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**Facility Effluent Monitoring Plan for the
325 Radiochemical Processing Laboratory**

March 1999



Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

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Pacific Northwest National Laboratory
Richland, Washington 99352

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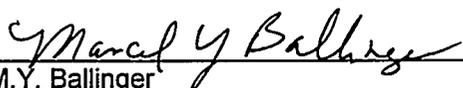
Environmental Management Services

FACILITY EFFLUENT MONITORING PLAN
FOR THE 325 RADIOCHEMICAL PROCESSING
LABORATORY

Prepared by:



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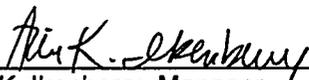


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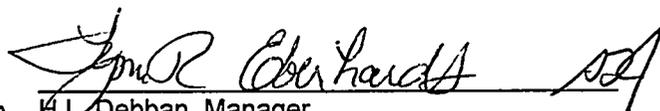
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Summary

This Facility Effluent Monitoring Plan (FEMP) has been prepared for the 325 Building Radiochemical Processing Laboratory (RPL) at the Pacific Northwest National Laboratory (PNNL) to meet the requirements in DOE Order 5400.1, "General Environmental Protection Programs." This FEMP has been prepared for the RPL primarily because it has a "major" (potential to emit > 0.1 mrem/yr) emission point for radionuclide air emissions according to the annual National Emission Standards for Hazardous Air Pollutants (NESHAP) assessment performed. This section summarizes the airborne and liquid effluents and the inventory based NESHAP assessment for the facility.

The complete monitoring plan includes characterization of effluent streams, monitoring/sampling design criteria, a description of the monitoring systems and sample analysis, and quality assurance requirements.

The RPL at PNNL houses radiochemistry research, radioanalytical service, radiochemical process development, and hazardous and radioactive mixed waste treatment activities. The laboratories and specialized facilities enable work ranging from that with nonradioactive materials to work with picogram to kilogram quantities of fissionable materials and up to megacurie quantities of other radionuclides. The special facilities within the building include two shielded hot-cell areas that provide for process development or analytical chemistry work with highly radioactive materials and a waste treatment facility for processing hazardous, mixed radioactive, low-level radioactive, and transuranic wastes generated by PNNL activities.

The research activities have been assigned to the following activity designations: High-Level Hot Cell, Hazardous Waste Treatment Unit, Waste Form Development, Special Testing Projects, Chemical Process Development, Analytical Hot Cell, and Analytical Chemistry.

Airborne Effluents

Potential radioactive airborne emissions in the RPL have been assessed, and all potential airborne release pathways have been identified. The primary stack at the RPL (EP-325-01-S) is currently registered with the Washington State Department of Health as required by WAC 246-247 and is continuously sampled for alpha and beta emitting particulate matter as well as tritium using stack samplers that meet 40 CFR 61 criteria. Chemical inventories were reviewed and determined to be well below the threshold requiring emissions monitoring or development of a risk management plan in accordance with 40 CFR 68.

Liquid Effluents

The RPL has three sewer systems: the Retention Process Sewer (RPS), the Radioactive Liquid Waste System (RLWS), and the Sanitary Sewer (SNS). All liquid effluent systems are either administratively or physically controlled. All laboratory sink and hood drains have been posted with labels stating the type of drain and the controls for disposing of liquid effluents. All other connections, such as floor drains, in the laboratory spaces that have the potential for inadvertent release of chemicals or radioactive material to process sewers have been plugged. RPS liquid effluent lines from the facility enter into the 300 Area liquid effluent system operated by Waste Management Hanford Company (WMHC). The RPS stream is monitored by WMHC before being discharged to the 300 Area Treated Effluent Disposal Facility (TEDF) which treats the waste before ultimate release to the environment. The SNS stream is monitored, as required, by DynCorp before being discharged to the City of Richland Publicly Owned Treatment Works (POTW). Radioactive liquid waste disposed to the RLWS is collected in a tank in the basement of the building, then shipped to the 200 Area tank farms. RLWS waste is not released to the environment.

NESHAP Determination

An inventory-based method was used to estimate the maximum offsite dose from potential airborne releases in accordance with 40 CFR 61, Subpart H. The potential unmitigated dose exceeded 0.1 mrem/yr. A number of chemicals in the building in greater than Reportable Quantity as defined in 40 CFR 302 were identified. This meets both DOE-RL criteria for preparing a FEMP.

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Acronyms List

ABPD	alpha-beta pseudocoincidence difference (method)
AC	analytical chemistry
ACL	Analytical Chemistry Laboratory
ACV	administrative control values
AED	aerodynamic equivalent diameter
AHC	analytical hot cell
ALARA	as low as reasonably achievable
AMAD	activity median aerodynamic diameters
ANSI	American National Standards Institute
AOP	air operating permit
BCAA	Benton Clean Air Authority
CFR	Code of Federal Regulations
CMS	Chemical Management System
CPD	chemical process development
DEPO	Deposition computer code
DOE	U.S. Department of Energy
DOE/RL	U.S. Department of Energy/Richland Operations Office
EM	Effluent Management
EMP	environmental monitoring plan
EPA	U.S. Environmental Protection Agency
FEMP	Facility Effluent Monitoring Plan
HEPA	high-efficiency particulate air
HLHC	high-level hot cell
HPGE	high purity germanium (detector)
HT	elemental tritium, diatomic hydrogen gas; (H_2 gas with 1 H as 3H)
HTO	tritiated water; (H_2O with 1 H as 3H)
HVAC	heating, ventilation, and air conditioning
HWTU	Hazardous Waste Treatment Unit
LEPD	low energy photon detectors
MBA	material balance area
MDA	minimum detectable activity
MDL	minimum detection levels
MEI	maximally exposed individual
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOC	notice of construction
OED	offsite emission dose
ONE	off-normal event
OSR	operational safety requirement
PHMC	Project Hanford Management Contractor
PNL	Pacific Northwest Laboratory (previous name)
PNNL	Pacific Northwest National Laboratory
PS	process sewer

PTE	potential to emit
QA	quality assurance
QC	quality control
RAT	Radioanalytical Application Team
RLWS	radioactive liquid waste system
RQ	reportable quantity
RPL	Radiochemical Processing Laboratory
RPS	retention process sewer
SAR	Safety Analysis Report
SBMS	Standards Based Management System
SNM	special nuclear material
SNS	sanitary sewer
SOP	safe (or standard) operating procedure
SOW	statement of work
STP	special testing projects
TEDF	Treated Effluent Disposal Facility
TT	diatomic tritium ($^3\text{H}_2$)
VAS	vacuum air sampling
WAC	Washington Administrative Code
WDOH	Washington Department of Health
WFD	waste form development
WHC	Westinghouse Hanford Company
WMHC	Waste Management Hanford Company

1.0 Introduction

It is the policy of the U.S. Department of Energy (DOE) and the Pacific Northwest National Laboratory (PNNL) to monitor effluents to determine if the public and the environment are adequately protected during DOE operations. Also, to determine whether operations are in compliance with DOE and other applicable federal, state, and local standards and requirements. It is DOE and DOE-contractor policy that effluent monitoring programs meet high standards of quality and credibility.

1.1 Purpose

DOE Order 5400.1 (DOE 1988), "General Environmental Protection Programs" states the following objective for environmental monitoring programs:

demonstrate compliance with legal and regulatory requirements imposed by applicable Federal, State, and local agencies; confirm adherence to DOE environmental protection policies; and support environmental management decisions (Section IV-1).

Plans must be prepared for each site, facility, or process that uses "significant pollutants or hazardous materials" (DOE 1988, Section, IV-2). These requirements are being met through the environmental monitoring program conducted for the Hanford Site and described by the DOE Richland Operations Office (DOE/RL) in the Hanford Site Environmental Monitoring Plan (EMP) (DOE 1997).

The EMP identifies and discusses two major activities as specified by DOE 5400.1: a) effluent monitoring, and b) environmental surveillance. Because the Hanford Site contains a number of facilities with effluent monitoring needs, individual facility effluent monitoring plans (Facility Effluent Monitoring Plans [FEMPs]) are prepared for those facilities to implement the effluent monitoring requirements. This report supplies information on effluent monitoring in the 325 Building Radiochemical Processing Laboratory (RPL). The information provided in this FEMP is current as of the time of FEMP issuance. DOE Order 5400.1 requires the EMP to be reviewed annually and updated every 3 years. Update of this FEMP will also occur on a 3 year schedule.

1.2 Scope

Characterizing the radioactive and nonradioactive constituents in inventory and in waste streams provides the underlying rationale for sampling and monitoring programs. Currently, routine sampling and monitoring compliance efforts at the RPL are confined to radioactive air emissions. Compliance assessments of the existing radioactive air sampling equipment are included in this FEMP. Compliance sampling for liquid streams from the RPL is incorporated into 300 Area compliance sampling activities conducted by Waste Management Hanford Company (WMHC) for process waste streams and DynCorp for sanitary discharges for the 300 Area, as required.

A major activity of the FEMP effort is to identify all the liquid and air release pathways (e.g., identify all access points to the various sewers and all radioactive emission release pathways) under normal operations and during process upset conditions. These are verified on as-built drawings that are maintained in PNNL's Essential Drawings System.

The method of characterization discussed in this plan identifies potential pollutants at the point of generation and potential upset conditions that are likely to occur, and evaluates the potential for those materials to enter an effluent stream.

1.3 Basis for Preparing FEMP

A FEMP was determined to be needed for the RPL because of the quantity of radionuclides and chemicals in the building. The RPL has a potential to emit (PTE) of >0.1 mrem/yr for radionuclides and has a number of chemicals in excess of their Reportable Quantity (RQ) value as defined in 40 CFR 302. This meets both DOE-RL criteria for the preparation of a FEMP. A list of radioactive material in the facility can be found in Appendix A and a list of chemicals in greater than the RQ is provided in Appendix B.

1.4 References

DOE 1988. *General Environmental Protection Program*, DOE 5400.1. U.S. Department of Energy Order. U.S. Department of Energy, Washington, D.C.

DOE 1997. *Environmental Monitoring Plan*, DOE/RL-91-50, Rev 2, United States Department of Energy, Richland Operations Office, Richland, Washington.

2.0 Facility Description

The 325 Building Radiochemical Processing Laboratory (RPL), Figure 2.1, houses radiochemistry research, radioanalytical services, radiochemical process development, and mixed waste treatment activities. The laboratories and specialized facilities enable work ranging from that with nonradioactive materials to work with picogram to kilogram quantities of fissionable materials and up to megacurie quantities of other radionuclides. The special facilities include 1) two-shielded hot cell areas that provide for process development or analytical chemistry work with highly radioactive materials, and 2) a waste treatment unit for processing mixed, low-level, and transuranic wastes generated by PNNL activities. The office, laboratory, and shop space house personnel from PNNL's research divisions and support services (maintenance staff, power operators, radiological control technologists, and building management).

