction Letter No. 2," Memo to W.R. Felts (Richland, WA: G.E. Hanford Co., January 13, 1959).

Hays, D.D., "Examination of Coupling Failure, 232-Z Building Incinerator," HW-84542 (Richland, WA: G.E. Hanford Co., December 2, 1964).

Hopkins, H.H., "Separation of Solids from Incinerator Off-gas Solution," memo to L.M. Meeker (Richland, WA: G.E. Hanford Co., September 11, 1961).

Huff, G.A., and Wenner, R.D., "Trip Report - October 5, 6 and 7, 1976," Memo to R.B. Gelman and V.D. Schrag (Richland, WA: Rockwell Hanford Operations, October 22, 1976).

Ingalls, W.P., "232-Z Building Incinerator Start-Up," memo to R.E. Olson (Richland, WA: Atlantic Richfield Hanford Co., July 15, 1970).

Johnson, A.J., Meyer, F.G., Anderson, D.L., Bell, B.A., and Feng, P.K., "Fluidized Bed Incineration Process Design for Transuranic Waste," RFP-2945 (Golden, CO: Rockwell Energy Systems Group, July 19, 1980).

Kinney, W.W., "CGC-813 Status," Memo to J.J. Courtney (Richland, WA: G.E. Hanford Co., October 12, 1961).

Kinney, W.W., "Incinerator Failure," Memo to R.W. Baalman, et al (Richland, WA: G.E. Hanford Co., January 30, 196).

Kinzer, J.E., "Program to Reduce Generation of Transuranic Contaminated Solid Waste," Letter to F.R. Standerfer (Richland, WA: Rockwell hanford Operations, November 15, 1977).

Kiser, S.K., "Westinghouse Hanford Company Surplus Facilities Manual," WHC-SP-0331 (Richland, WA: Westinghouse Hanford Co., September 1988).

Knights, L.M., "The Continuous Incineration of Plutonium-Bearing Scrap," ARH-SA-39 (Richland, WA: Atlantic Richfield Hanford Co., September 15, 1969).

Lee, H.A., Start Up of Repaired Incinerator," Memo to D.W. Corbell (Richland, WA: Atlantic Richfield Hanford Co., September 29, 1967).

Lee, H.A., "Incinerator Operation," Memo to R.E. Olson (Richland, WA: Atlantic Richfield Hanford Co., October 16, 1967).

Lee, H.A., "Incinerator," Memo to R.E. Olson (Richland, WA: Atlantic Richfield Hanford Co., October 17, 1967).

Low, A.J., "Incinerator Operations Study," Memo to R.E. Olson (Richland, WA: Atlantic Richfield Hanford Co., April 7, 1972).

Moulthrop, H.A., and Slind, M.T., "Buildup of Plutonium Within the Incinerator and Associated Hoods," Memo to R.Y. Lyons (Richland, WA: G.E. Hanford Co., March 27, 1963).

Nelson, T.C., "Examination of Furnace Belt Failure in 232-Z Incinerator," Letter to M.E. Borgeson (Richland, WA: Battelle Northwest Laboratories, February 11, 1965).

Nicholson, G.A., and Felt, R.E., "Incinerator Startup Review" (Richland, WA: Atlantic Richfield Hanford Co., January 7, 1974).

Olson, R.E., "Incinerator Repair," Memo to File (Richland, WA: Isochem, Inc., January 28, 1966

"Purchase Specification, Neutron Monitor" (Richland, WA: G.E. Hanford Co., September 2, 1960).

Purdie, O.D., "Active Waste Incineration," DPW-3821 (Wilmington, DE: E.I. DuPont de Nemours and Co., November 1, 1951).

Rasmussen, O.R.H., "Incinerator Operation Study" (Richland, WA: Atlantic Richfield Hanford Co., April 7, 1972).

Reinker, P.H., "Revised Schedule for Post Acceptance Report, Plutonium Recovery from Contaminated Materials - 234-5 Building (Project CGC-813)," Memo to W.E. Johnson (Richland, WA: G.E. Hanford Co., August 22, 1962).

Reinker, P.H., "Request for Authorization, Additional Leach hood, 232-Z Building," Memo to W.E. Johnson (Richland, WA: G.E. Hanford Co., February 15, 1963).

Reinker, P.H., "Contingency Maintenance Request, Incinerator Repair and Modification 232-Z Building," Letter to A.T. Gifford (Richland, WA: U.S. Atomic Energy Commission, March 29, 1963).

Reinker, P.H., "Plutonium Waste Incineration," letter to A.T. Gifford (Richland, WA: G.E. Hanford Co., June 11, 1964).

Rey, G., "Incinerator and Off-Gas Scrubber Tests," HW-68788 (Richland, WA: G.E. Hanford Co., March 9, 1961).

Safety Hazards Analysis,"Plutonium Removal from 232-Z - 3rd Reissue," Memo to D.R. Spears (Richland, WA: Westinghouse Hanford Co., February 15, 1990).

Schilling, A.E., "Plutonium Finishing Plant (PFP) Remediation project Management Plan," SD-CP-PMP-003 (Richland, WA: Westinghouse Hanford Co., March 8, 1989).

