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IDAHO CHEMICAL PROCESSING PLANT

SAFETY REVIEW DOCUMENT

Section 4.10

LABORATORY FACILITIES

Volume II

by

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4.10 Laboratory Facilities.

ICPP laboratories are primarily analytical and development facilities designed to perform chemical, radiochemical, and spectroscopic analyses, analytical methods research, and engineering research and development, for nuclear projects at the Idaho National Engineering Laboratory (INEL). A wide variety of analytical techniques are used, including methods that depend on measuring electrical conductivity of solutions, colorimetry, fluorophotometry, and measuring alpha, beta, and gamma activities. Other analyses include liquid-liquid separations; chromatographic separations; color titration; X-ray diffraction; infrared, optical emission, and atomic absorption spectrometry; and laser techniques. Facilities include instrumental and conventional chemical laboratories, radiochemical laboratories for small quantities of radioactive materials, and remote shielded facilities for larger quantities of radioactive substances.

Laboratories described in this section include those located in the Process Building (CPP-601), the Laboratory Building (CPP-602), the Remote Analytical Facility (RAF) Building (CPP-627), and the Process Improvement Facility (PIF) Office and Laboratory Building (CPP-637) within the ICPP complex. The pilot plant-scale laboratories associated with CPP-637 (i.e., the High- and Low-Bay Laboratories) are described in SRD Section 4.11, Experimental Facilities.

Physical characteristics, utilities, waste disposal, and control methods and procedures for all the buildings and associated laboratories are generally described in SRD Section 3. Material for that section is referenced as appropriate. In this section, laboratory equipment and activities, interconnections with other systems, and control methods and procedures are presented in sufficient detail to provide a basis for the final safety evaluation subsection.

4.10.1 Equipment and Activities. The major pieces of equipment, including instruments, and the primary activities in each laboratory area are described as follows. The descriptions, while typical, are subject to change depending on customer requirements and methods development. Instrumental equipment, for example, is occasionally modified, replaced, added to, or moved about within and between laboratories. Most changes of this type, as well as changes in analytical methods, are not safety related. If such changes are safety related, pertinent Standard Operating Procedures (SOPs) are revised, reviewed, and approved by the Safety Review Board (SRB) before implementing the proposed change.

Throughout this section, equipment and instruments are illustrated by photographs. In general, a particular type of apparatus is shown only once, even though it may be used for various purposes in many of the laboratories.

4.10.1.1 CPP-601 Laboratory. The only laboratory in CPP-601 is X Cell, an alpha-handling laboratory, located on the lowest subgrade level of CPP-601, as shown in Figure 3.1-1, SRD Section 3.

The major apparatus and primary activities carried out in X Cell are summarized in Table 4.10-I. The primary alpha-handling equipment is located along the south wall of the cell, and includes a chain of four Type III gloveboxes interfacing to a Type III cave (workplace types are defined in 4.10.3.2).[a] The third glovebox is airlocked, with a bagout port, to the fourth glovebox, which in turn is airlocked to the cave. A photograph of a part of this equipment is shown in Figure 4.10-1.

4.10.1.2 CPP-602 Laboratory Building. CPP-602 is a three-story building housing numerous laboratory facilities. The laboratories are categorized and discussed by floor (basement, first floor, second floor) in this section.

[a]This laboratory is currently inactive. All alpha-handling caves within X Cell are scheduled for replacement or upgrade.

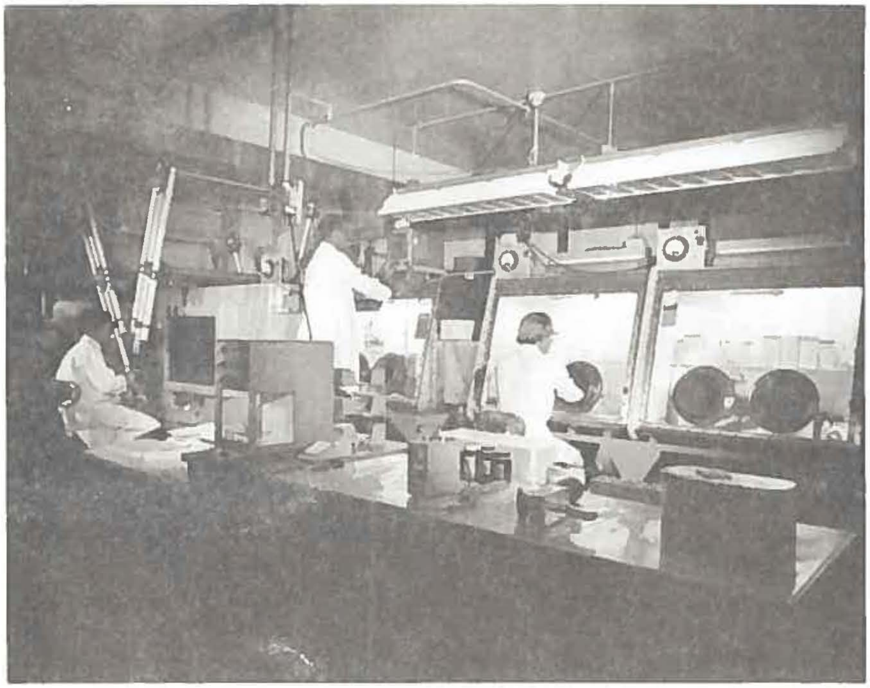


Fig. 4.10-1 View of X-Cell equipment, CPP-601

TABLE 4.10-I

CPP-601 LABORATORY AREA - X CELL

Major Apparatus[a]	Primary Activities[b]
4 Type III Gloveboxes Type III Cave Type II Hood	Dissolution and preparation of samples containing amounts of transuranics requiring Type II and III workplaces. Most samples prepared or analyzed are plant process samples and experimental transuranic samples and standards.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

[b]Former activities. This laboratory is currently inactive. All alpha-handling caves are scheduled for replacement or upgrade.

The basement laboratories of CPP-602 are used primarily for radiochemistry work. Figure 3.2-2 in SRD Section 3, a plan view of the basement area, shows the physical arrangement of the laboratories. The major apparatus and primary activities carried out in each basement laboratory area are summarized in Table 4.10-II. Room 103, partitioned into four areas, is used primarily for radiochemistry work. Rooms 109, 114, and 118 are instrument laboratories. Chemically separated fractions of samples from Rooms 103-A, -B, -C, and -D are generally sent to second floor laboratories for isotope dilution-mass spectrometric analysis and to Room 114 for radioactive counting. Occasionally, gas samples and chemical separations are sent to second floor counting laboratories for radioactivity counting or for gas-mass spectrometric analysis. Gas samples prepared in Room 103-C are usually sent to Rooms 109 or 118 for gas dilution or gas chromatographic analysis.

The combustion trains for gas analysis and the gas absorption efficiency apparatus located in Room 103-C are shown in Figures 4.10-2 and 4.10-3, respectively. The gas chromatographs, gas dilution equipment, and mass spectrometer located in Room 109 are shown in Figures 4.10-4 through 4.10-6, respectively. Figure 4.10-7 shows the gamma counting multichannel analyzers in Room 114. The alpha pulse height detector is also located in Room 114 but is used infrequently.

CPP-602 first floor analytical laboratories include facilities for radiochemical and special analyses, spectrochemical analyses, mass spectrometry analyses, and analytical research. The physical arrangement of the first floor laboratories is shown in Figure 3.2-3, SRD Section 3. The major apparatus and primary activities carried out in each first floor laboratory are summarized in Table 4.10-III.

Chemistry laboratories for radiochemical and special analysis are in Rooms 204, 207, and 208. Counting laboratories for radioactive samples are in Rooms 223 and 229. Sample separations for mass analysis are sent from Rooms 204, 207, and 208 to the mass spectrometry laboratories. Room 211 is used for analytical research and to prepare and store quality control samples.

TABLE 4.10-II

CPP-602 LABORATORY AREAS - BASEMENT

Sheet 1 of 2

Room No.	Description	Major Apparatus[a]	Primary Activities
103-A	Radiochemistry R&D Laboratory	Type II Hoods 2 Type III Gloveboxes airlocked to a third Type III Glovebox interfaced with a Type III Cave	Dissolution, preparation, and chemical analyses of materials containing transuranic elements. Chemical separation of materials.
103-B	Radiochemistry R&D Laboratory	2 Type II Hoods Micro-Analytical Balances Radioactive Sample Storage Areas Quartz Distillation Apparatus	Chemical separation and material preparation of research studies. Storage of spike solutions, including transuranic elements, in ampoules. Purification of plant water and reagent-grade acids for laboratory use.
103-C	Radiochemistry R&D Laboratory	4 Type I Hoods Combustion Trains for Gas Analysis Gas Absorbance Efficiency Apparatus	Chemical analyses and preparations of materials for research purposes or non-ICPP analyses. Few plant process samples are analyzed in this area.
103-D	Radiochemistry R&D Laboratory	2 Type I Hoods	General analytical studies.
109	Office and Counting Room	Type I Hood Gas Chromatographs Gas Dilution Equipment Mass Spectrometer	Gas samples prepared in 103-C are subjected to gas dilution, gas chromagraphic, or mass spectrometric analysis.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-II (cont'd)

Room No.	Description	Major Apparatus[a]	Primary Activities
114	Office and Counting Room	Counting Equipment	Analysis of separations from search materials.
		Gamma Multi-Channel Analyzers	
		Alpha Pulse Height Detector	
118	Office and Laboratory	2 Gas Chromatographs	Gas samples from other basement laboratories are analyzed.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

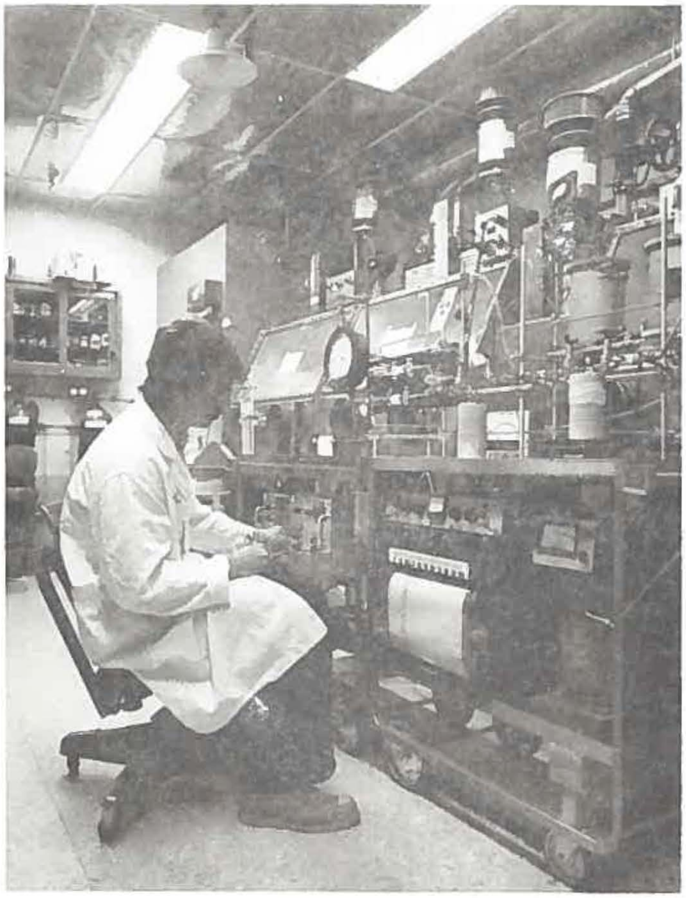


Fig. 4.10-2 Combustion trains for gas collection in Room 103C, CPP-602.

Fig. 4.10-3 Gas absorption efficiency apparatus in Room 103C, CPP-602.

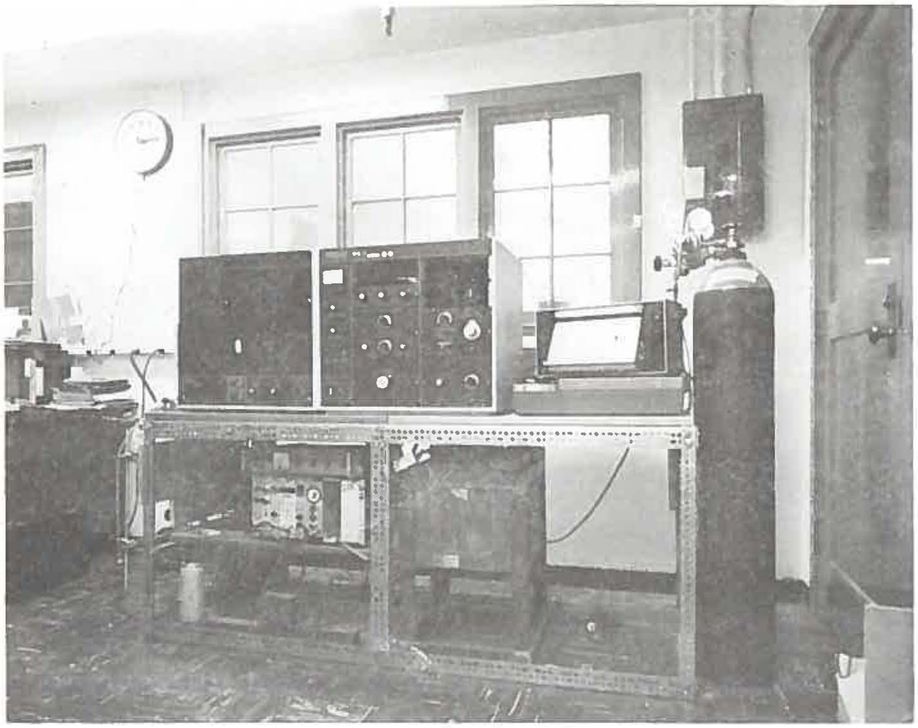


Fig. 4.10-4 Gas chromatographs in Room 109, CPP-602.