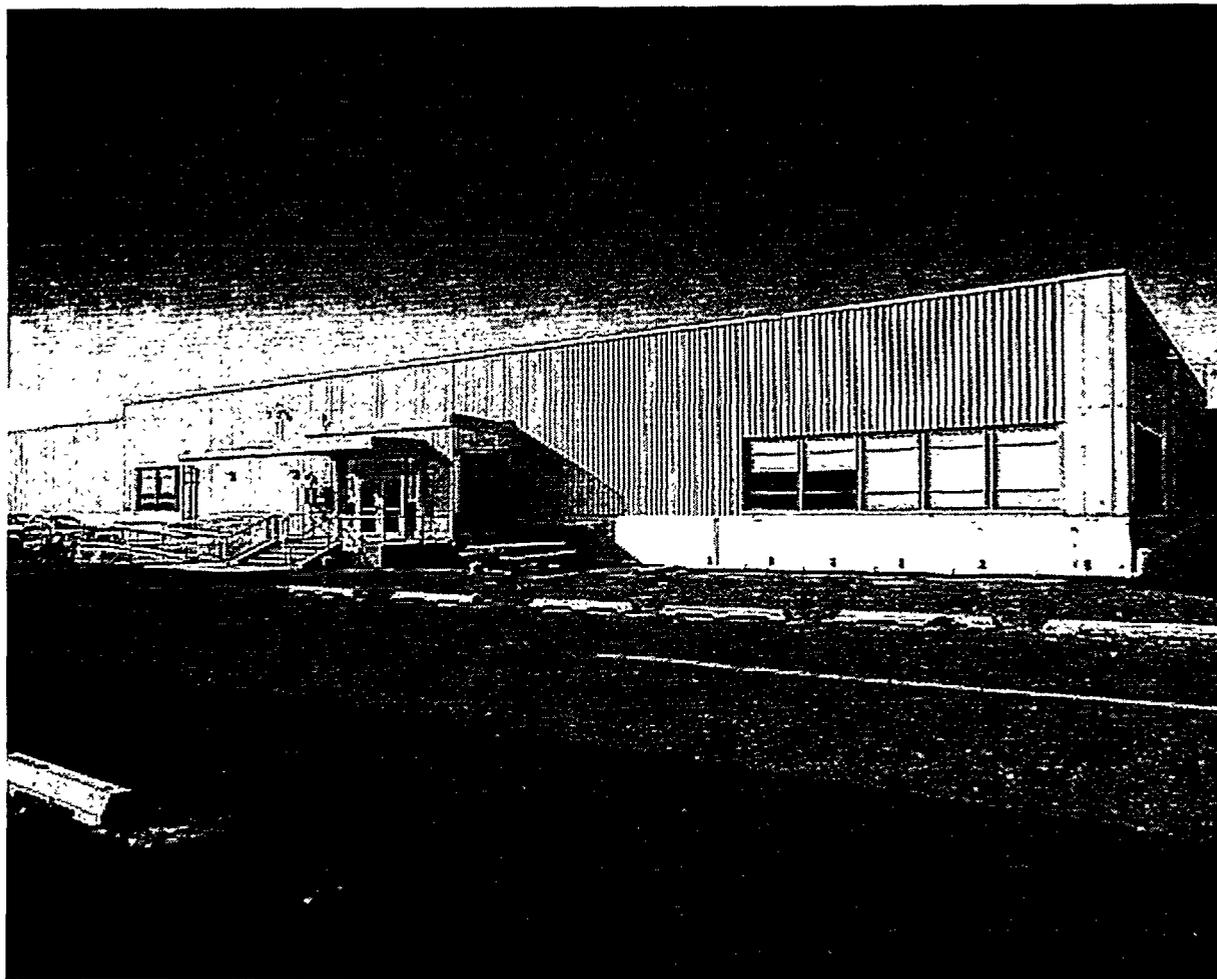


Figure 2.1 Radiochemical Processing Laboratory
Photo by Jim Reed from Shadow Works Photo Company

2.1 Physical Description

The RPL, Figure 2.1, is a rectangular-shaped, welded metal frame structure with insulated metal siding erected on reinforced concrete footings, walls, and slabs. Exterior walls are constructed of insulated 1-1/2 in. fiberglass sandwich metal panels. The flat roof is a metal deck with a built-up gravel surface insulated with 1-in. board. Windows are single pane. The facility dimensions are listed in Table 2.1.

Table 2.1 Dimensions and Space Assignments

Description	Dimensions
Perimeter Basement	220 ft 4 in. x 271 ft 9 in.
First Floor	235 ft 4 in. x 271 ft 9 in.
Second Floor	195 ft 10 in. x 116 ft 2 in.
Office Space	14,114 ft ²
Laboratories	46,415 ft ²
Common	70,593 ft ²
Storage	1,113 ft ²
Other	11,857 ft ²
Total Area	144,092 ft ²

The building consists of 1) a central portion containing general purpose laboratories designed for general chemical and low-level radiochemical work, 2) a south (front) wing containing office space, a machine and electrical shop, locker rooms, and a lunch room, 3) east and west wings provided with shielded enclosures with remote manipulators for high-level radiochemical work, 4) a filter addition area that provides a final testable high-efficiency particulate air (HEPA) filtration stage for ventilation exhaust air, and 5) outside radioactive-materials storage area and cargo containers.

The first floor of the building contains approximately 100 laboratories and offices; the laboratories contain numerous hoods and gloveboxes for working safely with radioactive and hazardous materials. Offices are also located on the second floor and on a mezzanine area between the first floor and the basement (see Figures 2.2 and 2.3). The basement, Figure 2.4, contains several laboratories in addition to a portion of the ventilation and waste-handling systems. Instrument rooms, certain isolated laboratories, and the basement mezzanine office area have refrigerated air conditioning for temperature and humidity control.

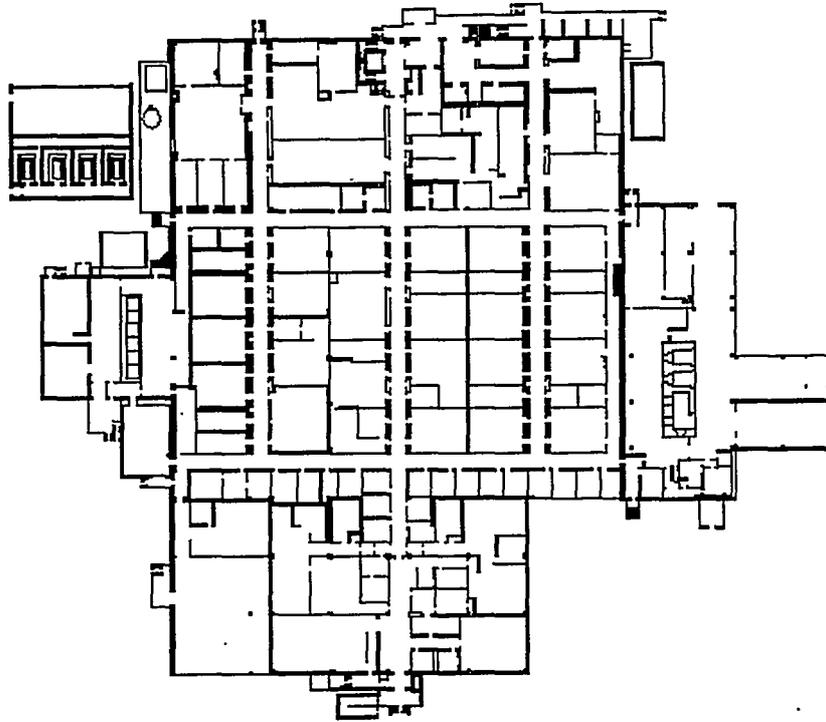


Figure 2.2 325 First Floor Layout

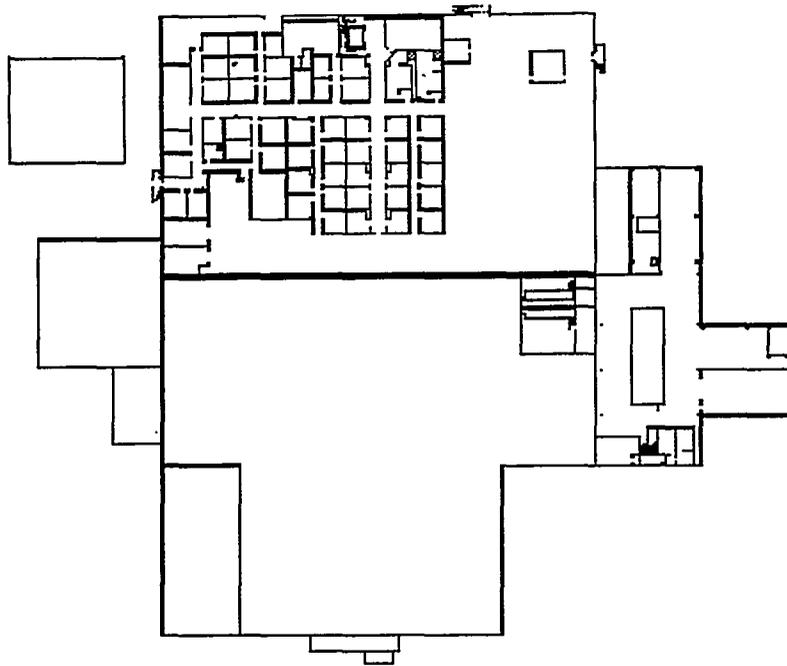


Figure 2.3 325 Second Floor Layout

The building's main heating and ventilation system, located on the second floor, has four nominal 65,000 cfm supply fans with heating/cooling coils, spray chambers, and filters. Four 55,000 nominal cfm exhaust fans and a filter room are located in the filter addition annex northwest of the main building. Typically, three fans operate continuously with the remaining fan as a standby. Air is supplied to offices and corridors and exhausted from the laboratories through HEPA filters to a 90-ft (27-m)-high stack.

Small refrigerated air conditioning units serve other special purpose laboratories as well.

Utility services include steam; hot, cold, process, sanitary, deionized, and distilled water; compressed air; laboratory process vacuum; and three sewer systems. In addition to the laboratory vacuum provided by two pumps, a high-volume vacuum is furnished to air samplers by two additional pumps.

Electrical systems provide some isolated circuits for instruments, a 3000-lb electric elevator, and emergency power. Both the normal transformer and the emergency transformer are rated at 1000 kVA.

Safety/emergency equipment installed in the building includes safety showers, eyewash stations, decontamination shower, fire sprinklers, smoke alarms, heat detectors, storage cabinets for flammables, and emergency alarm systems: fire gongs, crash phones, and criticality horns.

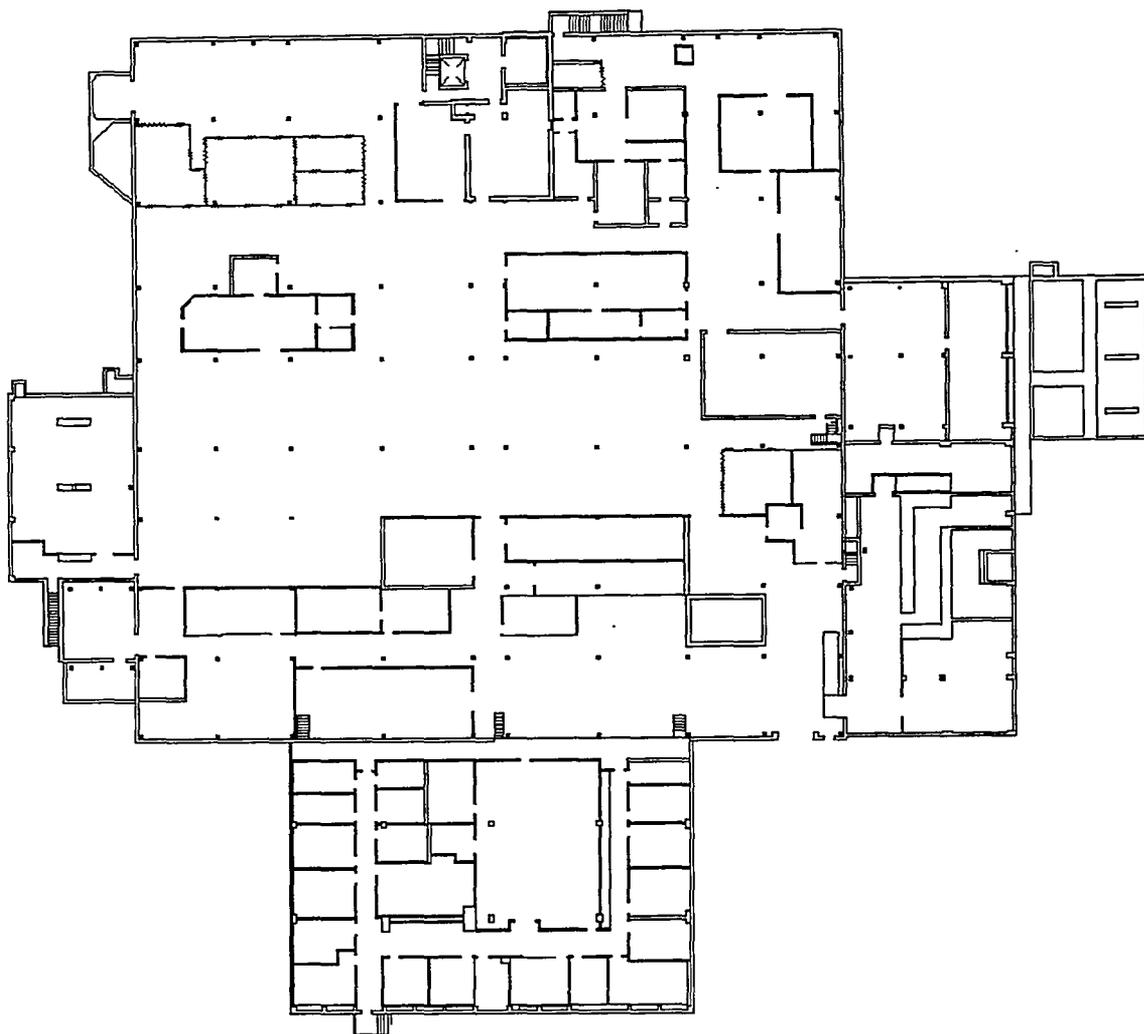


Figure 2.4 325 Basement Layout

2.2 Process Description

The facility houses laboratories for organic, inorganic, and radiological chemistry activities. It also provides specially shielded, ventilated laboratory space for studies with chemical and mechanical processes that have high radiation levels. The facility contains a very comprehensive hot-cell capacity with 4-ft-thick walls and 30-ton and 5-ton bridge cranes to perform process and physical chemistry on high-level samples, such as spent fuels. It also has shielded analytical cells with 18-in. walls and 3-ton hoists for process chemistry research and development. Other processes performed in the facility are waste formulation and durability testing as well as empirical studies supporting the evaluation of various waste types and forms. Additional activities include analytical chemistry work in support of environmental restoration, waste management, and new and spent fuel evaluations. The RPL research activities have been assigned to the following major activity designations:

- *High-Level Hot Cell (HLHC) Activity.* The HLHC activity is conducted in a portion of the RPL that includes nine laboratories. Special laboratory facilities used in this activity include hot cells with 4-ft-thick walls, open-face hoods, and special enclosures.
- *Hazardous Waste Treatment Unit (HWTU) Activity.* The HWTU activity is conducted in a portion of the RPL that includes two laboratories. Special laboratory facilities used in this activity include open-face hoods, a glovebox, and a waste compactor.