Shaw, H.P., "Work Authority, Project CGC-813" (Richland, WA: G.E. hanford Co., June 10, 1959).

Shaw, H.P., "Contingency Maintenance Request MA-41, Incinerator Repair and Modification 232-Z Building," Letter to A.T. Gifford (Richland, WA: G.E. Hanford Co., June 5, 1963).

Silletto, R.H., "Analysis of Estimated Project Cost Increase, Pu Recovery From Contaminated Materials (Revision No. 2, project CGC-813), Memo to File (Richland, WA: G.E. Hanford Co., January 14, 1959).

Silletto, R.H., "Project Proposal Revision 2; Plutonium Recovery From Contaminated Materials, 234-5 Building," HW-58318 (Richland, WA: G.E. Hanford Co., April 21, 1959).

Silletto, "Project CGC-813, Review of Scrubber System," Memo to A. Bradway (Richland, WA: G.E. Hanford Co., October 6, 1959).

Silletto, R.H., "Design Review Meeting Minutes, Project CGC-813, Scrubber Equipment" (Richland, WA: G.E. Hanford Co., November 2, 1959).

Silletto, R.H.,"CG-813 - Pu Recovery from Contaminated Material, Design Instruction letter No. 4," Memo to W.R. Felts (Richland, WA: G.E. Hanford Co., December 31, 1959).

Silletto, R.H., "Design Review Meeting Minutes, Project CGC-813, Pu Recovery From Contamination" (Richland, WA: G.E. Hanford Co., October 6, 1960).

Silletto, R.H., "Hazards Review, Project CGC-813, Plutonium Recovery From Contaminated Materials - 234-5 Bldg," HW-69580 RD (Richland, WA" G.E. Hanford Co., May 12, 1961).

Silletto, R.H., "Project CGC-813, Pu Recovery From Contaminated Materials -234=5 Building, Recommended Temperatures for Incinerator Operation," Memo to D.W. Corbell (Richland, WA: G.E. Hanford Co., July 28, 1961).

Silletto, R.H., "Project CGC-813, Pu Recovery of Contaminated material, 234-5 Building, Project Start-up Costs," Memo to A. Bradway (Richland, WA: G.E. Hanford Co., December 27, 1961).

Slind, M.T., "Pu Monitor for Scrubber - CGC-813," Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., February 14, 1961).

Slind M.T., "Pu Monitor for Feed Bin - CGC-813," Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., April 3, 1961).

Snyder, D.A., "Preliminary Project Proposal; Plutonium Recovery from Contaminated Materials, 234-5 Building," HW-56562 (Richland, WA: G.E. Hanford Co., June 27, 1958).

Snyder, D.A., "Project Proposal Revision 1; Plutonium Recovery from Contaminated Materials, 234-5 Building," HW-57124 (Richland, WA: G.E. Hanford Co., August 11, 1958).

Stedwell, M.J., "Incinerator Off-Gas Scrubber Tests," Memo to R.J. Sloat (Richland, WA: G.E. Hanford Co., April 6, 1960).

Stedwell, M.J., "Comments on Peabody Scrubber Prints from Project CGC-813," Memo to R.H. Silletto (Richland, WA: G.E. Hanford Co., July 25, 1960).

Thorburn, R.C., Letter to R. Silletto (San Jose, CA: G.E. Atomic Power Equipment Department, September 19, 1960).

Unzicker, W.F., and Lyon, R.Y., "Z Plant Weekly Report; Task I - II and Incinerator, From January 1, 1963, to December 31, 1963," HW-76162 RD (Richland, WA: G.E. Hanford Co., January 2, 1964).

Vinyard, J.W., and Dixon, W.H., ""Project CGC-813, Pu Recovery From Contaminated Material, 234-5, Material and Equipment List," Final Issue (Richland, WA: G.E. Hanford Co., October 23, 1961).

Walser, R.L., and Lyon, R.Y., "Z-Plant Weekly Report, Task I-II & Recovery Operations, January 1, 1964 through December 31, 1964," HW-80356 RD (Richland, WA: G.E. Hanford Co., January 2, 1965).

Walser, R.L., and Lyon, R.Y., "Z Plant Weekly Report; Task I-II and Recovery Operations, January 1, 1965, through December 31, 1965," RL-SEP-249 RD (Richland, WA: G.E. Hanford Co., January 1, 1966).

Walters, F.F., and Teal, J.A., "Review of Plutonium Accumulations in Service Piping and Ductwork, Monitoring Enhancement Plan Plutonium Finishing Plant," SD-CP-ER-019 (Richland, WA: Westinghouse Hanford Co., November 17, 1988).

Watters, F.S., "Trip Report - Argonne National Lab," DPW-4224 (Wilmington, DE: E.I. DuPont de Nemours and Co., January 2, 1952).

Westsik, G.A., "Proposal to Perform Source Term Reduction in 232-Z Building," Memo to E.C. Vogt (Richland, WA: Westinghouse Hanford Co., January 15, 1990), with attachment: "232-Z Building Source Term Reduction Project."