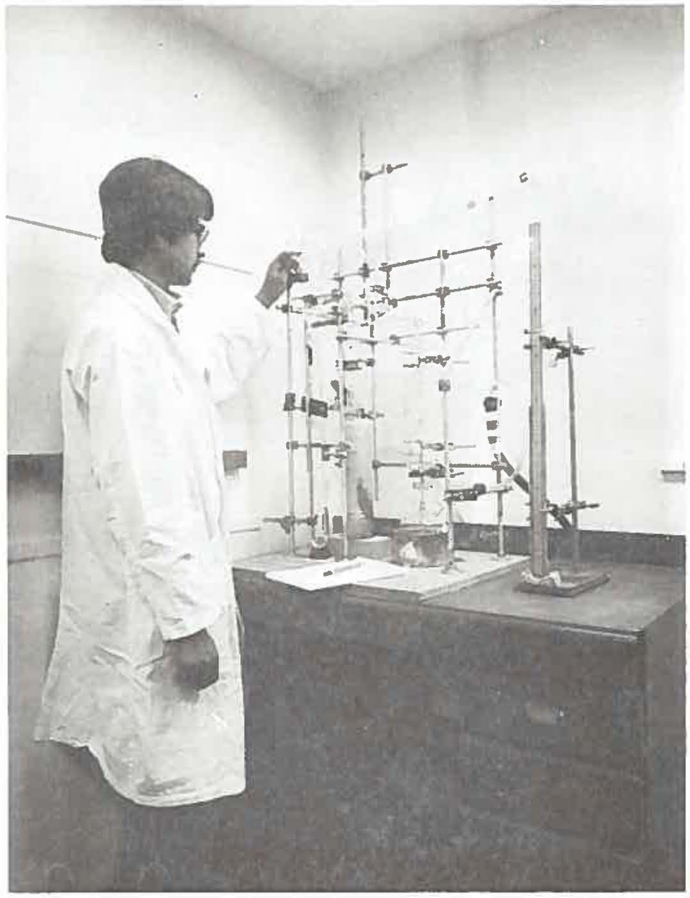
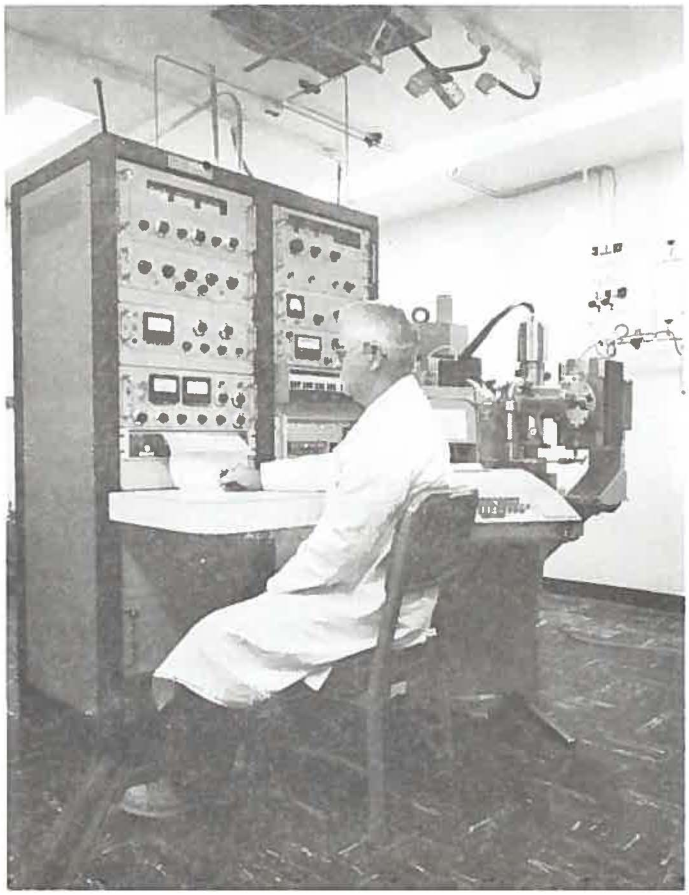


Fig. 4.10-5 Gas dilution equipment in Room 109, CPP-602.



ig. 4.10-6 Mass spectrometer in Room 109, CPP-602.

Fig. 4.10-7 Gamma counting multichannel analyzers in Room 114, CPP-602.

TABLE 4.10-III

CPP-602 LABORATORY AREAS - FIRST FLOOR

Room No.	Description	Major Apparatus[a]	Primary Activities
204	Radiochemcial Laboratory	3 Type II Hoods Type III Glovebox Muffle Furnace Vacuum Drying Oven Vacuum Desiccator	Radiochemical and special analysis on plant process and support samples and samples from outside contractors.
207	Radiochemical Laboratory	Type II Hood Perchloric Acid Fume Hood Shielded Radioactive Sample Storage Barricade Flammable Liquid Vented Closet	Radiochemical and special analysis on plant and outside contractor samples. $HClO_4$ fuming of high alpha-emitting samples to oxidize plutonium prior to isotope dilution mass spectrometry. Storage of radioactive samples and flammable liquids.
208	Radiochemical Laboratory	2 Type II Hoods Induction Furnace Carbon-Sulfur Determination Apparatus Vacuum Desiccator Tritium Distillation Apparatus	Radiochemical and special analysis on plant and outside contractor samples.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplaces are described in 4.10.3.2

TABLE 4.10-III (cont'd)

Room No.	Description	Major Apparatus[a]	Primary Activities
211	Analytical Research Laboratory	Type III Glovebox Perchloric Acid Hood Type II Hoods Balances Clean-Air Module Ovens Sample Storage Racks	General analytical research. Preparation and storage of quality control samples.
212	Mass Spectrometer Laboratory	2 Solid Source Thermal Ionization Mass Spectrometers On-Line Computer System Type II Glovebox Type II Hood	Determine concentration and isotopic distribution of various elements in plant process and research program samples. Prepare filaments for analysis on thermal ionization mass spectrometers.
213	Instrument Laboratory	Atomic Absorption Spectrometer Cary Recording Spectrophotometer Coulometer	General electrochemical and spectroscopic research.
214	Mass Spectrometer Laboratory	Electron-Bombardment Source Mass Spectrometer	Analysis of gas samples from inside and outside ICPP.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplaces are described in 4.10.3.2.

TABLE 4.10-III (cont'd)

Room No.	Description	Major Apparatus[a]	Primary Activities
216	Mass Spectrometer Laboratory	Tandem Solid Source Thermal Ionization Mass Spectrometer Type III Glovebox Type II Hood	Analysis of plutonium and other transuranic materials. Preparation of filaments for analysis on tandem source mass spectrometer.
220	Mass Spectrometer Preparation Laboratory	Gas Mass Spectrometer Storage Area for Dewar Flasks Type II Hoods Darkroom	Analysis of gas samples from inside and outside ICPP. Processing of galvanometer records from mass spectrometer. Storage of flasks containing liquid nitrogen used in gas traps of mass spectrometer.
222	Spectrochemical Laboratory	Emission Spectrograph Vacuum Spectrometer Densitometers Type I Open Port Glovebox	Instrumental analysis of samples primarily from Operations Division, the Process Support and Technology Branch, and outside contractors. Radioactive sample storage.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplaces are described in 4.10.3.2.

Room No.	Description	Major Apparatus[a]	Primary Activities
223	Counting room	Well- and Barricade-Type Na(Tl) Detectors interfaced to Gross Gamma Detectors or Multi-Channel Gamma Analyzers 3 GeLi Gamma Detection Systems interfaced to Multi-Channel Analyzers with Dedicated Computers X-ray and Low Energy Gamma Ray Si(Li) Detector interfaced to a Multi-Channel Analyzer Alpha Pulse Detector interfaced to a Multi-Channel Analyzer	Radiological assay of radioactive samples.
224	Spectrochemical Laboratory	Type II Shielded Cave connected to a Type III Glovebox Radioactive Sample Storage Barricade	Samples emitting > 10 mR/hr beta-gamma are prepared for emmission spectroscopy in the glovebox. The samples are arced in the cave, and the arc image sent for analysis by lenses to the emission spectrograph in Room 222. Transuranic elements are not analyzed. Samples are stored in the barricade.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplaces are described in 4.10.3.2.

TABLE 4.10-III (cont'd)

Room No.	Description	Major Apparatus[a]	Primary Activities
226	Laser Laboratory	3 Laser Generators Emission Spectrograph with Laser Sampler Low Temperature Asher Lathe Belt Sander Darkroom	Spectroscopic sample preparation and analysis, and photographic plate processing.
227	Spectrochemical Preparation Laboratory	Atomic Absorption-Flame Emission Spectrometer 2 Type II Hoods Gas Chromatograph Dissolved Gas Separator Muffle Furnace Atomic Absorption Furnace Spectrometer	Spectroscopic sample preparation and analysis. Gas analyses.
229	Office and Counting Room	Liquid Scintillation Detection System Gross Alpha Detection Systems Gross Beta Detection Systems Alpha Pulse Height Analysis System Time Share Computer System	Radiological assay of radioactive samples.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplaces are described in 4.10.3.2.

The carbon-sulfur determination apparatus and the tritium distillation apparatus in Room 208 are shown in Figures 4.10-8 and 4.10-9, respectively. The quality control sample storage racks are shown in Figure 4.10-10.

Mass spectrometry analysis laboratories are located in Rooms 212, 214, 216, and 220. Room 213 is an additional instrument laboratory used for general electrochemical research projects. Mass analysis instruments are used to determine concentration and isotopic distribution of various elements in separated fractions from plant process samples and miscellaneous research program samples. Uranium concentration and isotopic distributions are the most numerous analyses performed in these laboratories. Samples are normally prepared in other ICPP laboratories for isotopic or concentration analysis.

Figure 4.10-11 shows a photograph of the solid-source thermal-ionization mass spectrometers and the on-line computer system, located in Room 212. The atomic absorption spectrometer, Cary recording spectrometer, and coulometer used for general electrochemical research in Room 213 are shown in Figures 4.10-12 and 4.10-13. The electron-bombardment-source, gas-mass spectrometer in Room 214 is shown in Figure 4.10-14. The tandem solid-source thermal-ionization mass spectrometer in Room 216 is shown in Figure 4.10-15.

Room 220 contains a gas analysis mass spectrometer, shown in Figure 4.1-16. There gas samples from both ICPP and other INEL facilities are analyzed.

The spectrochemical laboratories on the first floor include Rooms 222, 224, 226, and 227. Samples are analyzed by emission spectroscopy in Rooms 222, 224, and 226, and by atomic absorption spectroscopy in Room 227. Room 227 is the primary laboratory for preparation of spectroscopic samples. Most samples received for analysis are from Operations Division, the Process Support and Technology Branch, and outside contractors. Samples are stored in the Remote and Service Analysis Laboratory (RSAL) if they emit less than 1 R/hr beta-gamma activity.

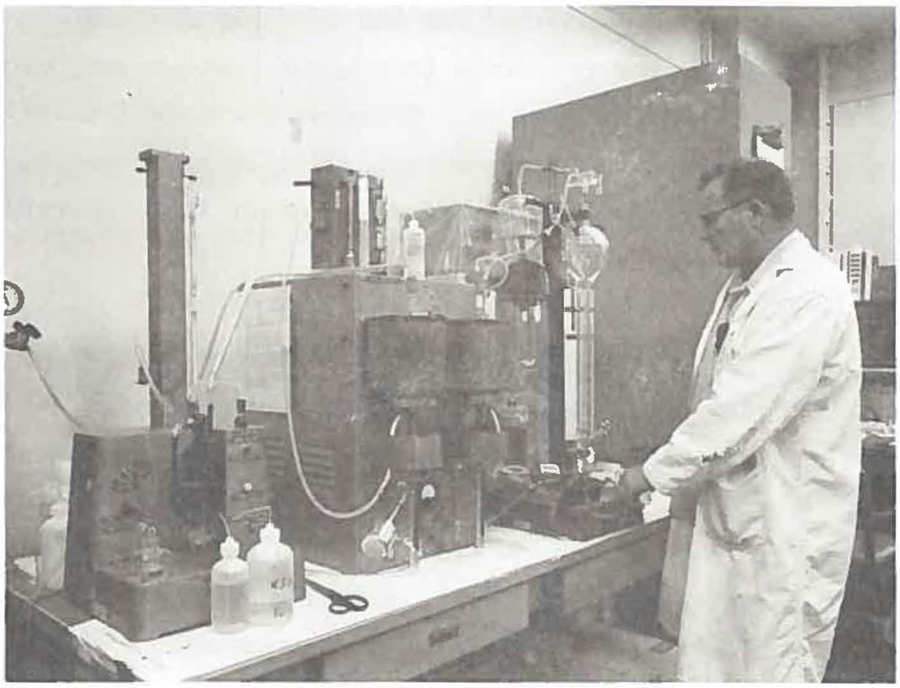


Fig. 4.10-8 Carbon-sulfur determination apparatus in Room 208, CPP-602.