- *Waste Form Development (WFD) Activity.* The WFD activity is conducted in a portion of the RPL that includes three laboratories. Special laboratory facilities used in this activity include open-face hoods and gloveboxes.
- *Special Testing Projects (STP) Activity.* The STP activity is conducted in a portion of the RPL that includes five laboratories. Special laboratory facilities used in this activity include open-face hoods and gloveboxes.
- *Chemical Process Development (CPD) Activity.* The CPD activity is conducted in a portion of the RPL that includes 15 laboratories. Special laboratory facilities used in this activity include open-face hoods and gloveboxes.
- *Analytical Hot Cell (AHC) Activity.* The AHC activity is conducted in a portion of the RPL that includes five laboratories. Special laboratory facilities used in this activity include hot cells with 18-in.-thick walls and open-face hoods.
- *Analytical Chemistry (AC) Activity.* The AC activity is conducted in a large portion of the RPL and includes 54 laboratories. Most of the work is analytical chemistry and radiochemistry to support environmental restoration and waste management. Special laboratory facilities used in this activity include open-face hoods, gloveboxes, and special enclosures.

2.3 Source Term Definition and Description

The characteristics of releases that could contribute to each effluent stream during normal operating and upset conditions are described in this section. Unconfined contact with ventilation air or an unrestricted flowpath to a sewer are the only prerequisites for an inventory to present a potential source term to an effluent stream. For the purposes of this section, a source term is a description of the nature and location of potential sources of releases of radioactive and/or chemical materials within the building. Thus, all "passive" inventories stored in open containers, as well as those undergoing sparging, boiling, pouring, and other "active" processes, can potentially produce air or liquid source terms. The following subsections discuss potential source terms under normal and upset conditions.

Normal Operations

Normal operations can be broken down into storage and handling, sample preparation, use of instrumentation, and process chemistry (at various scales). Storage and handling operations tend not to produce emissions, with the exceptions of: waste management activities including compaction; mixing the liquid waste tanks in the vault; and pouring large containers' contents (whether powder or liquid) into smaller containers. Sample preparation is likely to include small-scale wet chemistry (such as acid digestion, dissolution, and extraction), pouring liquids and powders, and perhaps, cutting or grinding solid samples. Some resuspension of aerosol from open sample cans, crucibles, and vials probably also exists. The releases from using instrumentation are less well-defined, but probably small compared to others. Process chemistry should be the largest contributor of releases.

The processes producing releases tend to be more similar in kind or location for hazardous chemicals than for radionuclides. Releases can be described in terms of four basic physical forms in which radioactive and other chemicals are found:

- nonvolatile liquids, dispersible powders, and crushable solids
- nondispersible metals
- volatile liquids
- gases and vapors.

Powders are typically subjected to the physical processes of pouring, sieving, calcining, and resuspension of particulates from loose powders by airflow or wiping. Nonvolatile liquids may be sparged, heated, boiled to dryness, poured, or simply resuspended from open containers. Operations normally performed on friable solids (such as fuel pellets) are cutting and grinding, and tests such as heating or burning. However, the amounts of solid radionuclides that undergo such processes are

already categorized as powders in the inventories. Releases from solids are much lower than for powders or liquids, and releases from metals are even lower than those from other solids. Volatile liquids and solids can evaporate from open vials, beakers, or trays. Heating may or may not be involved; some work is done at higher temperatures. Gases and vapors may also be released during normal operations.

The Appendix A source-term fractions, 1.0 for gases and volatiles, 0.001 for nonvolatile powders and liquids, and 1×10^{-6} for solids are believed to be conservative for the estimated annual building release fraction *within* the building. Sealed sources are exempted in the regulations and are given a release fraction of 0.0.

The radionuclide releases from the RPL, during normal operations, depend on the in-building source term, the effectiveness of effluent filtration, and the amount of inventory that undergoes normal operations during the year. The source term from normal operations varies over a wide range of isotopes, but the most significant contributors have historically been isotopes of americium, cesium, neptunium, plutonium, and strontium. Particles contaminated with these materials would be effectively removed by the HEPA filtration system with only a small fraction exhausted through the main facility stack, which is monitored for radiological releases. Additionally, work with tritium has produced airborne tritium that is also monitored and exhausted through the main stack.

A number of different chemicals are used in the building. Chemicals are tracked using the Chemical Management System (CMS). The amounts of chemicals in the facility are used to determine the level of chemical hazard in the building. The needs for monitoring airborne emissions of hazardous chemicals are established in the Hanford Site Air Operating Permit (to be issued in under WAC 173-401). Based on the current potential to emit, the permit is not expected to require chemical monitoring. Needs for future monitoring will be established by future permits issued pursuant to the applicable state and federal regulations (e.g. WAC 173-400 General Regulations for Air Pollution Sources, and WAC 173-460 Controls for New Sources of Toxic Air Pollutants)

Under normal operating conditions, any release to airborne effluent pathways of regulated materials would undergo at least two stages of HEPA filtration before reaching the sampling and monitoring system prior to leaving the building through the stack.

Under normal operating conditions, the sanitary sewer system (SNS) only receives effluent from the restrooms, water fountains, lunchrooms, and change rooms. No radioactive or hazardous chemicals from processes or operations are normally released through this pathway. There are no indications that radioactive or hazardous materials would be present in the 325 SNS from past operations.

The retention process sewer (RPS) serves a number of laboratory areas with the potential for contamination; therefore, under upset operating conditions, this system may contain radioactive material. Under normal operations, administrative controls (Standards Based Management System [SBMS], Managing Liquid Effluents, Managing Nonradioactive Chemical Wastes) are followed and liquid effluents are evaluated against sewer system acceptance criteria and approved prior to disposal. Liquid effluents in the RPS are actively monitored when exiting the RPL and again by WHMC at the 307 Facility for gross alpha activity before they are subsequently discharged to the 300 Area Process Sewer System.

The current normal operations do not call for routine monitoring or sampling the RPL SNS or RPS effluent. However, sampling is performed on an as-needed basis.

Upset Conditions

Upset conditions considered in this document are those that are likely to occur. These events may either cause an unusual source term that follows a normal effluent pathway (source-term upset), or a normal source term that follows an unusual pathway (flow-path upset). Both of these types of upset conditions are discussed in this section. Please note that because of the separation between the SNS and chemical and radioactive source terms, no upset conditions exist in which normal chemical or radioactive source terms can escape via the SNS.

- *Flow-Path Upsets. Flow-path upsets occur when normal source terms (expected emissions during normal processing) follow unintended paths to be released at effluent exit points. This can result in an increased release owing to bypassed engineered controls such as HEPA filters. Possible flow-path upsets in the RPL include many types of events.*
 - Glovebox confinement failures could develop from several kinds of damage or failure. The worst-case result is that an unfiltered normal source term from one glovebox escapes to room air. Hot-cell confinement failure is considered beyond upset conditions.
 - A HEPA filter could fail mechanically (expelling part of its contents as well as permitting particles to flow through). This type of upset would likely result in increased emissions to the stack.
 - Possible supply system upsets include unanticipated shutdowns and excessive flow (resulting in pressurization). Source terms would be those from normal operations. The building would not be expected to remain at underpressure or overpressure for more than a few minutes. A short period at overpressure might lead to effluent escape through and around outside doors, restroom vents, and other unmonitored unfiltered pathways, including those in "clean" areas, such as the mezzanine, machine shop, or second floor. However, the loss of building air balance owing to oversupply would not cause a failure of the glovebox-to-room pressure gradient, but only some outflow of building air to the atmosphere through normal openings in the building skin. No unintended release path is expected from an oversupply air-balance upset.
 - Possible exhaust-system upsets include unanticipated shutdowns and excessive flow (resulting in depressurization). The only parts of the main exhaust-fan control system that are common to all four exhaust fans are a controller on the second floor and the fan outlet pressure sensor. Failure of either of these devices would lead to maximum flow-rate operation of the exhaust fans. This event would cause a decrease in building pressure, but would not result in effluent leaving the building at unintended exit points.
 - The loss of exhaust could also result in slight (nearly stagnant) backflow of all of the normal glovebox and hot-cell source terms to room air. A short period at overpressure might lead to a brief escape of contaminated room air through and around outside doors, restroom vents, and other unmonitored unfiltered pathways, including those in "clean" areas.
 - Releases to the liquid effluent pathways are those entering the RPS or radioactive liquid waste (RLWS) systems. Waste from the RLWS is collected in a tank in the basement of the building and is not released to the environment under normal conditions. The system is designed to prevent an environmental release under upset conditions.
 - On exit from the RPL, control and monitoring responsibility for the RPS passes from PNNL to WMHC. Because the stream is under WMHC control beyond the point of exit from the facility, any flow-path upsets would be the responsibility of the WMHC. Although PNNL does not have responsibility for compliance sampling of these 300 Area streams, PNNL does have the responsibility for maintaining control and accountability for operational discharges from its facility. Releases are controlled via administrative restrictions on disposal of liquid to the sewer systems. Because of this, PNNL is not currently routinely sampling RPL liquid effluent streams. However, sampling may be performed on an as-needed basis.
 - In summary, the flow-path upsets can lead to the release of a normal source term to the atmosphere through less filtration than normal (two stages of HEPA filtration) or the release of hazardous chemicals or a leak into the RPS system. In most cases, the source term at risk is the inventory at a single work station (glovebox or set of hot cells) for atmospheric releases or the contents of a maximum single-container amount for liquids.

- *Source-Term Upsets. Source-term upsets occur when an upset creates an unusually large source term, which then follows normal release paths. Only the inventory in a single container or work-station would be affected, and damage to sealed sources would not be expected. Stack monitoring and sampling for radioactivity are already in place and are appropriate for potential upsets. (These would be expected to exhaust through the main stack.)* Accidents that affect multiple areas (such as fires) are considered in the facility Safety Analysis Report (PNNL 1998) and are beyond the scope of upsets considered here. For these types of event, data in addition to effluent sampling would be needed to quantify releases, such as using alternative sampling methods described in Section 3.9.
- 40 CFR 68 Accidental Release Prevention Requirements: Risk Management Programs requires facilities to do risk management planning to help prevent, detect and respond to accidental releases to the air of hazardous chemical. Chemical inventories were reviewed and determined to be well below the quantities requiring a risk management plan.
- Because the RPS serves areas of potential radioactive contamination, a source-term upset release of radioactive material could occur from spills or contamination of process water entering these systems. Such a release to the RPS could only be passed to the 307 basins where a redundant screen is done if the radionuclide concentration were below the diversion set-point of 1×10^{-4} $\mu\text{Ci/cc}$ of ^{137}Cs or its gamma equivalent. If the radionuclides in the spill were alpha or beta emitters, concentrations higher than the value cited above for ^{137}Cs might pass through to the RPS without diversion as a result of the source-term upset.