Wills, C.G., "Plutonium Recovery From Contaminated Materials, Project CGC-813, 232-Z Building, 200-W Area, Finished Products Chemical Technology Neutron Monitoring Investigation," HW-70792 (Richland, WA: G.E. Hanford Co., August 23, 1961).

Zangar, C.N., ""Summary Report of Accidental Nuclear Excursion, RECUPLEX Operation, 234-5 Facility," TID-18431 (Richland, WA: U.S. Atomic Energy Commission, 1962).

Ziegler, D.L., Johnson, A.J., Meile, L.J., Johnston, A.L., and Shamhart, E.L., "Pilot Plant Development of a Fluidized Bed Incineration Process," RFP-2271 (Golden, CO: Dow Chemical Rocky Flats Division, October 14, 1974).

Ziegler, D.L., "Fluidized Bed Incineration of Radioactive Waste," RFP-2471 (Golden, CO: Rockwell Atomics International Division, May 14, 1976).

Ziegler, D.L., and Johnson, A.J., "Fluidized Bed Incineration of Transuranic Contaminated Waste," RFP-2693 (Golden, CO: Rockwell Atomics International Division, 1977).

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ENDNOTES:

[0] Hanford Works (HW) was the name used to designate the Hanford Site by its federal management organization, the Atomic Energy Commission (AEC) from 1947-1973.

[1] Doud, "Plutonium Recovery....," May 27, 1958.

[2] Snyder, HW-56562,pp. 3-5.

[3] Ibid., p. 3. See also: Snyder, HW-57124, pp. 3-5.

[4] Ziegler, Johnson, Meile, Johnston and Shamhart, RFP-2271, p. 1; and Ziegler, RFP-2471, p. 1; and Ziegler and Johnson, RFP-2693, p. 1; and Johnson, Meyer, Anderson, Bell and Feng, RFP-2945, p. 1; and Doud, "Recovery of Pu...'" July 21, 1958, pp. 1-3; and Borgeson, "Trip Report...," October 27, 1965.

[5] Doud, HW-57288, pp. 3-10; and Gustavson, "Project CGC-813; Plutonium Recovery...," November 21, 1958.

[6] Gustavson, "Project Planning Meeting...," December 22, 1958, p. 1.

[7] Browne, "CGC-813 - Plutonium Recovery...," January 12, 1959; and Gustavson, "Project CGC-813; Plutonium Recovery...," January 13, 1959; and Silletto, "Analysis of Estimated project Cost...," January 14, 1959.

[8] Silletto, HW-58318, pp. 5-7; and Borgeson, "Trip Report...," October 27, 1965; and Thorburn, Letter to R. Silletto," September 19, 1960; and "Atomic Incinerator Operates at San Jose," September 30, 1960; and Purdie, DPW-3821; and Watters, DPW-4224.

[9] Engler, HWS-6495; and Shaw, "Work Authority, Project CGC-813," June 10, 1959; and Silletto, HW-58318, pp. 5-7.

[10] Bradway, "Project CGC-813, Plutonium Recovery...," September 15, 1959; and Silletto, "Project CGC-813, Review of Scrubber System," October 6, 1959; and Silletto, "Design Review Meeting Minutes...," November 2, 1959; and Stedwell, "Incinerator Off-Gas Scrubber Tests," April 6, 1960; and Stedwell, "Comments on Peabody Scrubber...," July 25, 1960; and Silletto, "Design Review Meeting Minutes...," October 6, 1960.

[11] Peabody is a registered trademark of the Peabody Engineering Corporation of Stamford, Connecticut.

[12] Rey, HW-68788, pp. 3-4.

[13] Conner and Crocker, HW-70932, p. 2; and Hopkins, "Separation of Solids...," September 11, 1961.

[14] "Purchase Specification, Neutron Monitor," September 2, 1960; and Slind, "Pu Monitor for Scrubber," February 14, 1961; and Browne, "Neutron Counters for Project CGC-813," March 10, 1961; and Slind, "Pu Monitor for feed Bin - CGC-813," April 3, 1961; and Silletto, HW-69580 RD, pp. 7-9; and Wills, HW-70792, pp. 3-5.

[15] Fisk, RL-SEP-350, p. 1.

[16] Browne, "Project CGC-813...," November 21, 1960; and Browne, "Nuclear Safety of the Chopper Feed Hopper...," August 31, 1961; and Corbell, "Fire Protection Equipment, 232-Z Building," April 19, 1961; and Silletto, HW-69580 RD; and Silletto, "CG-813, PU Recovery...," December 31, 1959.

[17] Borgeson, Letter to Gentlemen (Vendors), March 14, 1962.

[18] Browne, "Neutron Counters for Project CGC-813," March 10, 1961, p. 3.

[19] Silletto, "Project CGC-813 - Pu Recovery...," December 27, 1961. See also: Silletto, HW-696580 RD, p. 5.

[20] Silletto, "Project CGC-813, Pu Recovery...," July 28, 1961.

[21] Kinney, "CGC-813 Status," October 12, 1961.

[22] Bruns, Lyon and Unzicker, HW-72224 RD, pp. 3-6, 8-14, 16-18, 20-21, 23-24, 26, 28-30, 32, 34; an Reinker, "Revised Schedule...," August 22, 1962; and Borgeson, Letter to Gentlemen (Vendors), March 14, 1962; and Zangar, TID-18431.