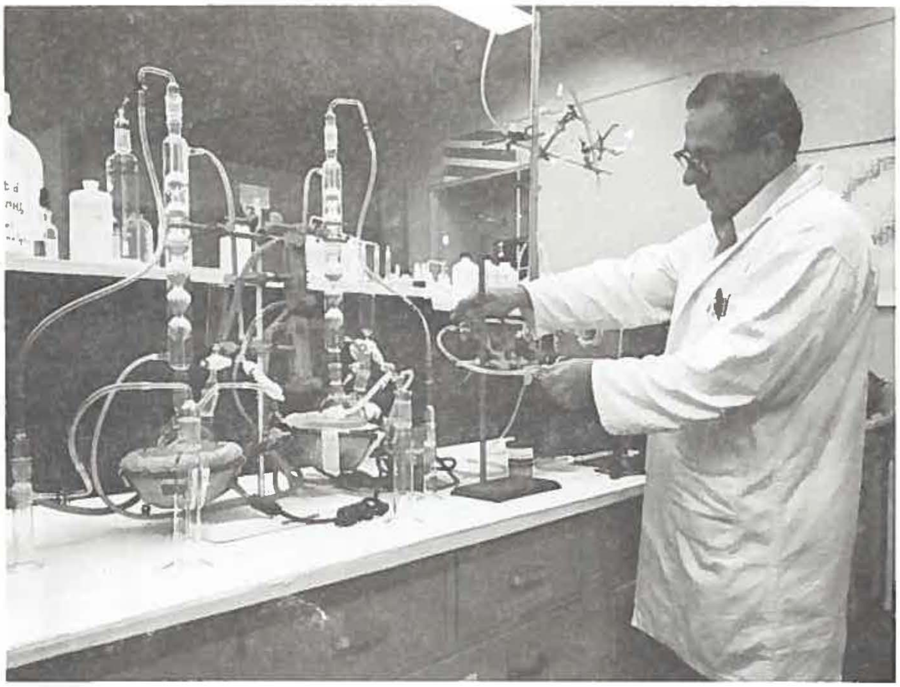


Fig. 4.10-9 Tritium distillation apparatus in Room 208, CPP-602.

Fig. 4.10-10 Quality control samples storage area in Room 211, CPP-602.

Fig. 4.10-11 Solid-source thermal-ionization mass spectrometers and on-line computer system in Room 212, CPP-602.

Fig. 4.10-12 Atomic absorption spectrometer and Cary recording spectrophotometer in Room 213; CPP-602.

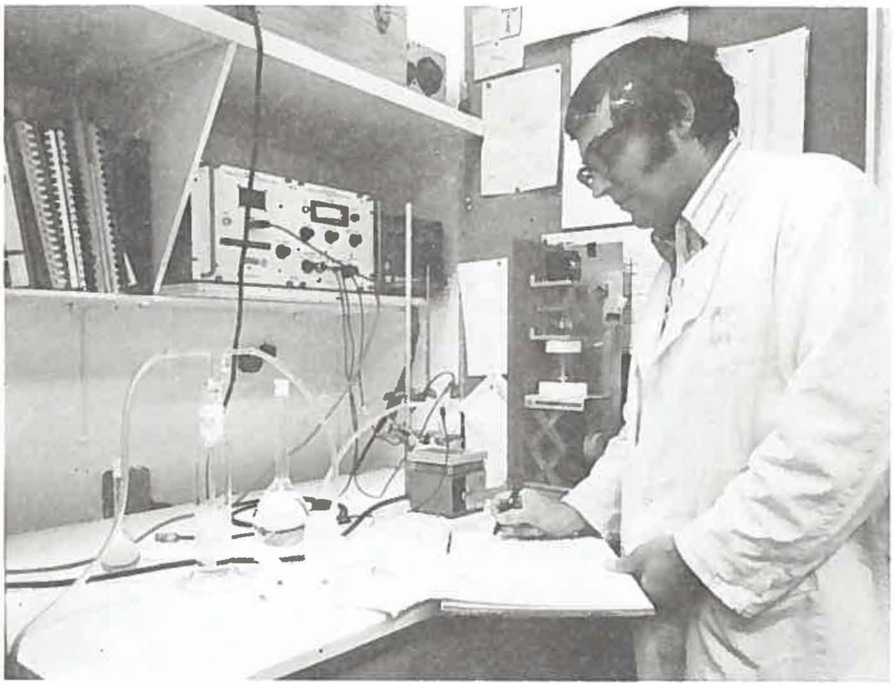


Fig. 4.10-13 Coulometer in Room 213, CPP-602.

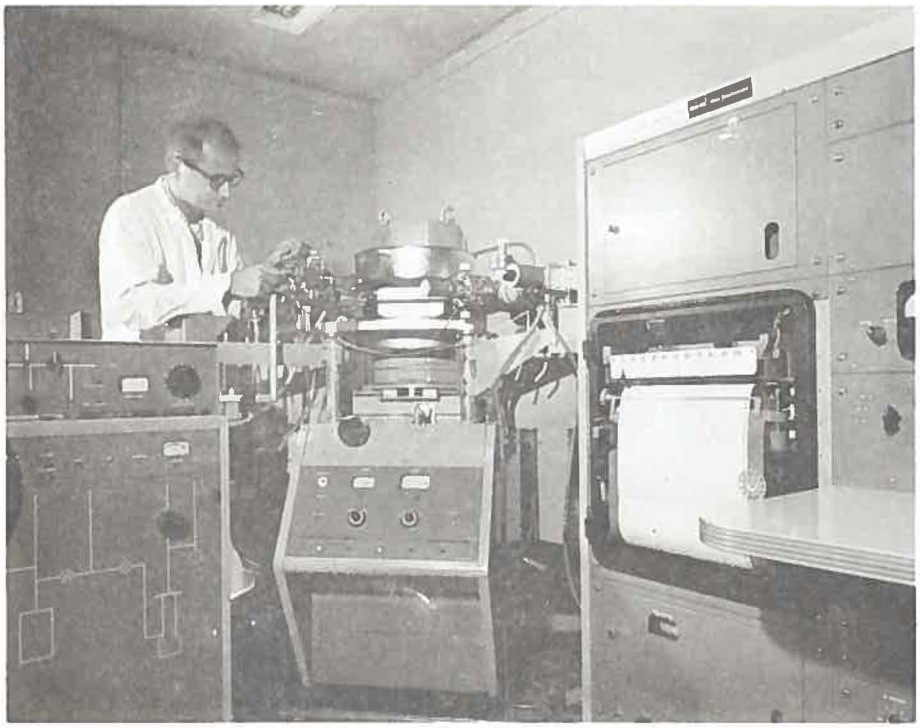


Fig. 4.10-14 Electron-bombardment source, gas-mass spectrometer in Room 214, CPP-602.

Fig. 4.10-15 Tandem solid-source thermal-ionization mass spectrometer in Room 216, CPP-602.

Fig. 4.10-16 Gas analysis mass spectrometer in Room 220, CPP-602.

Samples exceeding this limit are stored in the Remote Analytical Facility (RAF). General radiological assays of samples are performed in Room 223.

Photographs of (1) the emission spectrograph, (2) the vacuum spectrometer (both in Room 222), (3) well and barricade type NaI(Tl) and GeLi detectors in Room 223, (4) a laser generator in Room 226, and (5) the atomic absorption flame emission spectrometer in Room 227 are shown in Figures 4.10-17 through 4.10-21, respectively.

Laboratories containing X-ray analysis equipment are located on the second floor in Rooms 315, 317, 319, 321, and 327. Mass spectrometry group personnel are located in Room 329 along with equipment for spectrometric analysis of nonradioactive samples. The major apparatus and primary activities carried out in the second floor laboratories are summarized in Table 4.10-IV.

Most samples received for analysis are from ICPP operations and are obtained directly from the RSAL storage area or from plant process areas. Samples are also received for analysis from other ICPP branches as well as from other contractors.

The X-ray generator, equipped with diffractometers and X-ray diffraction cameras in Room 315, is shown in Figure 4.10-22. A photograph of an infrared spectrometer in Room 329 is shown in Figure 4.10-23. An X-ray fluorescence spectrometer, located in Room 319, is used infrequently.

4.10.1.3 CPP-627 Laboratories. The Remote Analytical Facility (RAF) Building (CPP-627) provides several laboratory areas for conducting chemical research, chemical analysis, and analytical process control. Laboratory facilities include the Remote and Service Analysis Laboratory (RSAL), the RAF, and the Multicurie Cell and Radiochemistry Laboratory Room. An isometric drawing illustrating the physical arrangement of the laboratory areas in CPP-627 is shown in Figure 3.6-1, SRD Section 3.

Fig. 4.10-17 Emission spectrograph in Room 222, CPP-602.

Fig. 4.10-18 Vacuum spectrometer in Room 222, CPP-602.

Fig. 4.10-19 Well and barricade type NaI(Tl) and GeLi detectors and interfaced equipment in Room 223, APP-602.

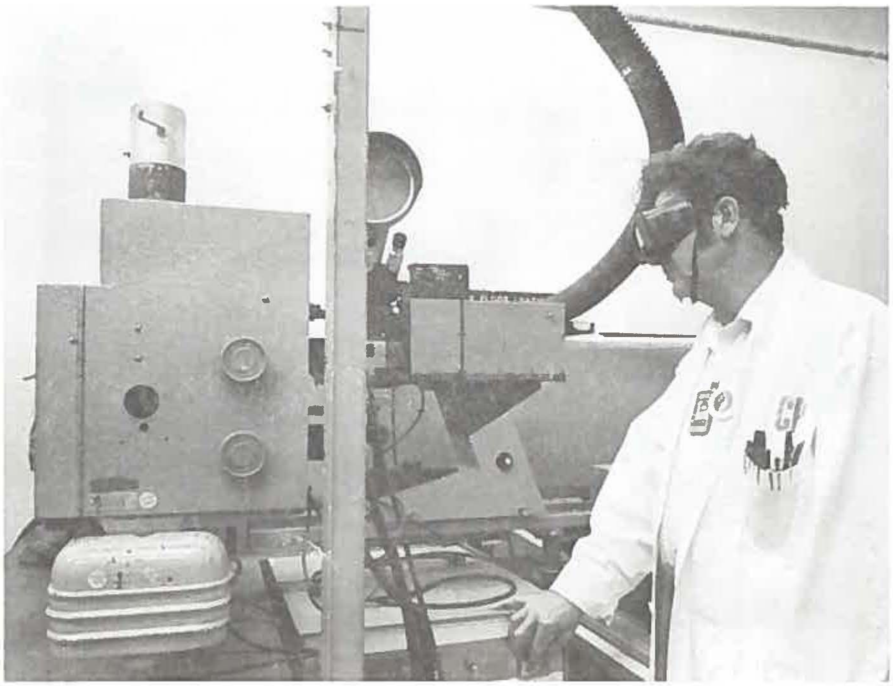


Fig. 4.10-20 Laser generator in Room 226, CPP-602.

Fig. 4.10-21 Atomic absorption flame emission spectrometer in Room 227, CPP-602.

Fig. 4.10-22 X-ray generator with diffractometers and cameras in Room 315, CPP-602.

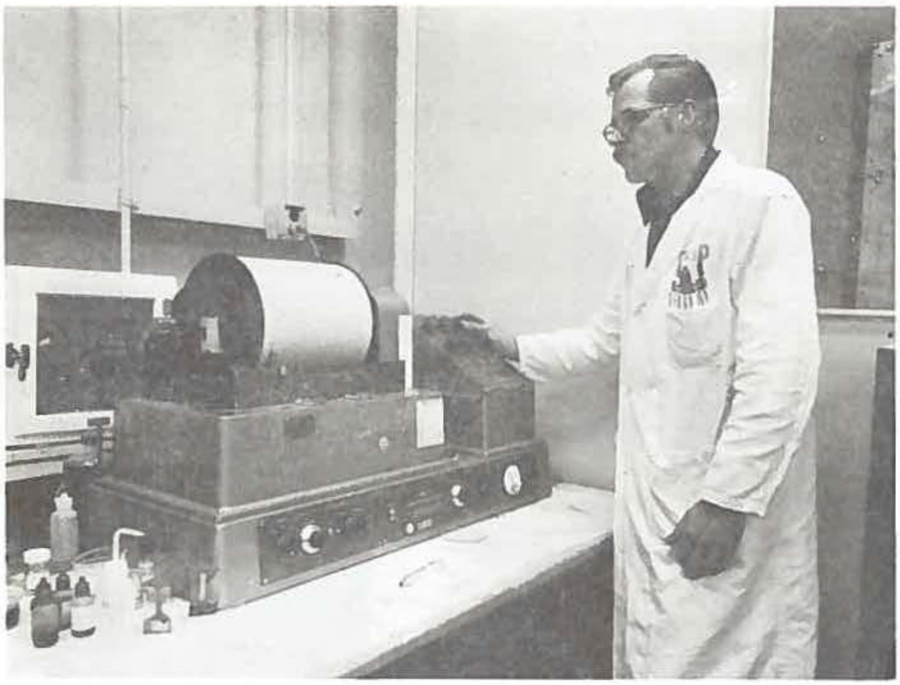


Fig. 4.10-23 Infrared spectrometer in Room 329, CPP-602.