2.3.1 Chemical

Chemical storage and usage are well dispersed throughout the facility and consist of bulk materials (solvents, acids/bases), small volume chemicals, and standards used in conducting laboratory experiments. All chemicals within the facility are inventoried and tracked via the CMS (SBMS, Working with Chemicals). A number of the chemicals in the facility exceed the reportable quantity (RQ) specified in 40 CFR 302.4. These chemicals are highlighted in Appendix B.

Many of the laboratories contain satellite accumulation areas for liquid and solid hazardous wastes. An active inventory of the waste contents is maintained. Liquid and solid wastes are disposed of in accordance with guidelines described in (SBMS, Managing Liquid Effluents and Managing Nonradioactive Chemical Waste).

2.3.2 Radionuclide

Radioactive material storage and usage are dispersed throughout the facility and include a large number of isotopes. These materials are found in several forms, including solid, liquid, particulate, and gas. Some of these materials are also heated during testing, producing vapors.

Some residual hold up is assumed from historical operation of mixed isotopes. This residual hold up could be found in the ventilation and filter system, the liquid waste system components, and fixed contamination in controlled areas.

Because the RPL is primarily intended for fissile material research, transuranics, uranium, and thorium compose the bulk of the radionuclides in the building. Fission products (usually derived from spent fuel) are also stored and handled. The radionuclides in the building may be in any physical form, although there are fewer gases than powders, liquids, and solids.

In general, plutonium and other transuranics are found inside gloveboxes or hot cells but are occasionally handled and stored in fumehoods. Uranium and thorium may be handled and stored in hoods as well as in gloveboxes and cells. Other radionuclides are handled as appropriate based on the potential dose to personnel and may be in hot cells, gloveboxes, hoods, or on the lab benches. The building also possesses low-level radioactive waste in a waste compactor and stores radioactive wastes in drums. Finally, an inventory of assorted radionuclides is present as "holdup" in HEPA filters and as plated deposits in ventilation ducts, gloveboxes, hoods, and liquid pipes (Haggard et al. 1996).

A detailed inventory for the building is provided in Appendix A. This inventory list is a combination of three material sources:

- Part 1 - Inventory Estimates provided by RPL staff, which is any radionuclide material that is not included in the Part 2 or Part 3 inventories. This part also accounts for building holdup not covered in Part 3.
- Part 2 - Composite Radioactive Material Inventory, which is the sealed sources that are assigned to custodians and accounted for by PNNL Health and Safety Department.
- Part 3 - Nuclear Materials Inventory, which is the inventory of special nuclear material (SNM) that is maintained in a material balance area (MBA) and assigned to an MBA custodian. This building holdup of SNM within the boundaries of the MBA.

2.4 Identification of Effluent Pathways

Effluent pathways and their facility points-of-discharge of liquid and airborne effluents from the RPL are described in the following sections.

The term "point-of-discharge," as used in this chapter, refers to the point at which the effluent leaves PNNL control. For airborne emissions, the discharge point coincides with the point of effluent entry into the uncontrolled environment. Thus, "discharges" of airborne emissions must comply with PNNL administrative controls (SBMS, Airborne Emissions), DOE, the United States Environmental Protection Agency (EPA), and the Washington Department of Health (WDOH) emission control and monitoring requirements.

Liquid effluents originating in the RPL, on the other hand, remain in a controlled system at the "point-of-discharge." At these points, the responsibility for the effluent stream, including its ultimate disposition, passes from PNNL to the site waste management Hanford operations contractor, WMHC. As such, WMHC is responsible for monitoring and controlling environmental discharges of liquid effluents.

WMHC determines the need for and established separate FEMPs to cover liquid effluent discharge monitoring and control systems affecting operations of the 300 Area Treated Effluent Disposal Facility (TEDF). Although PNNL does not control the discharge of liquid effluent from all 300 Area facilities, PNNL is responsible for characterizing effluents originating in its facilities and for exercising appropriate control over these effluent sources. Characterization information is documented annually and provided to TEDF. The annual documentation includes updates to building flow rates, a list of new connections to the sewer systems, list of new processes added or changed in the last year and any other pertinent changes to sewer discharges.

The RPL produces both liquid and gaseous effluent streams, all of which are generated in the building rather than being pass-throughs from other facilities. The effluent streams during normal and shutdown operations include two sewers, one main ventilation stack, and a number of vents from support spaces (e.g., shops, restrooms, mechanical rooms). An interbuilding pipeline also runs between the 324 Facility and the RPL, but is currently inoperable, and no plans to revive its use exist.

2.4.1 Gaseous and Aerosol Emission Pathways

Figures 2.5 and 2.6 provide a simplified summary of the RPL main exhaust system. Greater detail can be found in the schematics presented in Appendix D. These drawings were prepared and field verified during the summer of 1991 and have been identified as "essential drawings." As such, they are updated whenever a building modification affects the systems shown on the drawings. Any facility modification that changes building flow paths must 1) receive prior concurrence of the building manager, and 2) requires updating of the appropriate drawing(s) before project close-out (SBMS, Creating or Modifying Engineering Calculations, Drawings, and Specifications).

Almost the entire RPL is in one ventilation zone, within which air balance causes flow from the outside atmosphere into the building and from lesser to greater areas of potential contamination. Confinement is

also provided by conducting high-inventory operations in gloveboxes and hot cells. Off-gas from individual activities is typically handled by the building vacuum system or by the heating, ventilation, and air conditioning (HVAC) system. Potentially radioactively contaminated airflow passes through at least two stages of HEPA filtration before exiting the building through a single, monitored, and sampled stack. Supply and exhaust systems are discussed in the following subsections

Supply

Three main supply fans (with a fourth on standby) using 100% outside air provide supply air to the majority of the RPL, as shown in Figure 2.5. In general, air is supplied first to the offices, from which it flows to the building hallways. The hallways serve as supply plenums for the laboratories that, in turn, may supply air to gloveboxes (at less than room pressure) and hoods. The "clean" second floor is also supplied with air (at a higher pressure than the first floor). The hot cells in the 325A and 325B annexes do not have a separate air supply, but draw air from the galleries through unfiltered inlet ducts and smaller leak paths.

Smaller supply systems serve other parts of the building: offices in the southern wing, laboratories in the northwest corner of the first floor and one in the basement, rooms 203, 209, 23, 23A, and 23B (basement), and the machine shop, instrument shop, and associated office (rooms 204, 205, and 206). Some of these supply systems partially recirculate the air, others do not.

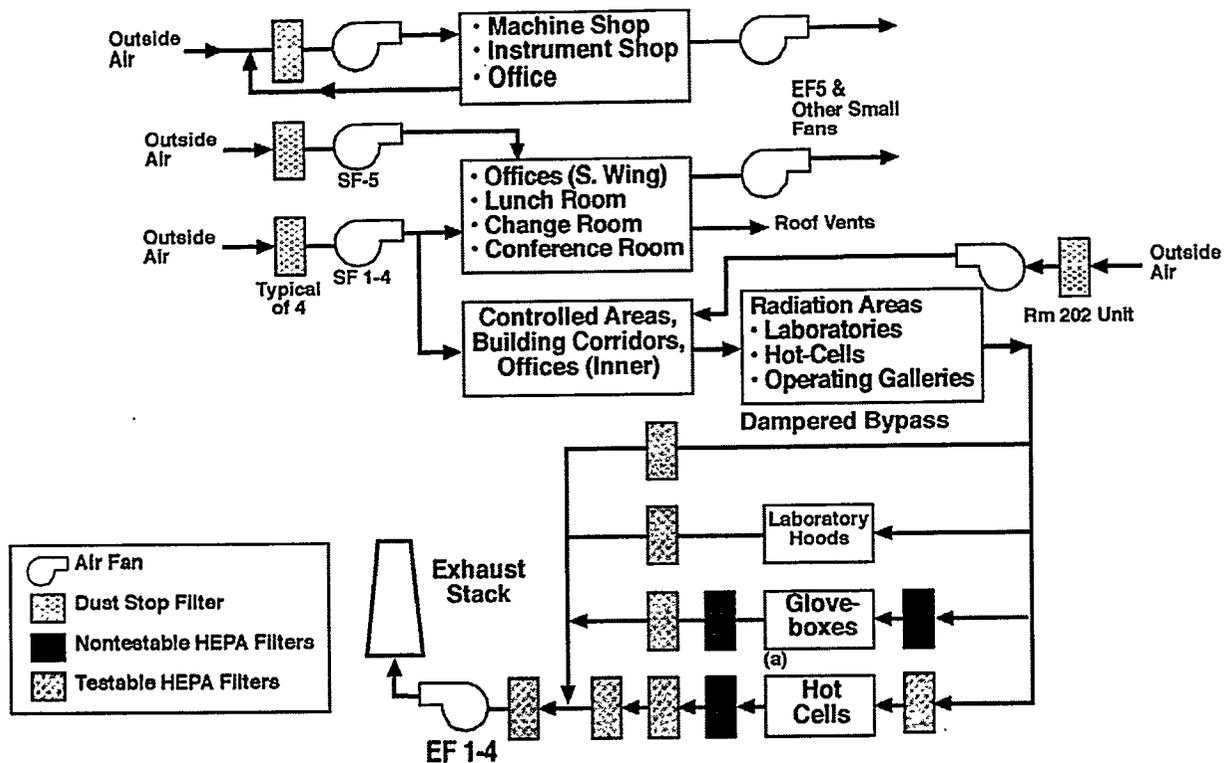
Exhaust

Three of the exhaust fans (with the fourth on standby) exhaust air from most of the RPL during normal operations. During normal operation, the exhaust system provides the only effluent path for in-building releases. The exhaust system consists of the air circulating first through the uncontrolled corridors, then to the controlled corridors, and finally to the laboratories. All rooms, gloveboxes, and hoods in potentially contaminated areas discharge through at least one stage of nearby testable HEPA filters to the main exhaust plenum, which leads to a second stage of HEPA filters just before the stack.

Thus, all potentially contaminated areas have at least two stages of HEPA filtration. The vacuum system also exhausts (through a stage of HEPA filtration) to the main exhaust plenum. Some potentially contaminated locations have more than two stages of HEPA filtration. The exhaust downstream from the final bank of HEPA filters is sampled for radioactivity as determined by WAC 246-247 and 40 CFR 61, Subpart H, and the Hanford Site Air Operating Permit (AOP) HNF-AOP-97-1.

The following "clean" areas have their own unfiltered exhaust systems: the south wing area of the first floor (exhausted through a roof vent), the restrooms in the south wing area and on the second floor (vented by small fans), and the second floor offices and equipment rooms. The exhausts for the restrooms in the first floor laboratory area are exhausted to the sample receiving preparation and storage laboratory HEPA filter bank.

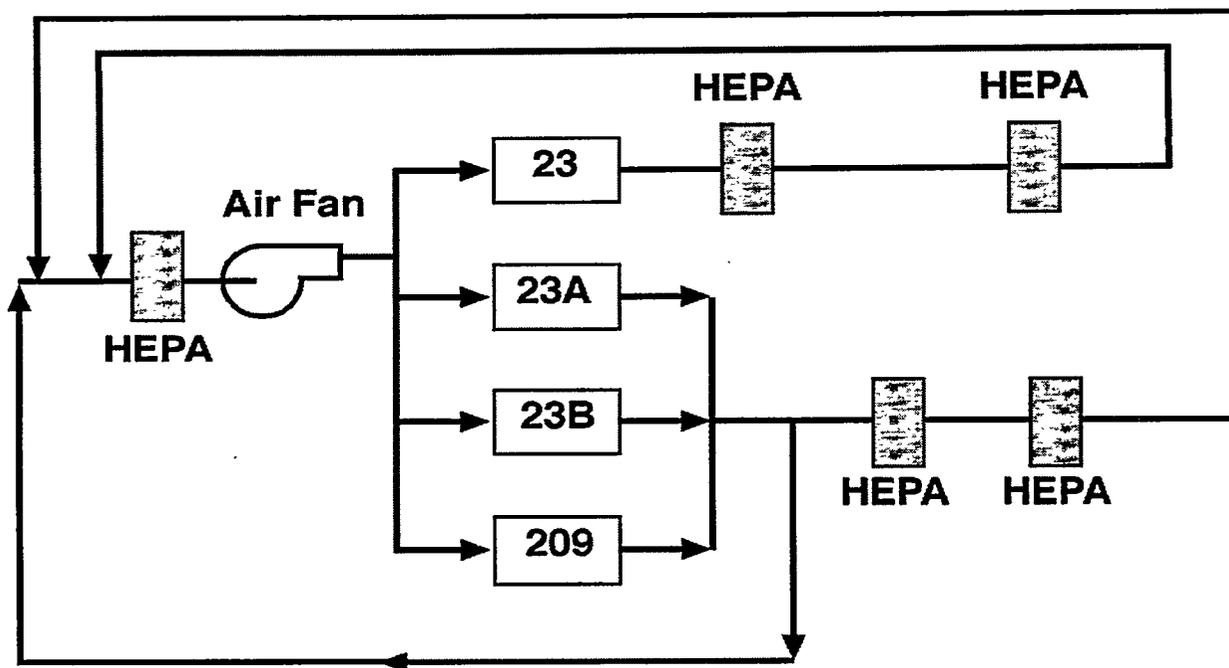
The main exhaust and supply fans are interlocked in pairs such that no exhaust fan can shut down without shutting down the corresponding supply fan. In the event the normal power supply is lost, standby power is automatically provided for two of the main exhaust/supply fan pairs. The exhaust fans serving the south wing office area of the first floor and rooms 209, 23, 23A, and 23B are interlocked to shut down if building pressure becomes insufficiently negative (with respect to atmosphere). The return air fan and supply fan for the laboratories in the northwest area of the first floor (and one in the basement) are interlocked to shut down the supply fan if the return fan does not operate. Finally, the supply fan for Room 203 is interlocked such that it will not run if neither main exhaust fan is operating:



(a) A-wing hot cells have in-cell, nontestable HEPA filters that are changeable with manipulators. B-wing hot cells do not have in-cell filters.