[23] Bruns, Lyon and Unzicker, HW-72224 RD, pp. 20-21, 23, 29-30, 32, 38-40, 49.

[24] Reinker, "Revised Schedule...," August 22, 1962.

[25] Courtney, "Project CGC-813, Pu Recovery...," October 29, 1962.

[26] Bruns, HW-75675, pp. 1-2; and Reinker, "Request for Authorization..., " February 15, 1963.

[27] Reinker, "Plutonium Waste Incineration," June 11, 1964, p. 3.

[28] Unzicker and Lyon, HW-76162 RD, pp. 14; and Fillmore, "Apparent Incinerator Furnace Failure...," July 13,1965; and Kinney, "Incinerator Failure," January 30, 1963; and Swain, "Incinerator Repair Alternatives...," February 14, 1963.

[29] Reinker, "Contingency Maintenance Request...," March 29, 1963; and Bradway, "Contingency Maintenance Request No. MA-41," March 27, 1963.

[30] Shaw, "Contingency Maintenance Request MA-41...," June 5, 1963; and Unzicker and Lyon, HW-76162 RD, p. 56; and Moulthrop and Slind, "Buildup of Plutonium...," March 27, 1963.

[31] Nichrome is a trademark of the National Westminster Bank of New York, New York.

[32] Inconel is a trademark of Inco Alloys International, Inc.

[33] Fillmore, "Status of Incinerator Furnace," July 30, 1965, p. 3; and Unzicker and Lyon, HW-76162 RD, pp. 66, 73, 75, 77, 90; and

Borgeson, "Furnace Conveyor Belt," December 31, 1964; and Walser and Lyon, HW-80356 RD, pp. 27, 71; and Nelson, "Examination of Furnace Belt Failure...," February 11, 1965.

[34] Unzicker and Lyon, HW-76162 RD; and Hays, HW-84542, pp. 1-2; and Walser and Lyon, HW-80356 RD.

[35] Unzicker and Lyon, HW- 76162 RD, pp. 73, 75, 77, 84, 90.

[36] Borgeson, "Chopper Glove Box...," September 1964; and Walser and Lyon, HW-80356 RD, pp. 4, 7, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 41, 44, 48, 50, 53, 55, 57, 60, 62, 64, 66, 69, 71.
Note: The direct quotations are from Walser and Lyon, HW-80356 RD, pp. 50 and 18.

[37] Borgeson, "Furnace Conveyor Belt," December 31, 1964; Unzicker and Lyon, HW-76162 RD; and Walser and Lyon, HW-80356 RD.

[38] Reinker, "Plutonium Waste Incineration," June 11, 1964, p. 3.

[39] Unzicker and Lyon, HW-76162 RD, pp. 14, 66; and Walser and Lyon, HW-80356 RD; and Reinker, "Plutonium Waste Incineration," p. 2.
Note: Although an ultrasonic leach bath had been recommended in 1962, the new leach facilities operated using the older, traditional method of mechanical agitation.

[40] Walser and Lyon, RL-SEP-350, pp. 4-5, 8-9, 12-13, 17-18, 20-21, 24-25, 28, 36, 41, 44-45, 49-50.

[41] Incoloy 800 was a trademark of the International Nickel Company, Huntington Alloy Products Division, of Huntington, West Virginia, but is now a trademark of Inco Alloys International Inc.

[42] Walser and Lyon, RL-SEP-350, pp. 53-54; and Fillmore, "Apparent Incinerator Furnace Failure...," July 13, 1965; and Corbell, "Request for Appropriation No. 66008," July 29, 1965; and Borgeson, "Recommended Temperature...," October 7, 1966; and Fillmore, "Status of Incinerator Furnace," July 30, 1965.

[43] Corbell, "Request for Appropriation No. 66008," July 29, 1965; and Fillmore, "Status of Incinerator Furnace," July 30, 1965; and Olson, "Incinerator Repair," January 28, 1966; and Engineers, ISO-57 RD, pp. 6, 9, 15, 19, 22, 25, 42, 45, 4872, 75; and Fillmore, Lyon, Teal and Upington, ISO-506; and Walser and Lyon, RL-SEP-350, pp. 28,33,45,50, 57, 60, 64, 70, 74, 77, 80, 97.

[44] Borgeson, "Recommended Temperatures...," October 7, 1966; and Engineers, ISO-57 RD, pp. 78, 81, 84, 91.

[45] Lee, "Start Up of Repaired Incinerator," September 29, 1967; and Lee, "Incinerator Operation," October 16, 1967; and Lee, "Incinerator," October 17, 1967; and Knights, ARH-SA-39, p. 6.