TABLE 4.10-IV

CPP-602 LABORATORY AREAS - SECOND FLOOR

Room No.	Description	Major Apparatus[a]	Primary Activities
315	X-ray Laboratory	2 X-ray Generators equipped with Diffractometers and X-ray Diffraction Cameras Connected Darkroom	Analysis of nonradioactive samples and contained solid radioactive samples up to 100 mR/hr beta-gamma activity. Develop films from diffraction instruments.
317	Office and X-ray Laboratory	Optical Microscopes X-ray Fluorescence Spectrometer	Nonradioactive sample preparation and data reduction from laboratory instruments. Microscopic and X-ray analysis of nonradioactive and small quantities of contained radioactive samples.
319	X-ray Laboratory	X-ray Fluorescence Spectrometer X-ray Generator	Analyze contained radioactive samples having activities greater than 100 mrad/hr.
321	X-ray Laboratory	Shielded X-Ray Diffractometer X-ray Generator Scanning Electron Microscope	Analyze contained radioactive samples having activities greater than 100 mrad/hr. Visual and X-ray microscopic analysis.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-IV (cont'd)

Sheet 2 of 2

Room No.	Description	Major Apparatus[a]	Primary Activities
327	X-ray Preparation Laboratory	Type II Hood Type I Glovebox Grinding and Polishing Equipment Sample Storage Area	Prepare samples for analysis in X-ray laboratories. Store samples as required.
329	Office and Laboratory	2 Infrared Spectrometers 2 Helium Leak Detectors	Office and laboratory area for Mass Spectrometry Group. IR-spectrometers used to analyze organic samples.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

The RSAL, located on the second floor, is the major analytical support facility for ICPP. The major apparatus and primary activities carried out in the RSAL are summarized in Table 4.10-V. All plant make-up and process solution samples not exceeding 1 R/hr beta-gamma radiation field and permitted within Type I, II, or III workplaces, either undergo or are prepared for chemical analysis in the RSAL. The laboratory bench space is centrally located in the RSAL, as shown in Figure 4.10-24.

The RAF, located on the first floor of CPP-627, consists of two parallel lines of shielded analytical boxes. The major apparatus and primary activities carried out in the RAF are summarized in Table 4.10-VI.

The boxes are constructed of stainless steel and set against a shielding wall. Leaded glass viewing windows are located in the front of each box. Equipment within the boxes is operated by Castle manipulators that extend through the shielding. Both pneumatic and electronic controls are used. Each box contains analytical equipment for specific determinations. Box 1 of each line is a feed-in box with dumbwaiters originating in these boxes that go to a hood in the RSAL. Boxes 2 and 3 of each line are radioactive sample storage areas. The last two boxes in Line A, the most northern line, have been replaced with a Type III cave with master slave manipulators.

Figure 4.10-25 shows the corridor in the RAF with the two lines of analytical boxes.

The Multicurie Cell (MCC) and Radiochemistry Laboratory Room is located on the first floor, at the south end of CPP-627. The major apparatus and primary activities carried out in this area are summarized in Table 4.10-VII. Samples are received from the plant process and experimental programs for study. Materials from this area are sent to the analytical laboratories for chemical analysis. The MCC and the custom dissolutions of up to kilocurie-level fuel materials conducted within it are described in SRD Section 5.3.

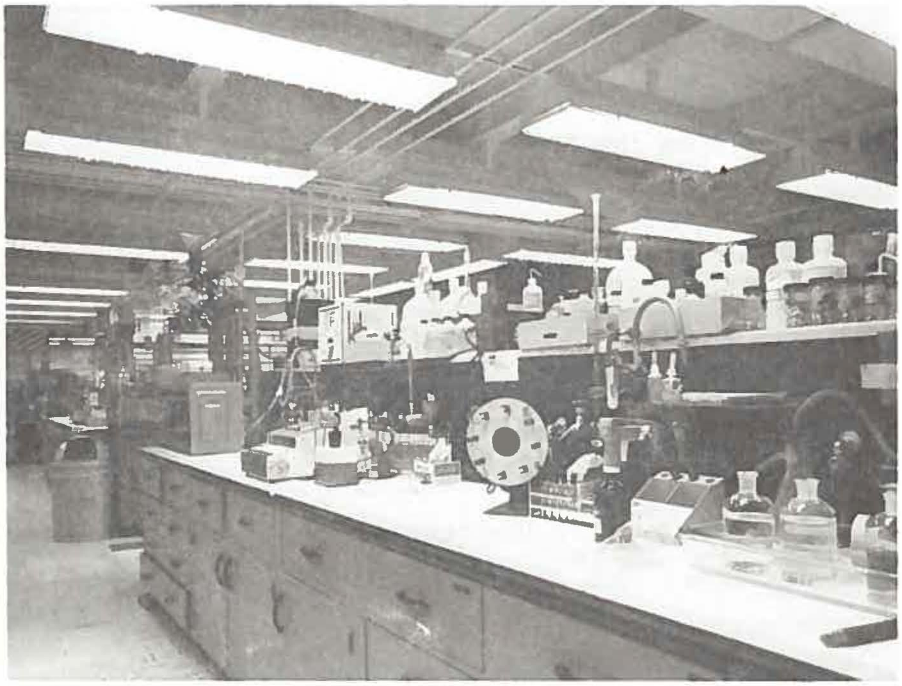


Fig. 4.10-24 Open laboratory bench space in Remote and Service Analytical Laboratory, CPP-627.

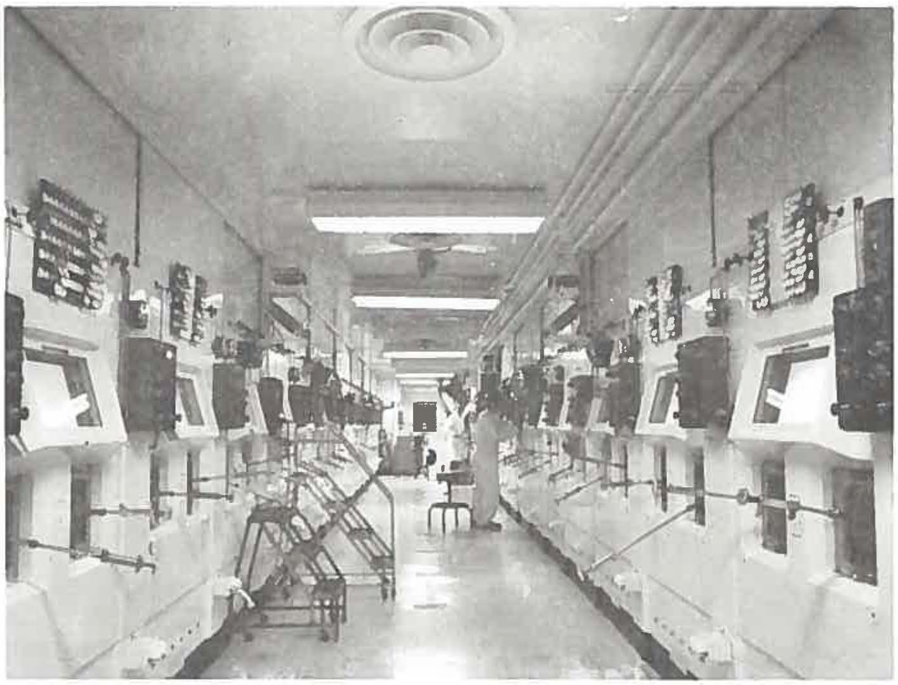


Fig. 4.10-25 Analytical operating corridor in Remote Analytical Facility, CPP-627.

TABLE 4.10-V

CPP-627 REMOTE AND SERVICE ANALYSIS LABORATORY

Sheet 1 of 2

Major Apparatus[a]	Primary Activities
140 ft of Open Laboratory Bench Space for routine nonradioactive analyses	Prepare and chemically analyze samples from plant-makeup and process streams. Limited to 1 R/hr beta-gamma radiation field or less. Crush and sieve calciner product and uranium oxide plant samples.
6 Type II Hoods	
Perchloric Acid Hood	
Glovebox Chain (3)	
2 Glassware Sinks	
Hand Sink	
Under-the-Bench Refrigerator	
Compressed Gas System	
500-lb Capacity Dumbwaiter connected to First Floor	
Sink	
2 Small Dumbwaiters connected to First Floor Remote Lines	
Distillation Apparatus	
Spectrophotometers	
Single Element Analyzers	

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-V (cont'd)

Major Apparatus	Primary Activities
Physical Measurement Instruments	
Atomic Absorption Spectrometer	
Flammable Organic Storage Cabinet	
Wall and Floor Storage Barricades	

TABLE 4.10-VI

CPP-627 REMOTE ANALYTICAL FACILITY

Major Apparatus [a]	Primary Use
Shielded Analytical Boxes Analytical Equipment within Boxes Sample Dollies Transfer Dollies Type III Cave Dumbwaiters	Dissolution of irradiated samples originating from within ICPP or from outside contractors. Transuranic samples are dissolved in the cave. Samples of greater than 1 R/hr beta-gamma activity are stored and analyzed. Sample dollies travel length of each line of gloveboxes and allow transfer of materials between boxes. Transfer dollies travel behind boxes to permit removal of each box for maintenance or replacement in adjacent decontamination room.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-VII

CPP-627 MULTICURIE CELL AND RADIOCHEMISTRY LABORATORY ROOM

Major Apparatus[a]	Primary Activities
Multicurie Cell 2 Type II Hoods Type II Walk-In Hood 1 Type III shielded cave with master-slave manipulator Shielded Sample Barricade Barnstead Still Type III Glovebox (double box)	Fuel Material with up to kilocurie-levels of activity are handled in the multicurie cell (see SRD Section 5.3). Curie-level samples can be manipulated in the shielded cave. Samples are stored as required.

[a]Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

4.10.1.4 CPP-637 Laboratories. The Process Improvement Facility (PIF) Office and Laboratory Building, CPP-637, contains a number of offices and small-scale general chemistry instrumentation and computer laboratories. A plan view of the PIF Office and Laboratory Building showing the location of the chemistry laboratories is shown in Figure 3.12-1 (SRD Section 3).[a] The laboratories on the main floor of CPP-637 are in Rooms 103-B, 107, 111, 113, 117, 127, 133, and 137. The laboratories on the second floor are in rooms 267, 268, 270, 272, 273, 274, 275, 277, 279, and 280. All other rooms on the second floor are offices, conference rooms, storage, and restrooms.

Normally, work in the first floor CPP-637 laboratories is conducted with nonradioactive materials; however, some projects are carried out with small quantities of radionuclides. Process studies include the handling of small quantities of enriched, depleted, or normal uranium. Reagents and materials are prepared in the CPP-637 laboratories for use in the CPP-637 Low-Bay Laboratory. A glass shop and balance rooms are also located on the first floor. The major apparatus and primary activities carried out in each first-floor laboratory are summarized in Table 4.10-VIII.

The work performed in the laboratories on the second floor of CPP-637 consists of diverse instrumentation-methods and instrument development, instrument maintenance, computer software development, computerized data gathering and analysis, and data input to the IBM-360/75 computer through the DATA-100 Remote Input-Output Terminal. The pilot plant computer in Room 277, the Health and Safety Computer in Room 275, and the Data-100 Remote Input-Output Terminal in Room 280 are shown in Figures 4.10-26 through 4.10-28, respectively. Virtually all the work in these laboratories is in direct support of ICPP Operations or Process Development. Table 4.10-IX is a summary of the major apparatus and primary activities carried out in second-floor laboratories.

The RF sputtering device in Room 103-B and the radioiodine absorbent and storage apparatus in Room 117 are shown in Figures 4.10-29 and 4.10-30, respectively.

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[a] This figure does not now show the recent second floor addition to CPP-637, but will be revised.

Fig. 4.10-26 Pilot Plant Computer in Room 277, CPP-637.

Fig. 4.10-27 Health and Safety Computer in Room 279, CPP-637.