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Figure 2.5 Schematic of the General Vent System for RPL



Rm 23-209 Schematic

980800087.14

Figure 2.6 Ventilation Schematic for Room 23-209 System

Vents

Most of the air vents in the RPL can be considered part of the ventilation exhaust system and are discussed as such. The remaining vents, including the elevator shaft vent and the sewer system vents are not considered part of ventilation. Upset releases of regulated material are unlikely to be released through these vents because they are generally at a less negative pressure than the surrounding parts of the building.

Normal building leak paths may also act as vents. At average wind speeds, the normal air balance and pressure gradient ensure that all flow exits by the final exhaust plenum and stack, even if doors or the truck lock or smaller leak paths are open. The building pressure is maintained at between 0.05 and 0.08 in. water negative (or 12 to 20 Pa negative) with respect to the atmospheric pressure measured on the roof. This same range of lower-than-roof pressure may be found on the sides of a flat-roofed building at wind speeds of 20 mph or greater. Thus, flow might leave the building through normal leak paths on the sides of the building that are parallel to a high wind. Such hypothetical situations may occur during normal operations, but could only produce releases if an upset release occurred. Only a small part of the air flow in the building could escape in this manner.

2.4.2 Liquid Effluent Pathways

Liquid effluents are discharged from the RPL via two primary liquid waste systems: SNS and RPS. These systems come under WMHC and DynCorp control just after exit from the building. Table 2.2 summarizes the characteristics of these systems, and Figures 2.4 and 2.5 show the general layout of liquid effluent systems in the 300 Area.

Rainwater from the building roof and runoff from the loading dock drain to the soil at various locations around the building. No radioactive or chemical contamination is present on external building surfaces.

Table 2.2 Liquid Effluent Discharge Lines

Liquid Discharge System	Pipe Size	Building Exit Point
Sanitary sewer	8-in. dia.	East Service Tunnel
Retention Process Sewer	8-in. dia.	East Service Tunnel

Sanitary Sewer

The SNS receives effluent from only the restrooms, lunchroom, change rooms, some cooling processes, and other water uses in which no contamination is believed to be possible. Under normal operating conditions, no regulated materials are present in the SNS effluent. The sanitary waste is discharged into the 300 Area SNS system, operated by DynCorp under contract with DOE. The 300 Area SNS is discharged to the City of Richland wastewater handling system.

Retention Process Sewer

The RPS receives waste liquids, such as equipment cooling water, laboratory waste liquids, and floor drain liquids, that are normally free of radioactive contamination, but have a potential for such contamination in the event of a failure of an engineered barrier or administrative procedure. Floor drains are nonexistent or blocked in laboratories, and most hood drains are blocked. The RPS is a system of pipes to which all of the labs in the RPL are connected that routes waste to the 307 Basins and ultimately to TEDF. The RPS is monitored and equipped with alarms to alert TEDF of unusually high concentrations of radioactivity.

The monitor consists of a lead-shielded, gamma-radioactivity counting instrument which alarms if radioactivity in the waste exceeds a preset level. The monitor is operated and maintained by WMHC. After passing the monitor, the RPL liquid wastes are subsequently discharged to the 307 basins operated by WMHC at the 340 Complex. If the monitor alarms, the stream is to be diverted to a dedicated basin at

the 340 Complex, if not, the effluent is then screened at the 307 basins for alpha radioactivity before being discharged to the 300 Area process sewer (PS) system. A liquid effluent sampling for the RPL RPS system is in place and maintained. The system is sampled by PNNL on an as needed basis.

Radioactive Liquid Waste System

The RLWS serves three liquid waste streams expected to be radioactive during normal operations. The sources for these streams are shown in Table 2.3. Wastes to this system go to a 3,000-gallon tank in the basement of the RPL. The tank contents will be transferred to a tanker for transportation to the 200 Area for disposal on an as-needed basis.

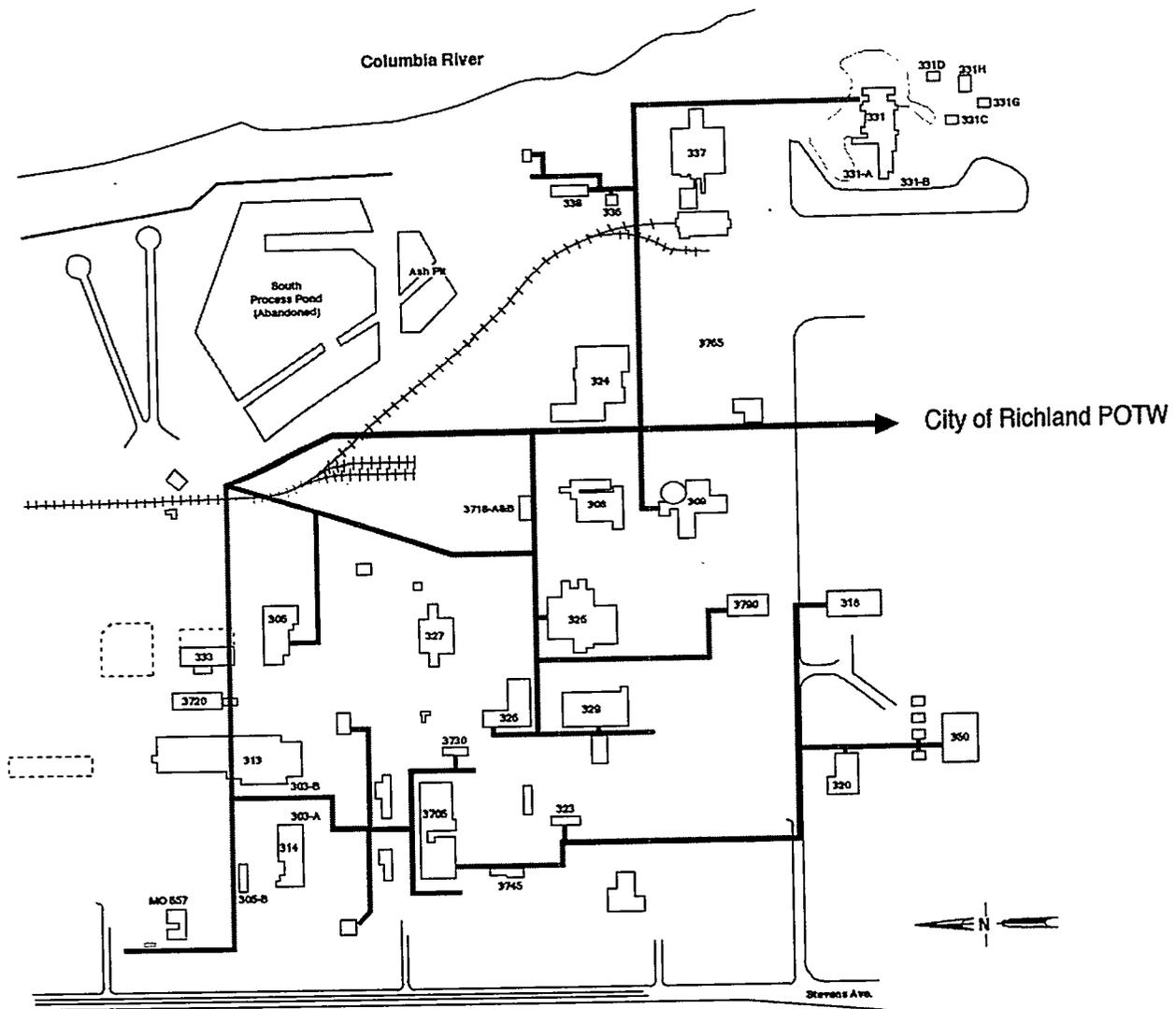
The first stream comes from one hood in Room 528 and from one floor drain (currently plugged) in Room 529. Prior approval is required to dispose of wastes via this stream. The second stream comes from the 325B hot cells and from two sinks in the 325B Addition. The third stream comes from the 325A Annex and Lab 603 including: cell drains, sink and floor drains, decontamination shower and sink, and process and tank cooling water.

Table 2.3 Sources for RLWS Waste Streams

Stream 1.	Lab 528 contains a sink drain in a hood for handling and disposing of radioactive liquid waste.
Stream 2.	The 325B analytical hot cells have a 330-gal holding tank where waste is held for less than 90 days.
Stream 3.	The 325A hot cells drain to waste holding tanks and Lab 603 containing three points of access: a sink drain in a hood, a drain from a liquid transfer hood, and a drain connected to the ultrasonic cleaner.

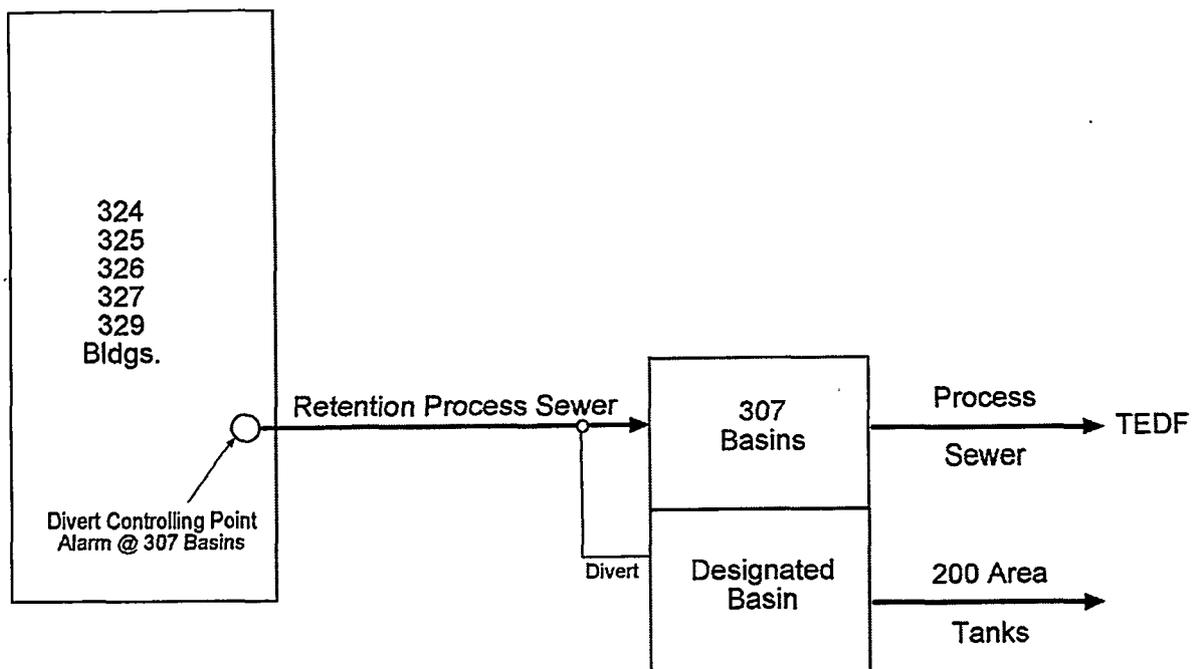
Administrative controls for each access point include appointing a cognizant space manager (CSM) who is trained in the requirements for disposal of radioactive and hazardous wastes. The CSM is to be responsible for the handling and disposition of material down the drain. PNNL has SBMS policy and procedures in place concerning disposal of material via the RLWS. All RLWS users must receive training on appropriate procedures and possess an approved RLWS disposal request before using the system.