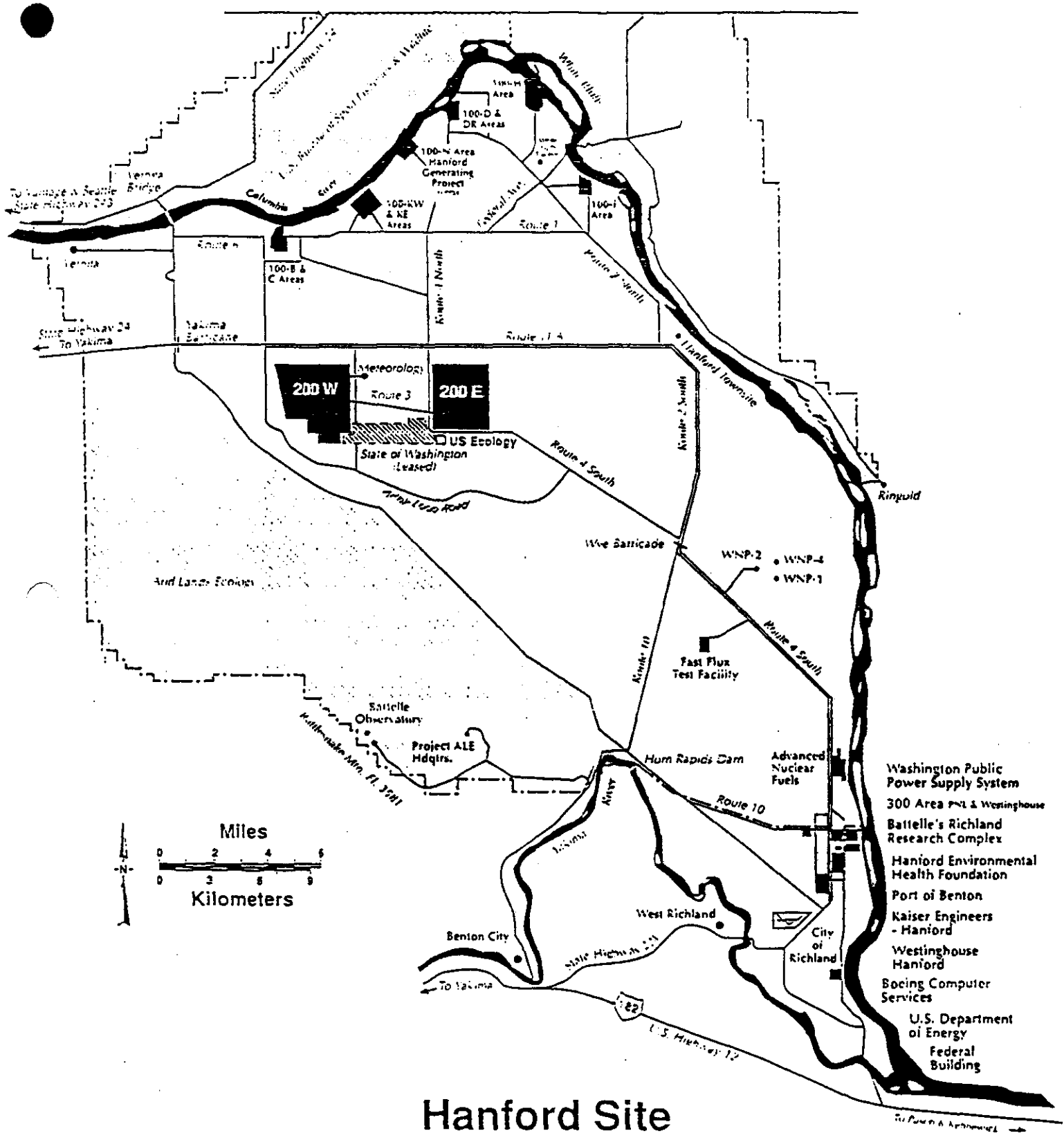
[46] Knights, ARH-SA-39, pp. 4-7; and Ingalls, "232-Z Building Incinerator Start-Up," July 15, 1970.

[47] Nicholson and Felt, "Incinerator Startup Review," January 7, 1974, pp, 1, 17, 18; and Low, "Incinerator Operations Study,"

April 7, 1972; and Rasmussen, "Incinerator Operations Study," April 7, 1972.
NOTE: The overall PFP review of interfaces with the environment was part of a Site-wide effort to re-evaluate environmental and waste management practices following the largest high level waste tank leak in Hanford's history. This leak occurred at Tank 106-T, throughout the summer of 1973.

[48] Felt, "Incinerator Operations Analysis," November 8, 1974; and Huff and Wenner, "Trip Report...," October 22, 1976; and Kinzer, "Program to Reduce...," November 15, 1977.