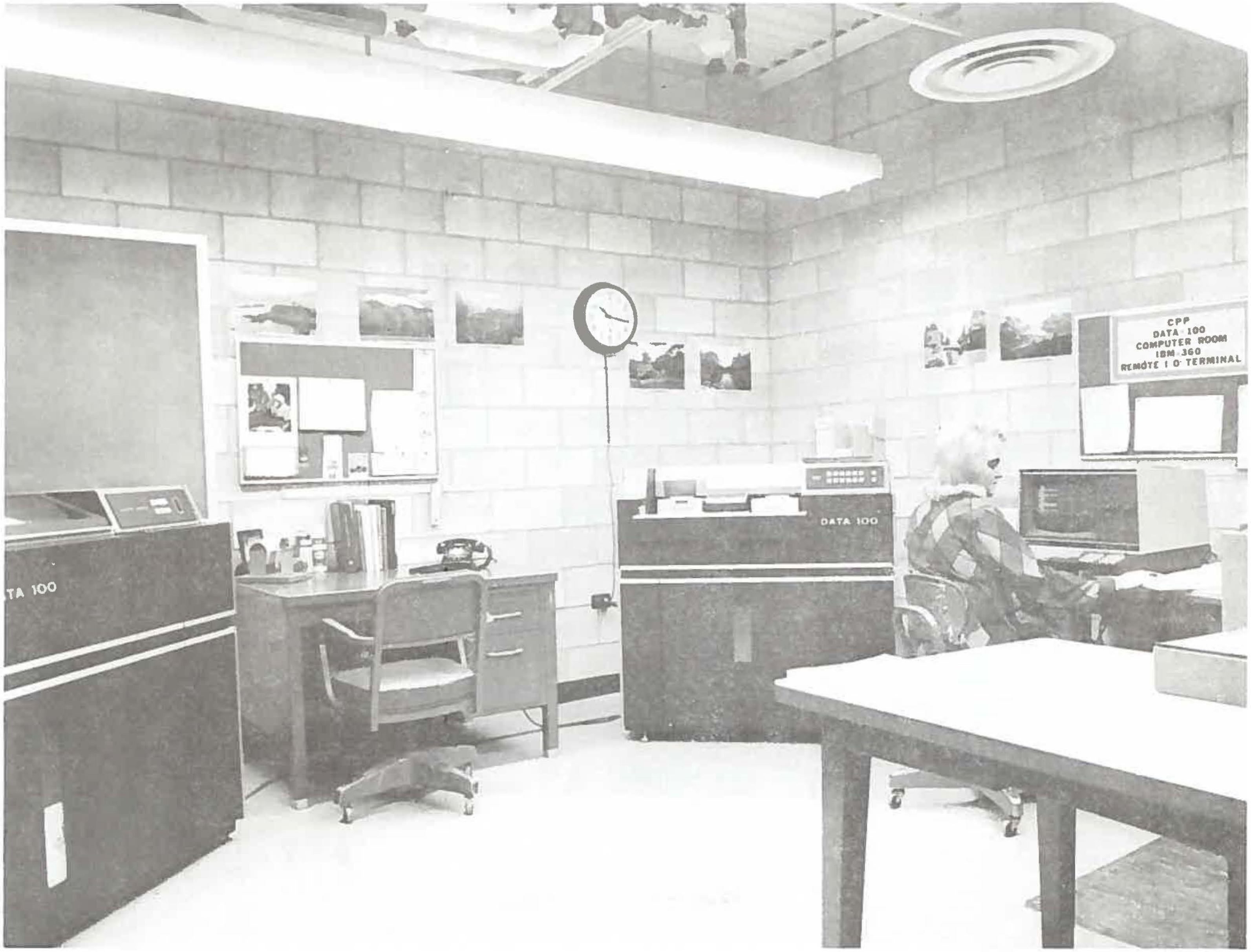

Fig. 4.10-28 The Data-100 remote input-output terminal in Room 280, CPP-637

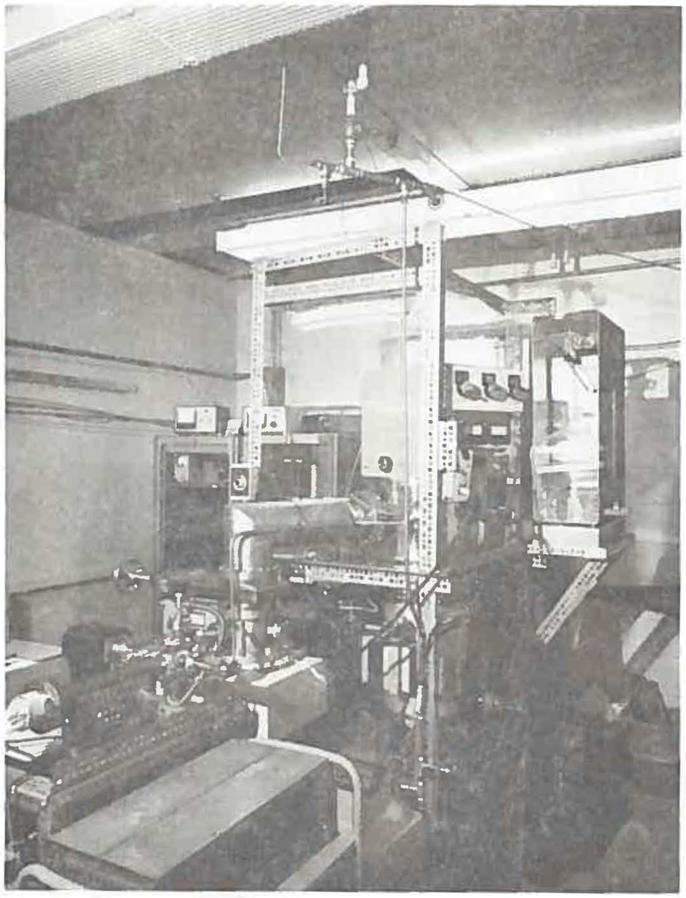

Fig. 4.10-29 RF sputtering device in Room 103B, CPP-637.

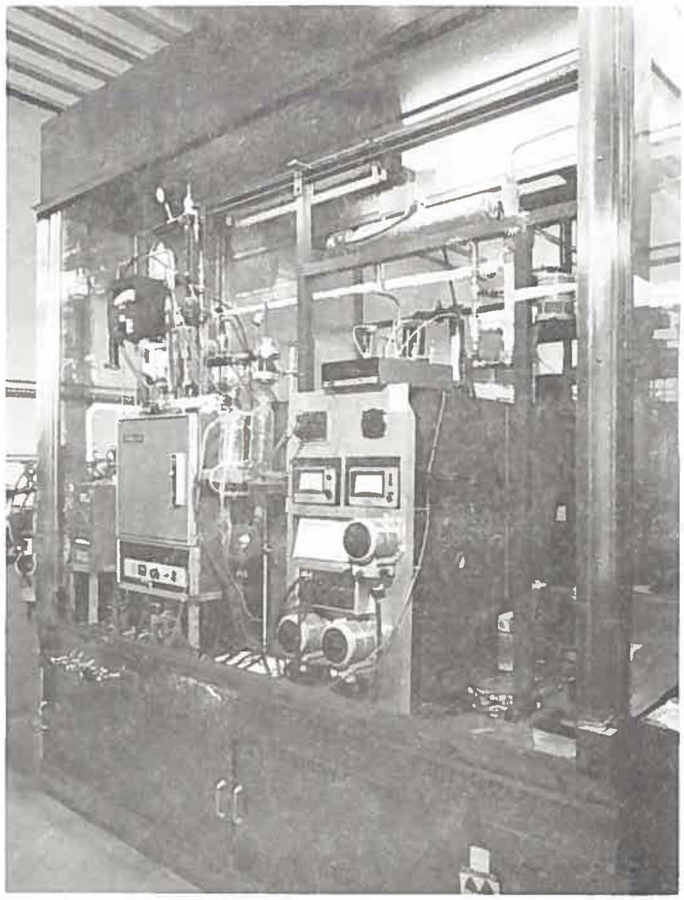

Fig. 4.10-30 Radioiodine absorbent and storage apparatus in Room 117, CPP-637.

TABLE 4.10-VIII

CPP-637 FIRST FLOOR LABORATORY AREAS

Sheet 1 of 2

Room No.	Major Apparatus[a]	Primary Activities
103-B	RF Sputtering Device Mass Spectrometer High-Temperature Furnace	Coating of materials - membrane studies. Silicon wafer preparation in furnace.
107	2 Type I Hoods	Gas phase and fuel dissolution studies. High Temperature Gas Reactor (HTGR) and Waste Calcining Facility (WCF) fluidized bed burning studies. WCF NO_x analysis studies.
111	Type I Hood Type II Walk-In Hood	Flourinel process laboratory studies (classified).
113	2 Type I Hoods 3 High-Temperature Furnaces	Fuel storage basin water clarity analyses. Ruthenium absorption studies.
117	2 Type I Hoods Radioiodine Absorbent and Storage Apparatus Noble Gas Absorbent and Storage Apparatus	Radioiodine and noble gas absorbent and storage programs.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-VIII (cont'd)

Sheet 2 of 2

Room No.	Major Apparatus[a]	Primary Activities
127	2 Type I Hoods	Plant support and general laboratory studies.
		Waste Calcination and DTA studies
	3-in. dia. Waste Calciner and Off-Gas Train	
	DTA/Mass Spectrometer	
133	Type I Hood	Post-calcination laboratory studies on solid product.
	Type I Walk-In Hood	
137	2 Type I Hoods	Corrosion studies on various metals.
171	2 Glass-Working Lathes	Laboratory glassware formation.

[a] Type I, II, and III workplaces refer to the degree of confinement and type of ventilation provided. Workplace types are described in 4.10.3.2.

TABLE 4.10-IX

CPP-637 SECOND FLOOR LABORATORY AREAS

Sheet 1 of 2

Room No.	Major Apparatus	Primary Activities
267	Bench space, storage cabinets with spare parts, and office	Maintenance of operational and experimental instrumentation.
268	Flowmeter and test apparatus and office	Safeguard flowmeter and other instrument devlopment.
270	Workbench and offices	Safeguards portable mass spectrometry and other instrument development.
272	Computer/electronics/instruments and office	Computer interface, planning, design and maintenance.
273	Signal generation equipment and office	Liquid level measurement development; new-process instrumentation review.
274	Computer system and offices	Safeguards development planning.
275	Computer system	Development of software for ROVER process data gathering.
277	Pilot plant computer system and office	Collection and analysis of data from the fluorinel pilot plant process; general computer software development.

TABLE 4.10-IX (cont'd)

Room No.	Major Apparatus	Primary Activities
279	Health and Safety Computer System and Office	ICPP Health and Safety instrumentation data acquisition and information handling; other computer development work.
280	Data-100 Remote Input-Output Terminal with associated card reader, plotter, and key punching machines	Computer data input to the IBM-360/75, located in the Computer Science Center in Idaho Falls.
	Analytical Computer System	Initial program development for analytical information handling and management.

4.10.2 Interconnections with Other Systems. A schematic of the connections between the laboratory facilities and other systems is presented in Figure 4.10-31. The inputs from process systems are samples transferred manually to the laboratories. Outputs to the process systems include new methods for improving the processes, primarily resulting from work in the PIF (CPP-637).

The laboratory areas have relatively few physical interconnections with other systems. The interconnections include utility services, compressed gases, drains for disposal of liquid wastes, exhaust systems for venting gaseous wastes, and salvage drains for uranium recovery, The physical characteristics of these interconnections are described in SRD Section 3.

Laboratory interconnections for liquid and gaseous wastes are summarized in Table 4.10-X. Inadvertent transfers are prevented by administrative controls. In general, laboratory wastes are generated in small quantities, which are disposed of intermittently. Inadvertently disposing of these wastes in inappropriate drains or exhaust systems may cause a minor loss of uranium, contamination, or corrosion, but would normally have little effect on laboratory operations. Management of liquid, gaseous, and solid wastes at ICPP is described in SRD Sections 4.2, 4.3, and 4.4, respectively.

4.10.3 Control Methods and Procedures. Numerous flammable, toxic, and radioactive materials are routinely used in analyses carried out in the ICPP laboratory areas. Control methods and procedures provide means by which laboratory operations can be efficiently conducted, while minimizing the possibility of either injury to personnel or damage to equipment. Described in this section are precautions used to prevent criticality, radiation exposure, contamination, fire and explosion. Details pertinent to laboratory areas, instrument uses, and analysis methods are provided in the Standard Operating Procedures (SOPs) of the Analytical Chemistry, Process Support and Technology, and Chemical Research and Engineering Branches. General administrative controls and procedures for ICPP are summarized in SRD Appendix A. Implementation of those general procedures applicable to the laboratories are discussed in this section.