References



980800087.23

Figure 2.7 Schematic of Sanitary Sewer



980800087.1

Figure 2.8 Schematic of RPS

2.5 References

Haggard, D.L., J.E. Tanner, and P.L. Tomeraasen. 1996. *Determination of the Radioactive Material and Plutonium Holdup in Ducts and Piping in the 325 Building*, PNNL-11288, Pacific Northwest National Laboratory, Richland, Washington.

PNNL 1998. *Safety Analysis Report for Radiochemical Processing Laboratory*. PNNL-SAR-RPL. Pacific Northwest National Laboratory, Richland, Washington.

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SBMS, Managing Nonradioactive Chemical Waste. 1998. *Managing Nonradioactive Chemical Waste*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/0f/0f00t010.htm>), Pacific Northwest National Laboratory, Richland, Washington.

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3.0 Rationale and Design Criteria for Monitoring

This section discusses design criteria for the measurement program for RPL airborne emissions and liquid effluents. Liquid effluent streams from the RPL are sent to one of the 300 Area liquid effluent systems (operated by WMHC and DynCorp for DOE-RL). Thus, the RPL does not have any direct liquid discharge to the environment and this section will focus primarily on airborne emissions. Criteria are established to ensure that effluents are measured according to applicable regulations and guidance and are appropriate for existing facility operations.

In this section, the terms "sampling" and "monitoring" are used to distinguish between two types of airborne-emissions measurement processes:

- "Sampling" refers to collecting a representative portion of the emission over a period of time, with subsequent analysis for constituents of interest. "Sampling" is an "after-the-fact" measurement.
- "Monitoring", on the other hand, is measuring radionuclide emission rates by means of a detector located in the sample stream. "Monitoring" is a "real-time" measurement.

Airborne emissions are sampled to demonstrate compliance with emission standards, to identify emission trends, and to provide evidence regarding the effectiveness of emission control systems (procedures and equipment). Emissions are monitored as a means to provide timely indication of a significant change in emission rate. Effluent sampling may also be performed to characterize waste streams or investigate discharges of concern.

Based on the current potential to emit for hazardous chemicals from the RPL no monitoring is required under the Hanford Site Air Operating Permit (AOP) (WDOE and WDOH 1999). Therefore the discussion in this section will focus on radiological air emissions.

Section 3.2 describes design and operation of the airborne-emission sampling/monitoring system at the RPL with specific reference to the criteria discussed in this section.

3.1 Basis for Design Criteria

The following regulations, DOE Orders, and guidance were considered for effluent sampling and monitoring system design and operation:

Regulations on Standards of Performance for New Stationary Sources, Appendix A: Reference Methods. Environmental Protection Agency, U.S. Code of Federal Regulations, 40 CFR 60. (EPA 1971)

National Emission Standards for Hazardous Air Pollutants. Environmental Protection Agency, U.S. Code of Federal Regulations, 40 CFR 61 (EPA 1990).

Hanford Site Air Operating Permit. Washington State Department of Ecology and Washington State Department of Health. HNF-AOP-97-1 (WDOE and WDOH 1999).

Radiation Protection - Air Emissions. Washington Department of Health. Washington Administrative Code, WAC 246-247 (WAC 1994).

General Environmental Protection Program. U.S. Department of Energy. DOE 5400.1 (DOE 1988).

Radiation Protection of the Public and the Environment. U.S. Department of Energy. DOE 5400.5 (DOE 1990).

General Design Criteria. U.S. Department of Energy. DOE 6430.1A (DOE 1987).

Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance. U.S. Department of Energy. DOE/EH-0173T (DOE 1991).

Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities. American National Standards Institute ANSI N13.1-1969 (ANSI 1969).

Specifications and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents. American National Standards Institute ANSI N42.18 1980b (ANSI 1980).

The following additional requirements for sampling/monitoring at the RPL are prescribed in PNNL operational and programmatic documents:

Standards-Based Management System A-Manual PNL-MA-8, Waste Management and Environmental Compliance. Pacific Northwest National Laboratory, Richland, Washington. (PNNL 1997)

Standards-Based Management System Subject Area Airborne Emissions. Pacific Northwest National Laboratory, Richland, Washington. (SBMS, Airborne Emissions)

Standards-Based Management System Subject Area Creating or Modifying Engineering Calculations, Drawings, and Specifications. Pacific Northwest National Laboratory, Richland, Washington. (SBMS, Creating or Modifying Engineering Calculations, Drawings, and Specifications)

Standards-Based Management System Subject Area Managing Liquid Effluents. Pacific Northwest National Laboratory, Richland, Washington. (SBMS, Managing Liquid Effluents)

Standards-Based Management System Subject Area Managing Nonradioactive Chemical Waste. Pacific Northwest National Laboratory, Richland, Washington. (SBMS, Managing Nonradioactive Chemical Waste)

Standards-Based Management System Subject Area Working With Chemicals. Pacific Northwest National Laboratory, Richland, Washington. (SBMS, Working With Chemicals)

3.2 Criteria for Radionuclide Emission Sampling

Airborne radionuclide emission points at PNNL are classified as either "major" or "minor." These two categories are defined as follows:

Major emission points are those where radionuclide emissions could cause an offsite emission dose (OED)^(a) of 0.1 mrem/year or more, if emission controls were not applied. Major emission points are sampled according to requirements in Subpart H of EPA (1990).

Minor emission points are those that potentially could release radionuclides, but not at the levels of a "major" point.

The RPL main stack is considered a "major" emission point according to the criteria above and continuous sampling for radiological air emissions is required. There are no minor emission points at the RPL; radionuclides are only emitted out of the main stack.

^(a) The annual OED is the maximum committed effective dose equivalent that could be expected to be received by an offsite individual from facility airborne radionuclide emissions if the facility were operated without any HEPA filtration or other emission controls. The method for calculating the OED consists of identifying the radionuclide inventory potentially available for release, multiplying this by a fractional release value, and multiplying this product times an emission dose factor calculated by the EPA Clean Air Act compliance code CAP-88 (Ballinger et al. 1995).

3.2.1 Sampling System Performance

Sampling at each major emission point should be capable of detecting an annual radionuclide release quantity resulting in an OED of 0.01 mrem/year (DOE 1991).

All radionuclides anticipated to contribute greater than 10% of the potential to emit (PTE) from the sampled emission point shall be accounted for, either by direct analysis or by inference from an indicator measurement (EPA 1990).

Biases in emission measurements, arising from the sample collection and analysis process, shall be minimized through the judicious application of design and operation practices according to American National Standards Institute (ANSI) (1969) and DOE (1991).

3.2.2 Sampling System Design Criteria

Samplers shall be located according to criteria in EPA (1971) Method 1, in Appendix A. Method 1 states that

Sampling or velocity measurements are to be performed at a site located at least eight stack or duct diameters downstream and two diameters upstream from any flow disturbance such as a bend, expansion, or contraction in the stack, or from a visible flame.

However, the method also states that,

. . . if necessary, an alternative location may be selected, at a position at least two stack or duct diameters downstream and 0.5 diameters upstream from any flow disturbance.

Representative samples shall be withdrawn on a continuous basis at the sampling site following the guidance in ANSI (1969), Appendix A, Section A3.2, which recommends a minimum of six extraction points for the RPL stack (EP-325-01-S). Furthermore, ANSI (1969) recommends that each withdrawal point within a cylindrical stack be centered in an annular area of size equal to the cross sectional area divided by the number of probes. Withdrawal points may be on a single traverse or spaced to obtain samples from the total cross section. Additional design criteria for particulate and gaseous radionuclides are specified by ANSI (1969) and DOE (1991).

3.2.3 Sampling System Operation

Sampling system operating criteria are based on regulations and guidance documents listed in Section 3.1.

Sampling shall be performed to quantify emissions over a calendar year. Sample collection frequency shall be based on the need for unbiased samples while maximizing sensitivity and minimizing analytical costs. The period of sample collection, thus, should be as long as possible considering the half-life of the radionuclide, the capacity of the collection media, and the need for timely return of sampling data.

Laboratory analysis of samples shall be according to procedures required by Appendix B, Method 114 "Test Methods for Measuring Radionuclide Emissions from Stationary Sources" in EPA (1990). Analyses should be conducted by radioanalytical laboratories according to prescribed statements of work. Work statements specify analytical performance requirements, including minimum detectable activity (MDA), turnaround time, reporting requirements, quality control (QC) requirements, and sample handling.

Sampling program criteria in Section 3.2.1 specify an emission detection level of 0.01-mrem/year OED. The analytical MDA required to meet this criterion depends on a combination of factors, including sample size, stack flow rate, collection period, radionuclide half-life, and radionuclide emission dose factor. These factors shall be considered in sampling operations to ensure the required detection level is achieved.

When gross-activity measurements are used for assessing offsite dose, dose factors for the most restrictive radionuclide potentially contributing 10% or more to the annual emission dose shall be applied.^(a)

Radionuclide specific analyses shall include those radionuclides potentially contributing 10% of the PTE for the building.

Exhaust-stream flow rates at sampling locations shall be measured using EPA Method 2 (EPA 1971). (Beginning calendar year 1994, access to the vertical stack permitted the use of this method to measure flow in the RPL stack.) Flow rates should be measured on a periodic basis, as well as following modifications to the exhaust system that could be expected to cause the average exhaust rate to differ by $\pm 10\%$ from the previously measured rate.

Air-emission samplers should be designed to maximize the sensitivity of the sample, considering the capacity of the collection media, radioactive decay, and sample analysis costs.

Isokinetic sampling is required where particulate emissions are expected.^(b)

Under most operating conditions, isokinetic sampling shall be adequately accomplished by operating the sampler so that 1) sample probes are aligned axially with the stack and point into the direction of stack flow, and 2) sample nozzle inlet velocity is maintained within a factor of two of the mean stack exhaust velocity at the sample location.^(c)

At the "major" emission points, the sampler shall be operated continuously, except during planned sampler maintenance or testing outages. When continuous sampling is required, the loss of sampling capability shall be limited to 24 h/month. If this limit is exceeded, special interim sampling is provided, or pertinent facility operations shall be shut down.

3.3 Criteria for Radionuclide Emission Monitoring

3.3.1 General

Continuous emission monitoring is required for any emission system where

- a potential of greater than once per year exists for exceeding 20% of the OED standard of 10 mrem/year (credit may be taken for emission control equipment such as HEPA filters) per DOE (1991).
- continuous emission monitoring is specified by a safety analysis report (SAR) or operational safety requirement (OSR).

^(a) Before 1993, laboratory analysis of particulate emission samples consisted of total activity (total alpha, total beta) measurements. Total activity measurements were performed because emissions were historically very low, potentially significant constituents of the emission stream were known, and the gross activity measurement was nondestructive; radionuclide-specific measurement could be performed on the sample if gross activity measurements showed a potentially significant release quantity. Since 1993, airborne particulate samples have been analyzed for several specific radionuclides in addition to the gross activity measurements.

^(b) Emissions from the RPL stack are filtered using HEPA filters before discharge. Unless failure of a HEPA filter system occurs (an unlikely event), particle emissions are expected to be relatively small. Based on criteria in ANSI (1969), isokinetic sampling for systems emitting particles less than 5- μm aerodynamic diameter is not necessary. DOE (1991) recommends isokinetic sampling when particles are greater than 0.5- μm aerodynamic median diameter.

^(c) From Table C1 in ANSI (1969), a sampler operating at an inlet velocity of within a factor of two of the stack velocity will have a particle interception bias of 14% for a 4- μm aerodynamic equivalent diameter (AED) particulate emission.

3.3.2 Monitor Objectives

Continuous emission monitoring of building airborne radionuclide emissions shall detect significant increases in the stack emission rate. Rapid detection of such an increase may assist operational response actions.^(a)

The monitoring program should effectively provide notification of any transient or abnormal condition lasting more than 4 hours that would result in emissions of radioactive material in excess of applicable standards or license agreements if allowed to persist (WAC 1994). The emission monitor should be able to detect a sudden release that could (assuming 95th percentile atmospheric dispersion under 2-h meteorological conditions) result in an OED of 2 mrem/year (i.e., 20% of the emission standard) (DOE 1991). Notifications will be made in accordance with the requirements of the AOP (WDOE and WDOH 1999)

3.3.3 Monitor Design

General criteria for design of monitoring systems are provided in DOE (1991).