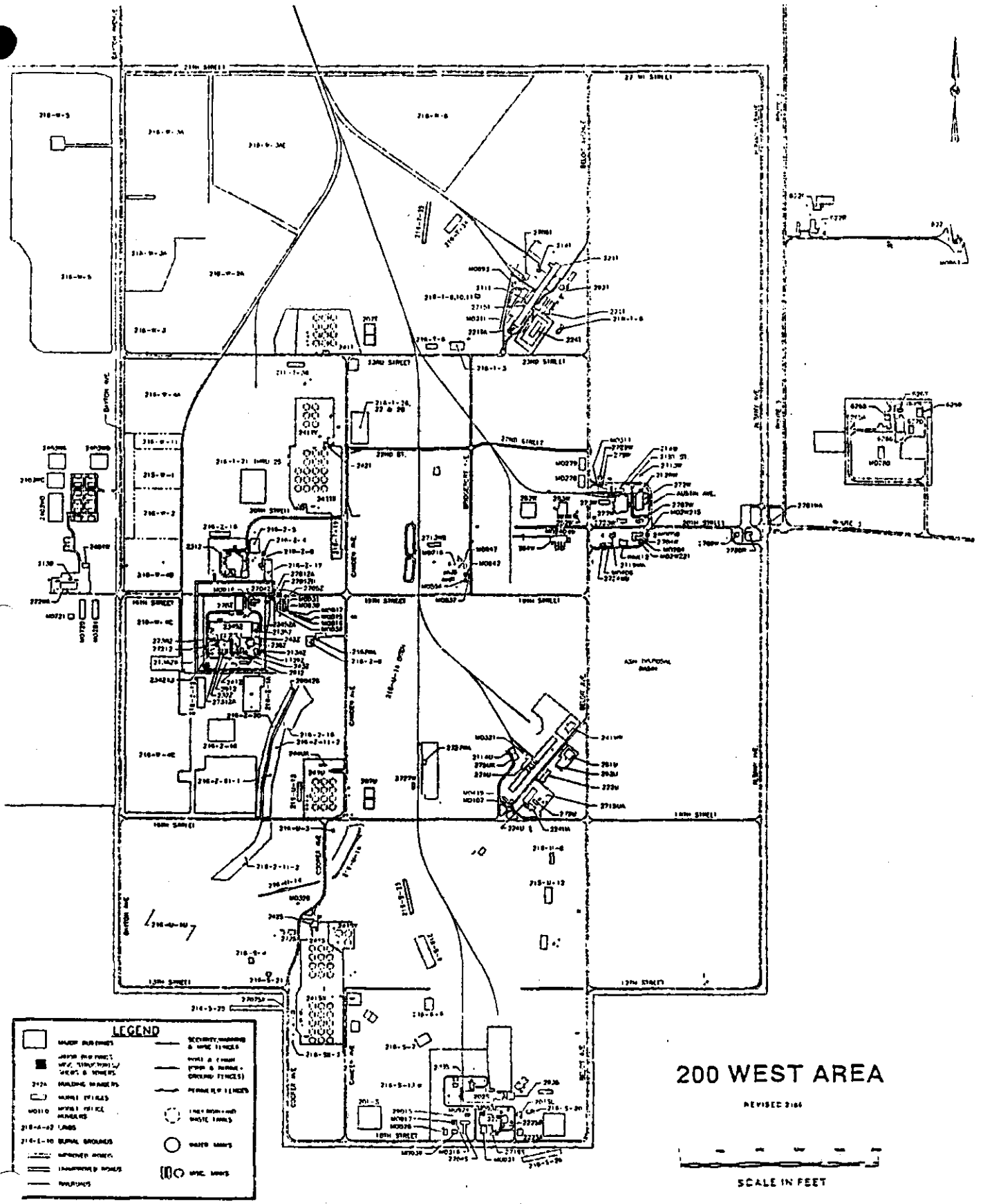
[49] Kiser, WHC-SP-0331, PP. A-207-209; and Walters and Teal, SD-CP-ER-019; and Schilling, SD-CP-PMP-003; and Westsik, "Proposal to Perform...," January 15, 1990; and Safety Hazards Analysis, "Plutonium Removal...," February 15, 1990.