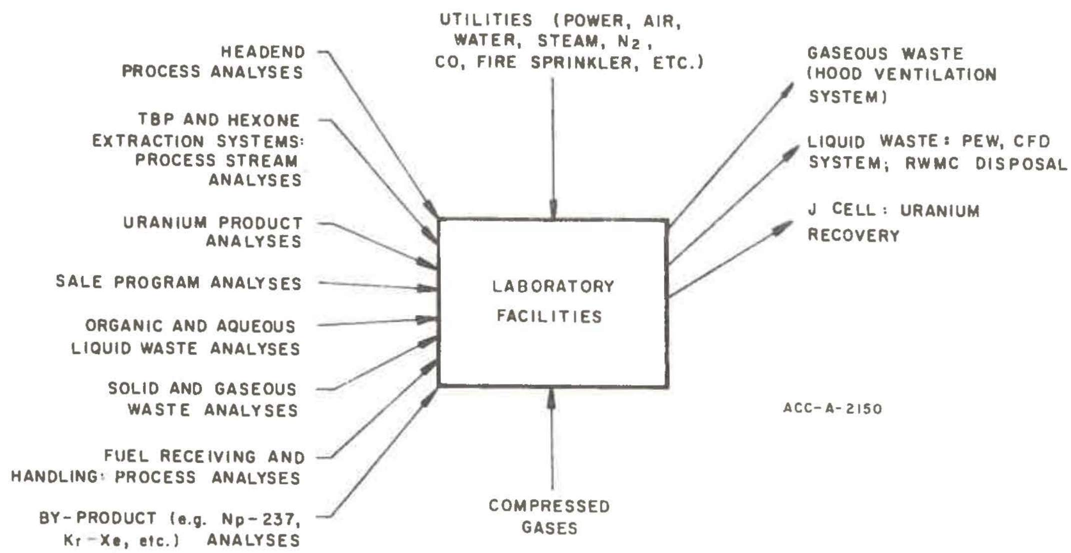

Fig. 4.10-31 Laboratory facilities interconnections with other systems.

TABLE 4.10-X

LABORATORY WASTE INTERCONNECTIONS

Sheet 1 of 3

Type of Waste	Normal Disposition	Consequences of Abnormal Disposition[a]
	LIQUID WASTES[b]	
Plant Compatible[c]		
Containing enriched uranium	Salvage (J-134/J-135)[d]	Contamination of drain and loss of uranium.
Containing normal of depleted uranium	Cell Floor Drain (CFD)[e] or Process Equipment Waste (PEW)[f]	Contamination of drain
Containing no uranium	CFD or PEW	Contamination of drain
Nonradioactive	Service Drain (SD)[g]	None
Corrosive		
Containing enriched uranium	Convert to nitrate and salvage (J-134/J-135)	Contamination and/or corrosion of drain and loss of uranium.
Containing normal or depleted uranium or no uranium or nonradioactive	Solidify in Vermiculite or plaster of paris, seal and dispose of as solid waste	Contamination and/or corrosion of drain.
Organic		
Containing enriched uranium	Extract into aqueous nitrate system and salvage (J-134/J-135)	Contamination of drain; loss of uranium; fire and toxic hazard.
Containing normal or depleted uranium or no uranium or nonradioactive	Accumulate in bottles and deliver to decontamination room (CPP-627); solidify in Vermiculite, seal and dispose of as solid waste	Contamination of drain and/or fire and toxic hazard.

TABLE 4.10-X

Type of Waste	Normal Disposition	Consequences of Abnormal Disposition[a]
	GASEOUS WASTES (Airborne Effluents)[h]	
Plant Compatible		
Radioactive (low-level)	Laboratory off-gas system to Vessel Off Gas (VOG) system [i]	Contamination.
	Hood[j] exhaust systems	Contamination.
Radioactive (high-level)	Glovebox[k] exhaust systems	Contamination.
	Containment enclosures[l]	Contamination.
Nonradioactive	Building heating and ventilation system	None
Corrosive		
Radioactive or Nonradioactive	Scrubbed in condensation system; diluted with copious amounts of water and disposed of in PEW system	Contamination and/or system corrosion.
Organic		
Radioactive or Nonradioactive	Filtered to hood exhaust system	Contamination and/or fire and toxic hazard.

[a]Disposal of wastes into incorrect drains.

[b]Liquid Waste - Liquids generated in the course of operation of the laboratories, including sample residues that have been approved by supervision for disposal. Not included are sample residues that must be returned to the originator.

TABLE 4.10-X (cont'd)

[c] Plant Compatible Waste - Liquid waste that will not significantly corrode the plant stainless steel piping or interfere with the waste treatment system. Excluded are wastes containing more than 50 ppm of chloride, flouride, or sulfate combined, or any immiscible organic liquids. Miscible organic liquids are restricted to those that have been combined with at leat 50% water in the course of operations.

[d] Salvage Drain - The four storage boxes in the Remote Analytical Facility (Boxes 2A, 3A, 2B, and 3B) and the multicurie cell are each provided with a drain that connects to Vessel J-134 located in J Cell of the ICPP. The purpose of these drains is to enable the return of sample residues containing enriched uranium to the plant processing stream.

[e] Cell Floor Drain - The designation for the drainage system in the ICPP designed to handle liquid waste with low levels of radioactivity. This waste is also sent to the PEW evaporator and then to permanent storage.

[f] Process Equipment Waste - The designation for the drainage system in the ICPP designed to handle liquid waste with intermediate levels of radioactivity. This waste always goes to the evaporator and into permanent storage.

[g] Service Drain - The designation for the drains in the ICPP connected to the service waste system that is designed to dispose of nonradioactive liquid waste. The effluent is continuously monitored for radioactivity and is discharged into a disposal well. The system is entirely separate from the sanitary sewer system.

[h] Airborne Effluent - Any gas, vapor, mist, fume, or dust resulting from operations that may become mixed with and transported by the building ventilating system.

[i] Vessel Off Gas - The off-gas system provided at the ICPP for handling medium levels of radioactivity. The system is exhausted by a steam jet to the Atmospheric Protection System and discharged into the plant stack.

[j] Hood - An enclosure that relies on air velocity to confine potential airborne effluents within the enclosure. Generally vented through roughing and HEPA filters to short vents on roof; may be vented to VOG System.

[k] Glove Box - A sealed enclosure operated by means of gloves. Generally vented through roughing and HEPA filters to short vents on roof; may be vented to VOG system.

[l] Containment Enclosure - A sealed enclosure operated by means of manipulators. Generally vented through roughing and HEPA filters to short vents on roof; may be vented to VOG system.

4.10.3.1 Nuclear Criticality Control. Nuclear criticality in the laboratory areas is prevented primarily by administrative controls on mass limits. Transfers of fissile material to and from the laboratories may not exceed 400 g of U-235 or its equivalent, unless a criticality evaluation has been performed and specific approval has been obtained from the ICPP Safety Review Board (SRB). Storage or use of U-235 or equivalent (1 g of other fissile material is considered equal to 2 g U-235) is routinely limited to 400 g in any laboratory area. Approvals from both the Operational and Environmental Safety (O&ES) office and the SRB are required to exceed this amount.

In general, the vessels used for fissile materials in the laboratories are small and thus critically safe. Mass and geometry control, therefore, are the principal means of preventing criticality in the laboratories. For vessels that exceed single parameter geometries, specific approval for use with fissile materials must be obtained from the SRB, based on an analysis of criticality potentials.

4.10.3.2 Radiation Protection and Contamination Control. Direct radiation in the laboratories is attenuated by shielding the work areas where required. For example, RAF analytical boxes, caves, and the multicurie cell are all shielded sufficiently to reduce the radiation levels from samples to acceptable levels in areas occupied by personnel. No sample is permitted in a hood or glovebox in which the radiation exceeds 1 R/hr at contact or in a shielded cave where the radiation exceeds 7-1/2 mR/hr at the outside face of the cave unless prior approval has been granted by Health Physics and an approved Safe Work Permit has been obtained. All radiation-emitting devices are also shielded to protect personnel.

All laboratory personnel wear assigned dosimeters to record exposure to beta-gamma radiation. Self-reading gamma dosimiters, thermoluminescent dosimeters, and other special dosimeters are assigned as required to personnel that could encounter high radiation fields. Anti-contamination and protective clothing and equipment is available for use by laboratory personnel. Items include laboratory coats, safety shoes, plastic and cloth shoe covers, latex boots, plastic and vinyl gloves, paper and cloth coveralls, safety glasses, hair covers, face dust-covers, and full-face respirators.

Health Physics personnel periodically survey laboratory areas for contamination. Personal beta-gamma and alpha monitoring stations and hand-and-foot counters are located in and about the laboratory areas. A number of constant air monitors (CAMs) are assigned to certain buildings for use at the discretion of the experimenter, analyst, or their supervision, as follows: (a) two beta-gamma CAMs in basement of CPP-602, (b) eight alpha CAMs on first and second floors of CPP-602, (c) one beta-gamma CAM in the RAF (CPP-627), and (d) one beta-gamma CAM on the main floor of CPP-637. Remote Area Monitors (RAMs) are also used, specifically over the X-ray generators in various labs. The location of these RAMs is detailed in SRD Section 3.0. All radiation instruments are under the control of the Health Physics organization.

Airborne effluents are exhausted from laboratory workplaces by special ventilation systems. Exhausts from the RAF shielded boxes (within CPP-627) are continuously monitored, as discussed in SRD Section 4.3. Enclosure requirements depend on the nature of the work, amount of material, form of material, radiological properties of material, and chemical toxicity of material. Three workplace types are used in ICPP laboratories:

(1) Type I Workplace - An open bench space laboratory area, hood or glovebox with a minimum air flow of six changes per hour.

(2) Type II Workplace - (a) A hood equipped with a HEPA filter and windows, with an air flow of not less than 100 linear ft/min at any opening and an average of 125 linear ft/min in the working opening. (b) A glovebox that provides total containment of an alpha-emitting material and has a HEPA-filtered exhaust qualifies as a type II workplace.

(3) Type III Workplace - A glovebox or cave approved by the O&ES office and the SRB. The glovebox shall have negative-pressure ventilation, capability for adjusting the negative pressure

and maintaining at least 1/4-in. water gauge vacuum on the box, a vacuum gauge to measure vacuum in the box, a HEPA filter on the exhaust, and the capability for controlled introduction and removal of materials (eg, airlock and bagout port).

Specific procedures exist for determining the minimum controls needed for any laboratory or experimental work involving toxic or radioactive materials. The workplaces, as just defined, are classified according to the degree of confinement and type of ventilation provided. The type of workplace necessary for any specific work is determined by a calculated hazards index for alpha-emitting materials, especially the transuranics (eg, Pu and Np), or by a calculated Use Quantity Toxicity (UQT) factor for all other toxic or radioactive materials. The hazards index or UQT factor depends on the radiochemical and chemical toxicity of the isotope to be handled, the quantity to be handled, the operation to be performed, and the physical or chemical form of the material. The hazards index is calculated by the following equation:

$$H = U\Sigma\frac{(M)}{(Q_A)}$$ where:

H = Hazards Index.

U = Use factor. A dimensionless indication of the probability for release of the alpha material depending upon the operation to be performed and the chemical form of the material. This factor must be selected from a list of use factors tabulated for various operations.

(M) = Quantity of the specific isotope or nuclide, μCi or μg.

(Q_A) = The quantity of that isotope or nuclide that if released to the atmosphere could lead to the deposition of 0.1 maxi mum permissible body burden in the critical organ. It is a function of maximum permissible body burden, specific activity, fraction inhaled that is retained in the body, and fraction dispersed into the air.

$\Sigma\frac{(M)}{(Q_A)}$ = Total standardized hazard units for those materials containing more than one alpha emitter.

Guidelines are provided on how to use this equation for such things as (a) unknown quantities of alpha material; (b) unknown isotopes; and (c) uranium or thorium. The calculated hazards index determines not only the workplace but also the required protective clothing, surveys, waste disposal, and emergency action to be followed for the duration of the experiment or analysis.

The UQT factor is calculated by the following:

factor = $U \cdot Q \cdot T$ where:

U = Use factor. A dimensionless indication of the probability for release of the alpha material depending on the operation to be performed and the chemical form of the material. This factor must be selected from a list of use factors tabulated for various operations.

Q = The quantity of each specific isotope or nuclide, μCi.

T = The relative toxicity of the specific isotope or nuclide, ranging from slight toxicity of 0.1 to very high toxicity, assigned 1000.

Once the UQT factor has been calculated, the assigned workplace is determined using the following general guideline:

UQT Factor	Type of Workplace
$\leq$ 100	I
100 to 10,000	II
$\geq$ 10,000	III

Laboratory personnel take precautions to assure that unacceptable releases to the environment do not occur. For example, even though an operation may be allowable based on enclosure requirements, O&ES approval is required through completion of a Safe Work Permit if there is a possibility of an unacceptable release.

Control of volatile nuclides is maintained by the design of the hood experiment. For example, any experiment using volatile radioiodine is contained within glass or metal vessels inside the hood. This internal system is equipped with a charcoal filter to prevent escape of the iodine to the hood. The hoods are not equipped with charcoal filters, however, so the quantities of volatile radioiodine permitted in the hood are administratively limited in the event the primary containment is breached. Alimit is now set at 10 μCi of radioiodine in any one hood at any time. Normal quantities are typically around 1 μCi.

Samples, both liquid and solid, are prepared, analyzed, stored, and disposed of according to SOPs. The storage, use, and disposal of strong chemicals and organics are also carefully controlled. Certain of the sample and chemical storage areas are kept locked with the keys in the possession of the laboratory supervisor. Doors to the laboratory areas are not normally kept locked, but may be if hazardous or classified activities are being carried out.

Any radioactive material spills are cleaned up according to procedures. Health Physics personnel normally isolate the contaminated area and determine when cleanup is completed.

Radioactive and nonradioactive trash is removed periodically from all laboratory areas. Disposal containers are labeled and placed conveniently throughout all areas.