3.3.4 Monitor Operation

Monitors are operated continuously, except

- when the monitored exhaust system is not operating, if approved by the building manager and Effluent Management (EM)
- during planned maintenance or testing of the monitoring system if scheduled through the building manager.

During periods when the exhaust system is operating and sampling is required, loss of monitoring capability is not to exceed 4 hours at a time. If monitor outage exceeds this time, EM will specify requirements for interim sampling of emissions or shut down of pertinent operations.

Continuous stack monitors must provide easily discernible alarms to responsible personnel in continuously or frequently occupied areas. A frequently occupied area is one that is occupied at least once every 4 clock hours.

Flow rates through monitors should, in combination with other operating parameters, be sufficient to enable the monitor to detect an emission meeting the above dose criteria.

3.4 Historical Monitoring/Sampling Data for Effluent Streams

The RPL was built in 1953 as a general purpose nuclear research and development laboratory. Some of the effluent streams from the building have been sampled and monitored over the history of operations. Information from historical sampling and monitoring is provided in this section to aid in providing a basis for future monitoring needs. A description of historic sampling and monitoring data under normal operating conditions for air and liquid effluent streams is given in Section 3.4.1. Estimates of the types of releases and release pathways experienced during plant operations under upset conditions are given in Section 3.4.2.

3.4.1 Normal Conditions

Sampling and monitoring of some of the air and liquid effluent streams has occurred since the RPL started operations. The types and locations of sampling and monitoring and analytical methods under normal operations are described in this section. Discussion is generally limited to the past 10 years (1987 to 1997) because this time period is the most relevant to future operations and monitoring needs. In 1987, control of the RPL was transferred from Westinghouse Hanford Company (WHC) to PNNL.

^(a) The RPL stack-monitoring system is not used to activate engineered control systems, is not relied on as a primary means for detecting an abnormal operating situation, and is not used to continuously monitor radionuclide release rates during normal facility operations.

3.4.1.1 Air Effluent Monitoring/Sampling

Effluent air from the RPL main exhaust has been sampled and monitored downstream of the final HEPA filters for radioactive particles, ¹³¹I, and tritium. Tritium has been sampled at the RPL since 1990. Sampling for ¹³¹I was performed from 1987 until 1992. Monitoring and sampling for particulate gross alpha and beta has been provided by continuous air monitors and a record sampler for many years. In 1993 PNNL began compositing the record particulate samples on a quarterly basis and analyzing them for various radionuclides including isotopes of americium, antimony, cesium, europium, plutonium, and strontium. Compositing was changed to semi-annual in 1996. The specific list of isotopes for which analyses are performed is evaluated annually.

The sampling and monitoring system was upgraded at the end of 1993 to meet the National Emission Standards for Hazardous Air Pollutants (NESHAP) (EPA 1990) requirements for continuous sampling. A multiple nozzle sampling array in the RPL stack was used for sampling before 1993, but little information was available on the actual configuration or design of the system. The new system is well documented and is described in Section 3.5. The sample collection system before the upgrades did not provide for an isokinetic sample, but the current sampler does. Under normal operating conditions, the size distribution of particulate emissions is fairly small, and biases due to anisokinesis and line loss were probably small for the sample system in place before 1993.

Monitoring continues to be performed by passing a continuous stream of stack gas through continuous air monitors that detect particulate alpha and beta activity and tritium. Samples also continue to be collected by passing stack air through a particulate filter for gross alpha and beta, and silica gel for tritiated water vapor.

Current analyses are done as described in Section 4.0. The MDL under the present analysis methods varies from sample to sample because it is sensitive to changes in background (which is highly variable) and counting time. Estimated emissions calculated from the sampling data from 1988 to 1993 and from 1994 to 1997 are shown in Tables 3.1 and 3.2 respectively.

Table 3.1. RPL Stack Sampling Data 1988-1993

Year	Total Alpha (Ci)	Total Beta (Ci)	¹³¹ I (Ci)	Tritium (Ci)	
				HT	HTO
1988	7.6E-6	2.5E-4	<9.9E-5	Not Sampled	Not Sampled
1989	1.1E-6	1.6E-4	<6.4E-5	Not Sampled	Not Sampled
1990	1.6E-6	4.1E-5	<6.6E-5	Not Sampled	Not Sampled
1991	1.6E-6	9.9E-5	Not Sampled	2.9E+1	5.4E+1
1992	8.5E-7	2.4E-6	Not Sampled	7.0E+0	2.5E+1
1993	1.2E-6	8.4E-6	Not Sampled	8.5E+0	8.5E+0

Some values in Table 3.1 are reported as less-than (<) values because samples collected for analysis on a weekly basis often contained levels of contaminant lower than the detection limit. Each of the weekly measurements were summed, including those assigned with a value of less than detection limit, to obtain the total for the year.

The sampling system is described in Section 3.5. Using this system, the values given in Table 3.1 have some degree of uncertainty. However, these data show that releases of contaminant from the stack can be measured. A longer collection period (2-week samples) was installed in 1991 to provide samples with higher contaminant concentrations, allowing better resolution of the data.

Table 3.2. RPL Annual Release Quantities 1994-1997 (Ci)

Nuclide	1994	1995	1996	1997
⁶⁰ Co	ND ⁽¹⁾	ND	NA ⁽²⁾	NA
⁶⁵ Zn	6.1E-7	NA	NA	NA
⁹⁰ Sr	ND	ND	2.4E-7	3.3E-8
⁹⁵ Zr	ND	NA	NA	NA
¹⁰⁶ Ru	2.4E-6	NA	NA	NA
¹²⁵ Sb	ND	NA	NA	NA
¹³⁴ Cs	ND	ND	NA	NA
¹³⁷ Cs	ND	ND	NA	4.4E-8
¹⁵⁴ Eu	ND	ND	NA	NA
¹⁵⁵ Eu	ND	ND	NA	NA
²⁴¹ Am	NA	1.2E-9	2.9E-8	4.6E-9
²³⁸ Pu	ND	ND	ND	ND
^{239/240} Pu	ND	3.6E-10	8.3E-9	ND
²⁴¹ Pu	NA	NA	NA	ND
Unspec. Alpha	2.3E-7	1.5E-7	NA	3.1E-8
Unspec. Beta	NA	NA	6.5E-7	7.3E-8
HT	2.3E+0	5.1E-1	1.4E+0	2.0E+1
HTO	1.4E+0	2.6E+0	1.6E+0	1.3E+0
⁽¹⁾ ND - Not Detected				
⁽²⁾ NA - Not Analyzed				

3.4.1.2 Liquid Effluent Monitoring

Liquid waste streams in the RPL have been served by three systems as described in Section 2.4.2. Table 3.3 lists the three systems and summarizes the type of historical monitoring/sampling each system has had. As noted in Table 3.3, no monitoring of the SNS or RPS occurred before 1994. The RPS was included in a characterization effort from March 1994 until September 1995 in support of the 300 Area Treated Effluent Disposal Facility startup (Thompson et al. 1997). As noted in the table, historically, 300 Area sanitary liquid waste was sampled at the SNS system just before the waste entered the SNS septic tanks. Before 1997, sanitary wastes were discharged to a 300 Area septic tank/trench system. In 1997 the 300 Area SNS was connected to the City of Richland POTW. A brief description of the sampling and analysis program before connection to the City of Richland POTW is given in the *Westinghouse Hanford Company Effluent Report for 300, 400, and 1100 Area Operations* (McCarthy 1990). Because this sampling program sampled combined effluent from all 300 Area facilities and not just from the RPL, its historical data are not reported here.

The RPS is routed to a diversion station in the RPL basement equipped with a radioactivity monitor that measures gamma activity. Prior to 1998 it automatically operated a three-way valve that diverted flow to the RLWS and the 340 Complex if radioactivity above of $5 \times 10^{-5} \mu\text{Ci/mL}$ of ¹³⁷Cs equivalent gamma activity was detected in the waste stream. Diverter alarms were annunciated in various locations in the RPL when diversions occurred and samples were taken automatically however, data from the monitor was not recorded. In 1998 the RLWS was modified in the RPL to alarm in the 340 Complex to allow for diversion of the 300 Area RPS to a dedicated basin in the 340 Complex, see section 2.4.2. This modification removed diverter control of the three-way valve.

Normally, the RPL RPS passes through the diverter stations and into several large basins (307 basins) at the 340 Complex (see Section 2.4.2). The RPS is monitored again before being discharged from the basins into the 300 Area PS lines. Before 1995, samples of the composite liquid waste from all the 300 Area PS lines were taken before the liquid was discharged to the 300 Area process trenches. A description of the sampling and analysis program is provided by McCarthy (1990). Sampling data from

this program were obtained from combined effluent from all 300 Area facilities with PS service and thus, are not specific to RPL and are not included in this report. In 1995 a treatment facility, the Treated Effluent Disposal Facility (TEDF), was constructed and brought into operation.

The RLWS serves liquid waste streams expected to contain radioactive liquids. This system is currently composed of pipes and holding tanks within the RPL. Waste from the pipes or holding tanks drain to a main collection tank in the RPL basement and are then pumped to a tanker truck for transfer to the 200 Area tank farms. The RLWS waste in holding tanks is sampled at the RPL before transfer to the tanker truck. However, one portion of the RLWS that includes a hood and floor drain (now plugged) in the central portion of the RPL is not connected to a holding tank. Waste through this portion flows directly through RLWS lines to the 3,000-gallon holding tank in the basement of the RPL.

Table 3.3. Summary of Historical Liquid Monitoring/Sampling

System	Notes
SNS	No sampling or monitoring at RPL. Sampled as composite with other 300 Area SNS before 1997 and sampled as required by contract with City of Richland POTW after 1997 hook-up.
RPS	Monitored at diverter station in RPL; grab samples taken in 1989; sampled as composite with other 300 Area PS, characterization study performed 1994-1995 (Thompson et al 1997).
RLWS	Sampled at RPL prior to transfer and as needed

In the past, the RLWS was connected to piping leading to tanks at the 340 Complex. The water in the RLWS holding tanks at the 340 Complex was sampled before being transferred to the 200 Area by rail car. Because the RLWS stream was not released to the environment, the sampling program is not pertinent to the FEMP.

Historical sampling of nonradioactive constituents in the RPL liquid effluent included grab samples in 1989 and a series of field tests in 1994 to 1995. One location along the 300 Area PS line where contributions from both the RPL and the 3714 Building were received was sampled three times in May and June of 1989 (WHC 1989). The data were insufficient to provide a reasonable representation of effluent releases in this stream.

As part of support efforts for the start-up of TEDF, a study was performed on the physical, chemical, and radiological makeup of the waste streams in the PS and RPS. The study of PNNL facilities (Thompson et al. 1997) was performed from March 1994 until September 1995. This study covered the 306, 320, 324, RPL, 326, 327, 331, and 3720 Buildings as well as covering some background and influent locations. The average results of the constituents analyzed for RPL are provided in Table 3.4. Details regarding number of samples, range, standard deviation, and other data quality discussions can be found in Thompson et al. (1997). Results showed that concentrations of pollutants in the RPL RPS were low (parts per billion) and met TEDF Waste Acceptance Criteria. However, only a limited number of samples were taken and a decision was made to discontinue routine sampling and to maintain the liquid effluent sampling and monitoring systems for periodic sampling as needed.

Table 3.4. Average Results from RPS Characterization for RPL 1994-1995

From Thompson et al. (1997)

General Chemical Parameter (µg/L)			
Alkalinity	43,400	Total Carbon	22,250
Chemical Oxygen Demand	42,333	Total Dissolved Solids	82,000
Conductivity	155 (µmhos/sm)	Total Organic Carbon	4,850
pH	7.55 (pH units)		
Ammonia and Anions (µg/L)			
Ammonia	70	Nitrate	28,983
Chloride	3,937	Nitrite	300
Cyanide	2.0	Sulfate	15,383
Fluoride	432		
Metals (µg/L)			
Aluminum	78	Potassium	946
Barium	25	Selenium	1.02
Calcium	17,800	Silicon	2,650
Chromium	5.6	Sodium	3,473
Copper	17.2	Strontium	98
Iron	186	Thallium	1.00
Lead	3.8	Tin	33
Magnesium	4,220	Vanadium	2.6
Manganese	5.1	Zinc	72
Mercury	1.167		
Volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene	1.1	Ethanol	6.1
Acetone	45.07	Hexone	18.4
Chloroform	9.6		
Semi-volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene	1.1	Phenol	2.6
Bis(2-ethylhexyl)phthalate	15	Tributyl Phosphate	0.84
Radiological Parameters (pCi/L)			
Gross Alpha	4.922	Tritium	318

3.4.2 Upset Conditions

The nature of upset conditions categorized as belonging in the Environmental Group (SBMS, Event Reporting) that have occurred during the operating history of the RPL are shown in Table 3.5. The table summarizes the events noted as unusual occurrences that have taken place since October 1, 1990.