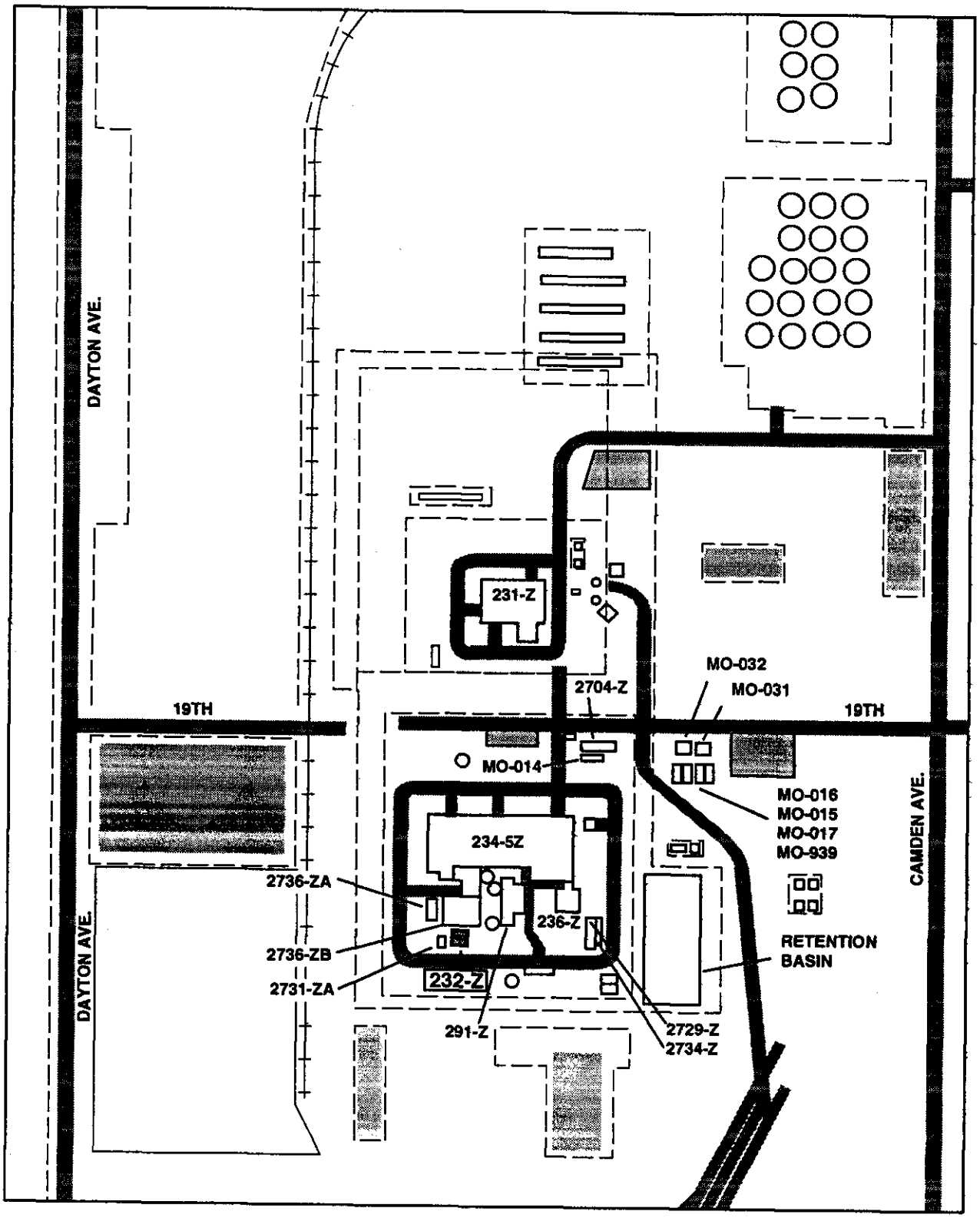



# Hanford Site

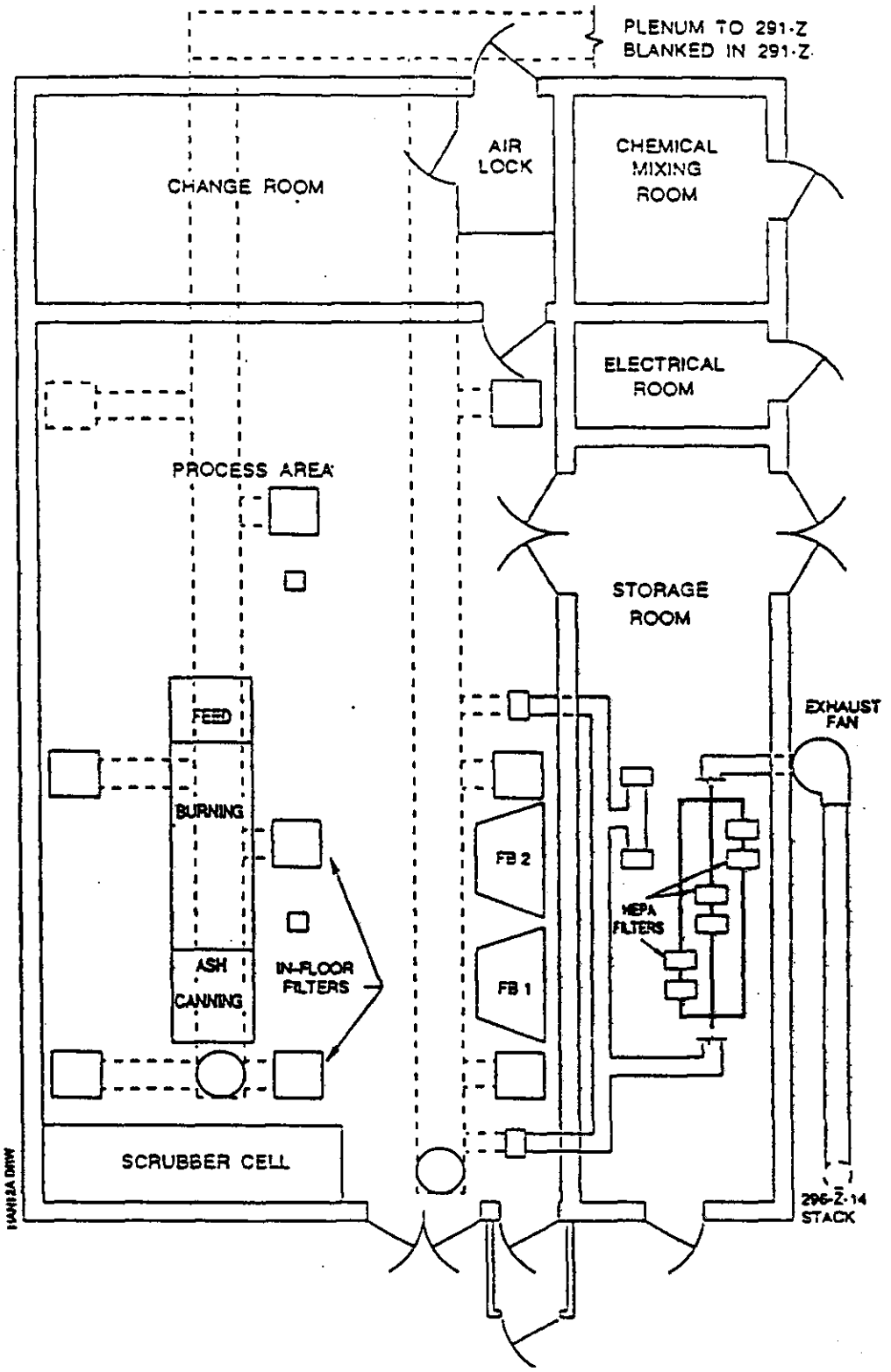
## Department of Energy

Office of Communications
U.S. Department of Energy
Richland, Washington 99352
(509) 376-7501