Liquid waste disposal is accomplished by drains to the CFD system, service waste, and PEW. A few labs have direct lines into J-Cell salvage. These drains are clearly labeled and located such that misuse is unlikely. Procedures govern all liquid waste disposal.

Radiation protection and contamination control in buildings with laboratories are further described in SRD Section 3 and Appendix A.

4.10.3.3 Fire and Explosion Protection. Numerous flammable and potentially explosive materials are stored and used in the laboratory areas. Procedures to control these materials and thus minimize the possibility of fire or explosion are contained in the SOPs. Fire protection equipment (specifically automatic sprinklers and hand fire extinquishers) are located in and about the laboratories. The type of fire protection provided varies depending on the type of materials and chemicals stored and used in each area. Several types of portable extinguishers and hose stations are generally provided. A trained fire brigade exists on each shift. Additional detail on the fire protection network is provided in SRD Sections 3 and 4.1.

4.10.3.4 <u>Chemical and Industrial Safety Control.</u> Most laboratories contain eye wash fountains, emergency showers, and protective clothing (including gloves, face masks, lab coats, and respirators). Ventilation air flows through all hoods must be checked on a routine schedule for compliance with applicable regulations. Rubber bottle carriers are regularly used for transporting concentrated acids or bases from supply areas to laboratories or between laboratories. These rubber carriers minimize the chance the bottles will break if dropped. The carriers also protect personnel from chemical burns if the bottles do break. Copies of the Handbook of Laboratory Safety [1] are available to all laboratory personnel. The SOPs require that this handbook be followed unless special procedures have been prepared as described in 4.10.3.5 below.

4.10.3.5 <u>Other Administrative Procedures.</u> ICPP procedural controls are summarized in Appendix A. Within the scope of these general controls, laboratory personnel are required to comply with procedures unique to the Analytical Chemistry Process, Support and Technology, and Chemical Research and Engineering Branches. These laboratory procedures are detailed in SOPs and briefly outlined in this section.

For the Analytical Chemistry Branch, request forms, which include activity levels, are prepared for each sample or group of samples received for analysis. Forms are logged in and samples labeled with the log number. Samples containing fissionable materials are specifically labeled. A label showing the type(s) and amount of fissionable material is also attached to the sample where feasible. Samples not submitted directly to a group for prompt analysis are stored in specific locations selected on the basis of the sample activity and makeup. Samples may be returned to storage following analysis.

Samples are assigned to appropriate group(s) where supervisory personnel select the proper analysis techniques to be used. In some nonroutine analyses, programs and methods are developed in consultation with the customer. Jobs that, in the opinion of the supervisor, are potentially hazardous, require a Safe Work Permit, which alerts the Health Physics Office and the ICPP Safety Engineer that the operation will be performed.

Completed analyses are approved by the appropriate supervisor. Worksheets are completed at the time of analysis and complete data entered. Results from approved worksheets are transcribed and checked prior to release to the customer. Analytical results to off-site customers and other special cases are transmitted by the Branch Manager. Records are maintained for five years.

Since the laboratory development and analyses performed by the Chemical Research and Engineering Branch and the Process Support and Technology Branch are rarely routine, a fixed procedure has not been established. Each experimenter is responsible for the type, schedule, and accuracy of the data collected, within the scope of existing Health Physics and industrial safety guidelines. Periodic progress and summary reports are issued by the experimenter to ICP management. Most chemical experiments require the completion of a "Hazards Checklist" designed more as a reminder to the experimenter than as an accounting of his actions. Computer rooms and instrumentation laboratories are similarly protected by internal management controls and are subject to periodic safety inspection by the ICP Safety engineering staff and ICP management.

4.10.4 Safety Evaluation. A safety evaluation of operations carried out in the ICPP laboratories is presented in this section. Topics covered include potential hazards from criticality, fire and explosion, radiation and contamination, and chemical-industrial practices. Based on this evaluation, the maximum credible accident is identified and described. Radiological effects on the environment are assessed both for normal operation and for the maximum accident.

4.10.4.1 Nuclear Criticality Safety. Criticality is prevented in laboratory areas by enforcement of mass and geometry controls. Fissionable materials are generally limited to quantities well below the minimum critical mass, and laboratory containers are generally small. Where larger quantities are handled or stored, special procedures must be written and be approved by the SRB.

There are no equipment or utility failures, adverse natural phenomena, fire, or explosion occurrences that could lead to a criticality in the laboratory areas. Operator errors, such as ignoring mass limitations or failure to update records, are minimized by the record-keeping procedures mentioned in 4.10.3.5. The 400 g limit allows for two batches to come in close proximity since 800 g of fissionable material cannot normally produce a criticality. The location of all 400 g storage areas must be approved by the SRB. A nuclear criticality incident in the laboratories is, therefore, not considered credible.

4.10.4.2 Radiation and Contamination Safety. A potential for minor radiation and contamination exists in the laboratories. However, such occurrences would take place within a hood and be confined to a small area. Major contamination and radiation occurrences capable of affecting other areas are remote, owing to the small quantities of material used in analyses.

All materials with the potential for contamination are handled and moved about within and between laboratories according to established practices. Particular attention is devoted to alpha-containing materials. Each branch involved in alpha-material handling has written procedures that define applicable handling methods and equipment restrictions. Workplaces for alpha materials are limited and are inspected, tested and tagged at regular and frequent intervals to assure minimum standards are met. Certain equipment is designed with airlocks to allow safe movement of high alpha activity materials within a laboratory. Air monitoring equipment, survey meters, and hand-and-foot counters are located in or about all alpha handling areas. Regularly scheduled routine contamination surveys are conducted in all alpha workplace and storage areas. Other radiation surveys can be requested at any time.

Radioactive materials in transit between and within laboratories are normally doubly contained to prevent spills. The type of containment used depends on the general makeup of the sample (activity, quantity, state, and materials). Shielded containers (sample pigs) are used if needed to reduce the gamma activity at the container surface to less than 7-1/2 mrad/hr.

The potential for overexposure of personnel from penetrating radiation is minimized by administrative controls. The beta-gamma activity level outside unshielded equipment is limited. Higher activity materials are handled in remotely operated shielded boxes and caves.

4.10.4.3 Fire and Explosion Safety. A potential for localized fires and minor explosions exists in laboratory areas owing to frequent work with hazardous chemicals (solvents, organics, strong oxidizers, corrosive acids, etc) and ignition sources. Preparations and analyses using these materials are controlled by written procedures. All alpha handling equipment is constructed with fireproof and/or fire retardant materials to minimize the possibility of fire. In general, hazardous materials are used in small quantities, thus minimizing the consequences of fire or explosion.

An independent evaluation of fire and explosion hazards in the ICPP laboratories is presented in Reference 2. The following quotation summarizes the findings:

> In general, no unusual hazards were observed in any of these laboratory facilities, and, in fact, most of the facilities presented reduced potential for fire and explosion hazards due to limitations on the quantities of chemicals handled. No undue

quantities of stored materials were observed, and storage appeared reasonably adequate and well maintained.

In all cases, segregation of acids from bases and of combustible materials from oxidizing agents should be observed. Mineral acids should not be stored with organic or reactive chemicals of any kind. Liquids should be stored on lower shelves than solids, in all cases in which the stored quantities permit.

Although there is no dearth of ignition sources of kinds common to chemical laboratories, the nature of the work permits adequate control of vapors and the hood system provides ample removal.

In short, no hazardous conditions were observed which constitute a significant risk to the overall facility. The possibility of conventional laboratory fires or explosions always exists; the fire protection systems, equipment and procedures are at least adequate to the possible risks.

The fire extinguishing sprinkling system is available in nearly all areas to quench fires before they can spread to other areas.

4.10.4.4 Chemical and Industrial Safety. Numerous chemicals used in the laboratories are toxic or otherwise damaging to personnel if they contact skin, are ingested, or are inhaled. Use of proper equipment and protective clothing as required by procedures minimize the possibility of personnel injury. Toxic chemicals are handled in confined enclosures with ventilating systems that carry harmful vapors away from occupied areas.

Equipment is subjected to scheduled preventive maintenance to minimize failures. All new equipment and techniques are thoroughly tested and reviewed by management prior to routine use in the laboratories. Personnel take part in regularly scheduled safety and training lectures to assure they carry out laboratory work in a safe and efficient manner.

4.10.4.5 Postulated Abnormal Occurrences. Despite careful planning and control measures, abnormal occurences can and do occur during laboratory operations. Imposing strict or detailed controls and procedures on laboratory operations without stifling the flexibility required to conduct experimental and developmental programs is a difficult problem, and ICPP management recognizes this dilemma. An analysis of the types of accidents that may occur in the many diverse laboratory operations does not indicate any inherent shortcomings in either the facilities or the generalized procedures used. Considerable responsibility for the safety of experimental or nonroutine laboratory operations is placed with the experimenter and his direct supervision. It is assumed they know best the hazards associated with the chemicals and materials involved in their operation or will solicit assistance from other knowledgeable people if needed.

The types of accidents evaluated generally include spills, fires (and minor explosions), and contamination. Any one of these accidents could be caused by operator error (or ignorance of the hazards) or mechanical failures. As described in previous sections, laboratory personnel are carefully trained to follow procedures, thus minimizing the chance of error. Equipment is subjected to regularly scheduled preventive maintenance and checked prior to use to minimize the possibility of failure.

The consequences of abnormal occurrences are generally confined to the immediate area, with spread to other areas possible by personnel tracking contamination from one area to another. Detection usually occurs immediately, or shortly therafter, thus allowing correction and control measures to be implemented while the occurrence is localized.

Therefore, because virtually all radioactive samples handled and analyzed within ICPP laboratories are small, any spills or loss of containment cause only small and localized doses and contamination. Always present, however, are the potential chemical and industrial hazards inherent in most industrial and academic laboratories: concentrated acids and basis; highly flammable solvents and reagents; bottled gases; pyrophoric solids; and toxic chemicals. Unique to radiation laboratories, however, are the additional hazards of radioactive sources, uranium and transuranic isotopes in hundreds-of-gram quantities, and the complications of remote handling.

The largest quantities of fissile material used in ICPP laboratories are handled within the multicurie cell (MCC) in CPP-627. Abnormal occurrences associated with the MCC are discussed in SRD Section 5.3.

The laboratory accident, with potentially the most severe consequences, is a fire in an open hot-waste container. This accident is described in detail in SRD Section 4.4.4. For this accident, it was assumed a container filled with combustible solid waste and contaminated to 50 mR/hr (measured one foot from the surface) is located within the CPP-627 shift laboratory, RSAL (see Figure 4.10-24). This container ignites and releases contaminated fission products to the air. Doses to personnel within the laboratory were calculated as summarized in SRD Section 4.4.4 and in 4.10.4.6. Only under rare circumstances (eg, area cleanup) would a waste container be permitted to achieve that radiation level. Similarly, ignition sources would not normally be placed in or near a combustible-waste container. Finally, a fire sprinkling system exists in most laboratories that should rapidly control any fire.

Many other generic laboratory accidents have been postulated and are summarized in Table 4.10-XI. None has consequences serious enough to warrant a detailed discussion. Many could result in minor alpha exposures, minor beta-gamma exposures acid burns, or minor equipment damage. Visual detection of any of these incidents should be rapid, allowing nearly immediate corrective actions to be taken to control the accident or mitigate the consequences. Where the experimenter or his supervisor feels a potential radiation hazard may be associated with a particular experiment, appropriate radiation detection instrumentation and alarms can be provided.

4.10.4.6 Radiological Effects of Normal Operation and the Maximum Postulated Accident. During normal operation of existing laboratory facilities, radiological effects to plant personnel and the environment are negligible. All handling and analyses of radioactive materials within the laboratories are monitored by Health Physics technicians. Any operations involving radioactive materials, whose radiation level exceeds 7.5 mR/hr at contact, must be shielded to protect the analyst.

TABLE 4.10-XI

LABORATORY FACILITIES - POSTULATED ABNORMAL OCCURRENCES

OPERATION[a]	POSTULATED ABNORMAL OCCURRENCE	CAUSE[c]	NORMAL PREVENTION[d]		DETECTION[e]	CORRECTION[f]	CONTROL[g]	POSSIBLE CONSEQUENCE[h]	
			PRIMARY SAFEGUARD	SECONDARY SAFEGUARD				THIS SYSTEM	OTHER SYSTEMS
Storage of solid combustible waste within laboratory	Fire in hot waste receptacles (maximum postulated accident)	Ignition source in waste container	Operator training and experience	Wastes are stored in enclosed metal containers	Visual. Activation of sprinkler system where protected. CAM alarms	Evacuate area. Pull fire alarm	Evaluate procedures for waste storage	Contaminated receptacles	Ingestion of contaminated smoke. Slight activity leased to environs.
Transfer of irradiated dissolved fuel within or between laboratories	Container dropped in transit	Operator error	Operator training and experience	Samples doubly contained. Small quantities (∿ 15 ml) in sample	Visual. Area survey	Decontaminate area (if necessary)	Review transport method	Possible container rupture and contamination of area. Personnel exposure	Minor contamination of other areas
Glovebox or shielded hood work with radioactive material	Source exceeds shielding properties of glovebox	Operator error	Health Physics surveys of source	Procedures limiting radiation levels in gloveboxes	HP survey. Self-Monitoring dosimeter	Remove source to more heavily-shielded cave	Review handling procedures	Exposure to operator	None

TABLE 4.10-XI (cont'd)

OPERATION[a]	POSTULATED ABNORMAL OCCURRENCE	CAUSE[c]	NORMAL PREVENTION[d] PRIMARY SAFEGUARD	NORMAL PREVENTION[d] SECONDARY SAFEGUARD	DETECTION[e]	CORRECTION[f]	CONTROL[g]	POSSIBLE CONSEQUENCES[h] THIS SYSTEM	POSSIBLE CONSEQUENCES[h] OTHER SYSTEMS
Glovebox handling of uranium oxide powder	Escape of powder from glovebox	Operator error, ruptured seal, or glove failure	Operator training. Preoperational pressure check of glovebox	Preventive maintenance. Ventilating inward air flow	Visual. Alpha monitor alarm. CAM alarm	Evacuate immediate area	Decontaminate area; replace any damaged equipment	Contamination of area. Inhalation by and exposure of operator	Possible spread of contamination to other areas
Glovebox laboratory analyses	Fire in glovebox	Chemical fire, electrical short-circuiting, etc.	Judicious use of flammable materials	Operator training and experience. Preventive maintenance	Visual	Pull fire alarm. Alert HP office if radioactive materials involved. Use dry-media fire extinguisher	Review laboratory procedure. Evaluate experiment	Glovebox damage; contamination of area	Possible release of contamination
Handling pyrophoric solids or preparing sodium metal	Fire or explosion	Operator error	Operator training and experience	Handling procedures. Laboratory safety practices	Visual	Extinguish fire. Pull fire alarm	Review laboratory handling procedures	Equipment damage. Personnel injury	None

TABLE 4.10-XI (cont'd)

OPERATION[a]	POSTULATED ABNORMAL OCCURRENCE	CAUSE[c]	NORMAL PREVENTION[d] PRIMARY SAFEGUARD	NORMAL PREVENTION[d] SECONDARY SAFEGUARD	DETECTION[e]	CORRECTION[f]	CONTROL[g]	POSSIBLE CONSEQUENCES[h] THIS SYSTEM	POSSIBLE CONSEQUENCES[h] OTHER SYSTEMS
Alpha pulse height analysis of plutonium or neptunium samples	Release of alpha-emitting material	Glovebox failure	Preventive maintenance	Proper preparation of sample planket to eliminate loose residue on sample	Alpha counter. High background count by pulse height equipment	Shutdown analyzer. Evacuate immediate area	Review sample preparation methods	Contamination of area. Exposure of operator	None
Isotope dilution mass spectrometry--filament removal	Escape of dry transuranic sample	Operator error	Operator training, knowledge and experience	Procedures require containment of filament during removal	Alpha counter HP survey	Evacuate immediate area	Decontaminate area. Review handling procedures	Contamination of area. Possible internal exposure to operator	Possible spread of contamination to other area
Gamma-ray spectroscopy of radioactive gas-sample bombs	Accidental release of gas	Operator error. Mechanical failure of sample bombs	Operator training. Preventive maintenance	Double-containment (bomb contained in plastic bag)	Visual. CAM alarms	Evacuate immediate area	Decontaminate. Evaluate similar bombs for defects	Exposure to personnel. Contamination of area	Possible exposure to other personnel.

TABLE 4.10-XI (cont'd)

OPERATION[a]	POSTULATED ABNORMAL OCCURRENCE	CAUSE[c]	NORMAL PREVENTION[d] PRIMARY SAFEGUARD	NORMAL PREVENTION[d] SECONDARY SAFEGUARD	DETECTION[e]	CORRECTION[f]	CONTROL[g]	POSSIBLE CONSEQUENCES[h] THIS SYSTEM	POSSIBLE CONSEQUENCES[h] OTHER SYSTEMS
Bench dilutions of laboratory acids or radioactive samples	Spill	Operator error	Operator training and experience	Use of rubber carriers in transit; protective clothing. Convenient placement of lab chemicals	Visual. HP surveys	Immediately flush acids from skin. Evacuate immediate area if spill is radioactive liquid	Decontaminate. Review procedures	Acid burns to personnel. Exposure to personnel	Possible spread of contamination to other areas.
X-ray analysis of laboratory samples	Operator exposed to X-ray	Operator error	Operator training and experience	Preoperational check out procedure. X-ray field monitor	Monitor alarm. Personal dosimetry results	Turn X-ray machine off	Evaluate preoperational checkout procedures. Reanalyze shielding reqirements	Penetrating radiation exposure to operator	None
Laser sample analyses	Operator exposed to laser beam	Operator error	Operator training and experience	Flashing warning lights. Locked laboratory doors. Preoperational checkout procedures	Visual. Sensory	Shut down laser machine	Reevaluate employee training, checkout procedures and warning devices	Burns to personnel	None

FOOTNOTES TO TABLE 4.10-XI

[a] Operation:

Performance of a specific operation.

[b] Postulated Abnormal Occurrence:

An event that results in:

(1) A severe violation of the safety limits and requirements, or

(2) Any uncontrolled or unplanned release of radioactive effluents to the environment, or

(3) A component failure which could render a system incapable of adequately performing any intended safety-related function, or

(4) Abnormal degradation of one or more of the boundaries designed to contain the radioactive materials generated by the fission process.

[c] Cause:

The reason the abnormal occurrence took place.

[d] Normal Prevention:

Primary Safeguard:

The principal design feature or administrative control whose purpose is to prevent the cause from resulting in the abnormal occurrence.

Secondary Safeguard(s):

Any other design feature(s) or administrative procedures(s) whose purpose is to prevent the cause from resulting in the abnormal occurrence.

[e] Detection:

The parameter(s) that change(s) as a result of the abnormal occurrence, the instrument(s) that detect(s) such change(s), and the visible or audible means that apprises the operator of the change(s).

[f] Correction:

The first action, preferably automatic, following the abnormal occurrence to reduce its consequences.

FOOTNOTES (cont'd)

[g] Control:

Any subsequent actions that permit operations to continue on an interim basis until the plant is shut down for repairs. For laboratory areas, actions taken to prevent reoccurrence may be included.

[h] Possible Consequences:

On This System:

Any effects upon the system (its components, facilities, and operation personnel), resulting from the abnormal occurrence.

On Related Systems:

Any effects upon other systems (their components, facilities, and operating personnel) resulting from the abnormal occurrence.

Various types of laboratory hoods exist for performing operations involving radioactive or toxic materials. The type of hood used for specific applications can be determined from guidelines provided in SOPs. Shielded sample carriers are used when deemed necessary by HP technicians.

The maximum postulated accident, defined in 4.10.4.5 as a fire in a waste container, could cause localized contamination and radioactive airborne effluents within the laboratory. This accident is described in SRD Section 4.4. The maximum dose anyone in the laboratory could receive from such a fire was calculated. In computing this dose, it was assumed that fire broke out in the largest receptacle used indoors for collecting hot waste (2x2x3 ft), and that the radiation outside this container was the maximum allowable, namely 50 mR/hr at one ft. Conservatively attributing essentially all this radiation to Ce-144/Pr-144 (contributions from the other isotopes are assumed small by comparison) there are 0.9 Ci each of (Ce-144 and Pr-144) inside the container.

In calculating the dose, it was conservatively assumed that the container resided in the shift laboratory, a room whose free air volume is 12,000 ft^3, the ventilation flow rate is (5000 cfm), and 10 percent of the radioactive material was released into the room[3,4]. Complete mixing of the smoke and ventilation air was assumed, so that the level of contamination fell off exponentially with a time constant of 2.4 min. For this case, the bone receives the maximum dose commitment-40 rem in one minute and a maximum of 120 rem in 10 min. Corresponding whole-body dose commitments are 2 rem in one minute and 7 rem in 10 min. For this worst case, these values are considerably less than the limits set for an accident at the site boundary by the Code of Federal Regulations, Title 10, Part 100 (10 CFR 100), namely 25 rem to the whole body and 300 rem to the thyroid. Probably, the exposure would be much less than that calculated because laboratory ventilation and equipment exhaust systems would remove any airborne effluents within a short time, thus minimizing the possibility of significant inhalation by personnel. There would not be any measurable radiological effects outside the plant.

4.10.5 References.

1. Norman Visteere (ed.), Handbook of Laboratory Safety, 2nd Edition, Cleveland, Ohio: The Chemical Rubber Company, 1971.

2. Fire and Explosion Hazards Evaluation, Idaho Chemical Processing Plant, HRC Report 3266, Hazards Research Corporation (January 18 1974).

3. C. W. Kruse et al, Behavior of Institional Incinerators When Used to Burn Radioactive Wastes, NYO-4517 (November 1952).

4. D. G. Lachapelle, An Engineering Evaluation of a Radioactive Waste Incinerator, Army Nuclear Defense Lab, Edgewood Arsenal, Md. Conf 660904 - Vol I and II, pp 509-569.

FORM ACC-2472
(REV. 7-75)

REF: PPM 8.10

Allied Chemical

ALLIED CHEMICAL CORPORATION

IDAHO CHEMICAL PROGRAMS - OPERATIONS OFFICE

SLR No. I.E

Page 1 of 1

SAFETY LIMITS AND REQUIREMENTS FOR:

OPERATIONS INVOLVING MORE THAN 400 GRAMS U-235

Originated by: M. K. Valentine

Revision: -0-

Issue Date: January 18, 1977

SAFETY LIMIT OR REQUIREMENT	SL OR SR	ESTIMATED FAILURE LEVEL FOR SL'S	ASSUMPTIONS, BASES, OR LIMITATIONS	CORRECTIVE ACTION
Operations within ICPP involving greater than 400-gram quantities of U-235 or equivalent[a] must have written procedures and a criticality evaluation approved by the SRB.	SR	N.A.	Operations involving more than 400 grams of U-235 may have high criticality potentials. Detailed procedures to follow for approval of such operations are contained in PPM 6.05.[b]	Terminate the operation. Obtain the necessary approvals.

REMARKS:

(a) One gram of fissile material other than U-235 is counted as two grams of U-235.

(b) PPM 6.05 "Nuclear Criticality Safety for Fissile Materials," latest approved revision.

*Letter, C. E. Williams to F. H. Anderson, "SRD Section 4.10 - Laboratory Facilities," dated 1/7/77

APPROVED:

1. BRANCH MANAGER: [illegible] DATE: [illegible]

2. MGR., [illegible] BRANCH: [illegible] DATE: June 6, 1976

3. CHMN., [illegible]: [illegible] DATE: 6/11/76

4. ASS'T. GEN. MGR., ICPP: [illegible] DATE: 6/18/76

5. GEN. MGR., ICPP: [illegible] DATE: 6/18/76

6. ERDA APPROVAL LETTER: * DATE: 1/7/77

SAFETY ANALYSIS REPORT ASSUMPTIONS FOR:

LABORATORY FACILITIES

Suggested Category [(a)]	Assumption
SR	1. Operations within ICPP involving greater than 400-gram quantities of U-235 or equivalent must have written procedures and a criticality evaluation approved by the SRB.
LCFO	1. A hazards analysis and hazard index must be determined for any work involving alpha-emitting materials. This index must be used to determine the appropriate environment to perform the work, according to the table in SOP 5.2.2.
LCFO	2. Storage areas within ICPP of greater than ½ gram but less than 400 grams of U-235 or equivalent must be approved by the SRB.
SP	1. Salvable quantities of uranium (> 1 g U/ℓ) in solution must be returned to the plant process (e.g., to J-Cell) from laboratories following completion of analyses, unless approval to dispose is granted by the area supervisor.
SP	2. No organic wastes will be disposed to the plant CFD/PEW system. All aqueous wastes disposed to the CFD/PEW system must be followed by a copious water flush.
SP	3. No sample may be placed in a shielded laboratory cave or transport container if the resulting radiation field at the face of the cave exceeds 7½ mR/hr, unless approved by the area supervisor and a health physics technician.
SP	4. Pressure seals on shielded caves designed and used for handling alpha-emitting materials (i.e., caves equipped with HEPA filters) must be checked for proper seal prior to each use.
SP	5. Ventilation air flow through all laboratory hoods must be checked at least annually for compliance with air-exhaust regulations.
SP	6. Periodic surveys of ICPP laboratories for radioactive contamination will be performed by HP technicians. Self-monitoring instruments and hand-foot counters will be made accessible to all laboratory personnel.
SP	7. Laboratory personnel must have access to Laboratory Safety Handbooks, eye wash fountains, and emergency showers.

Suggested Category [(a)]		Assumption
SP	8.	All radioactive samples and concentrated laboratory acids and bases should be doubly-contained for any transporting to, from, or between laboratories.
SP	9.	Relocation of laboratory equipment or major changes in operating procedures that may impact significantly the safety of the operation must be approved by the SRB.
SP	10.	Any radiation monitoring or safety interlock systems on the X-ray and laser generators must be checked for operability prior to each use.

(a) SR - Safety Requirement

LCFO - Limiting Conditions for Operations

SP - Safety Provision