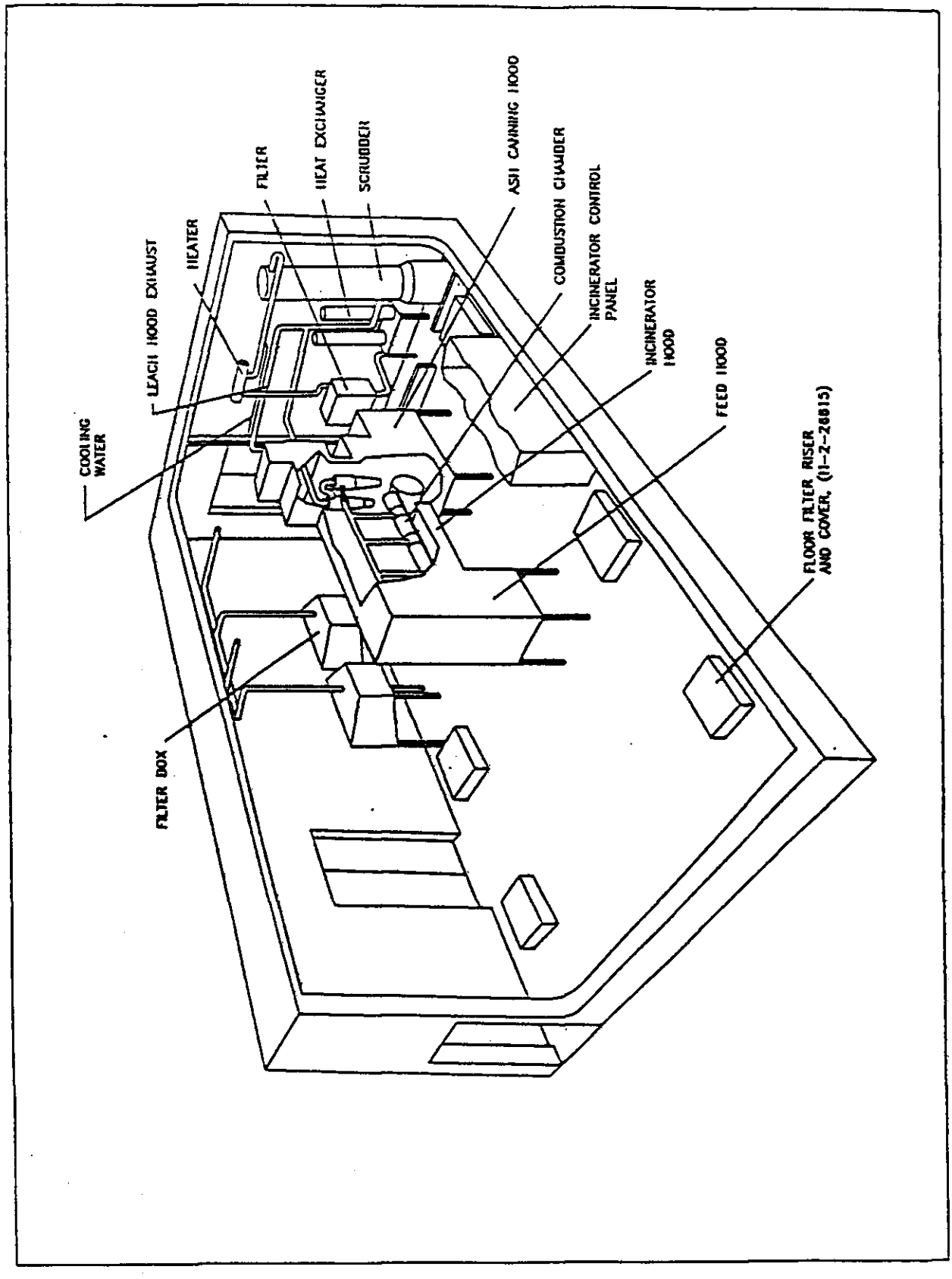

LEGEND
200 WEST AREA
REVISED 2166
SCALE IN FEET




**PLUTONIUM FINISHING PLANT AREA SITE MAP**




BUILDING 232-Z LAYOUT AND VENTILATION




BUILDING 232-Z PROCESS ROOM EQUIPMENT