Other upset conditions have occurred that were not reportable. No formal records exist to summarize these incidents, which include punctures or tears of glovebox gloves, spills or drops of radioactive or toxic materials, loss of normal electrical power, and hot-cell fire. Airborne materials released from these events were transported out the normal ventilation pathways to the stack. Stack monitoring and sampling is described in Section 3.5. Upsets involving liquid effluents were discharged to the appropriate liquid effluent system.

The types of events shown in Table 3.5 could be expected to occur during future operations. However, it is important to note, none of these events resulted in a release to the environment as indicated in the table.

Table 3.5. Unusual Occurrences in the RPL

Categorization of Event	
Environmental, Radionuclide Release (2A)	Radioactive contamination discovered in lab sink that connects to RPS.
Environmental, Agreement/Compliance Activities (2E)	Exceeded part "A" permit for waste treatment.
Facility Condition, Safety Status Degradation (1C)	HEPA filter failure during efficiency testing.
Facility Condition, Violation Inadequate Procedures (1F)	Waste discharged to RLWS that violated waste acceptance criteria at 340 Building. Procedure to check pH before disposal not followed. Violation of 90-day storage requirements applicable to dangerous waste.
Facility Condition, Operations (1H)	Building exhaust stack CAM alarmed; new replacement CAM did not show elevated readings.
Cross Category Item, Potential Concerns/Issues (10C)	WA dangerous waste violation associated with treatment of listed waste without a permit.
Cancelled (NA)	Divert of liquid effluent from the RPS to the RLWS.

3.5 Radionuclide Air Sampling/Monitoring System Description

Airborne radionuclide emissions are sampled and monitored at the RPL facility stack (EP-325-01-S), the only building exhaust point that could potentially contain radionuclides under normal operating conditions.

The building stack, located on the northwest side of the RPL, discharges ventilation exhaust from hot cells, maintenance shops, and canyon areas in the building at an average exhaust rate of 139,000 cfm^(a). Because the stack flow is primarily building ventilation air, stack-gas specific gravity, humidity, and temperature are typical of the ventilation exhaust from an occupied building.

The types and quantities of radionuclides potentially present in the ventilation exhaust from the RPL must be understood to develop a program for measuring stack emissions. An index of emission potential is used by PNNL so that the relative significance of different radionuclides and different emission points can be compared. The index, expressed in terms of a projected potential dose equivalent to a maximum offsite receptor, is based on emission assessment methods in EPA (1971). It is assumed that no engineered emission controls (e.g., HEPA filters) are provided in the ventilation system, and that without such controls, the potential for radionuclide emissions is related to the quantity and physical form of radioactive material in the facility. This assessment method is described in Ballinger et al. (1995).

Radionuclides of primary importance in the RPL from an emission-sampling standpoint are determined on an annual basis, using the above methods. For example, based on the 1998 assessment of radionuclides inventory, radionuclides potentially contributing $\geq 10\%$ of the PTE are ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Pu . Radionuclide inventories vary from year to year; therefore the nuclides of interest, those contributing $\geq 10\%$ of the total projected potential dose, are updated annually to account for these variations.

Continuous emission sampling for particulate radionuclides and tritium are performed using the isokinetic sampling system (ESP-325-01-S), which is compliant with NESHAP requirements in EPA (1990). Table 3.6 summarizes the types of emissions measurements performed by this system. A schematic diagram is provided in Figure 3.1. Detailed descriptions are provided below.

^(a) Based on average of total stack flow reported in annual emission reports from 1991 through 1997.

The radionuclide sampling system (ESP-325-01-S) was installed on the main building stack in late 1993. The system, which began operating in January 1994, complies with the sampler design criteria in Section 3.2.

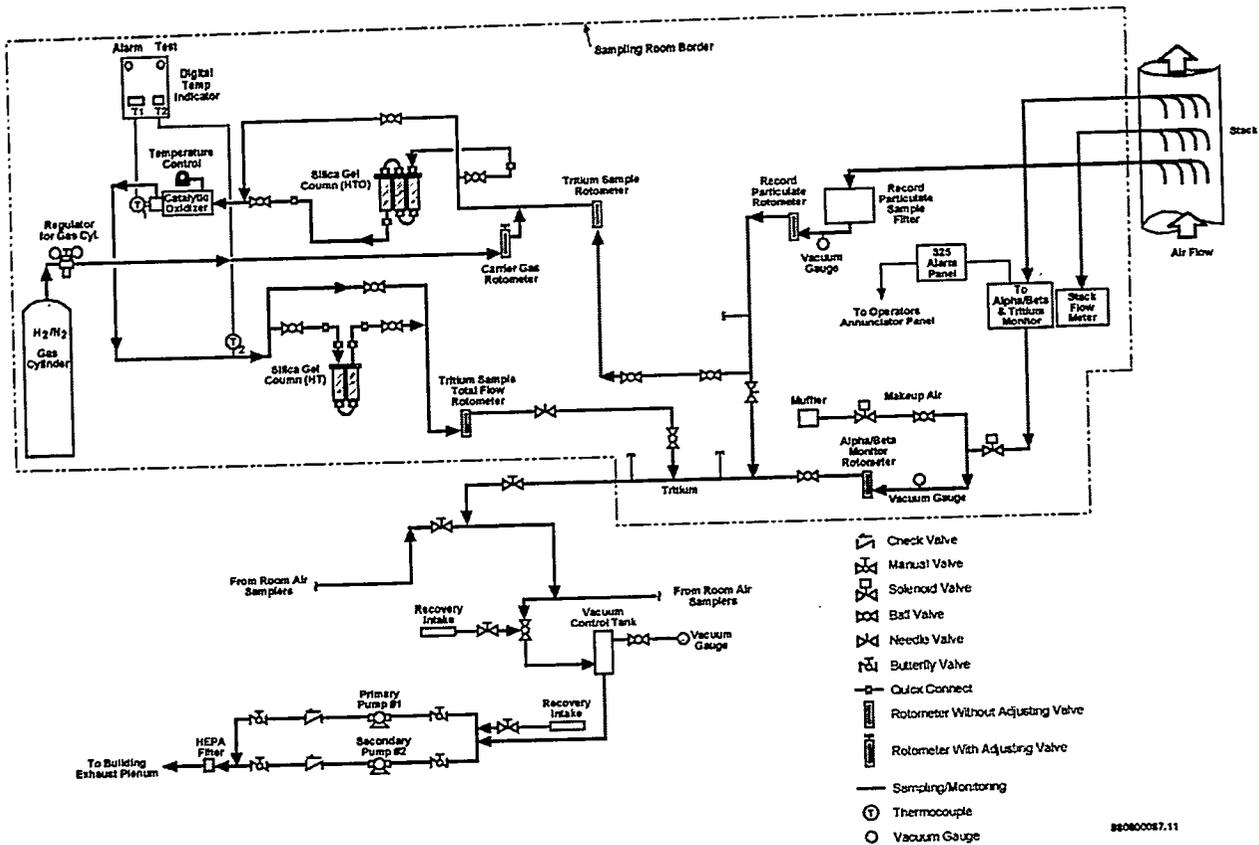


Figure 3.1. Schematic of RPL Main Stack Sampling System

Table 3.6. Airborne Emission Measurements - RPL

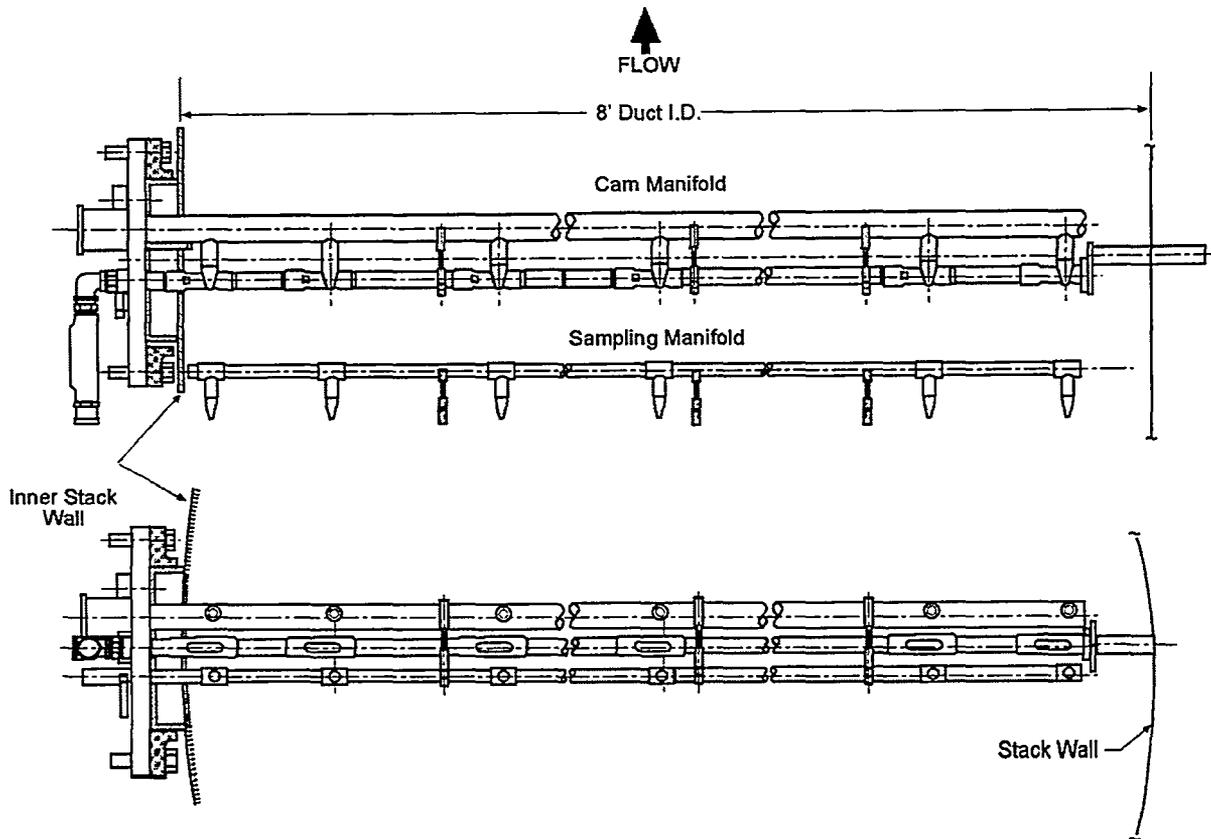
Continuous Sampling	Continuous Monitoring
Particulate Radioactivity	Particulate Alpha Activity
Tritium (HT and HTO)	Particulate Beta Activity
	Tritium Activity

The airborne radionuclide sampling system incorporates two co-located, six-nozzle, isokinetic sampling probe assemblies, Figure 3.2, positioned in the approximately 90-ft-high^(a) stack (Figure 3.3). The probes are 7 equivalent diameters downstream of the stack entrance and 1 equivalent diameter upstream of the stack exit. Structural difficulties precluded meeting the 8:2 (downstream: upstream) duct-diameter placement recommendation from ANSI (1969). However, this design does comply with the alternative 2:0.5 criteria. The duct enters the stack at approximately the 420-ft level. Table 3.7 shows a comparison of the physical configurations of the probes. The sampling probe is used to sample for the record particulate sampler and tritium sampling system, while the monitoring probe is used for the continuous alpha/beta and tritium stack monitors. Probe nozzles for both probes are located at the centers of equal annular areas according to requirements in ANSI (1969).

^(a) Height from ground. Stack height was increased as part of the sampling system upgrade in late 1993.

Table 3.7. RPL Stack Probe Comparison

	Sampling	Monitoring
Nozzles	6	6
Nozzle Size	0.187"	0.494"
Header Size	1.25" (OD)	3" (OD)
Header Flow	3.1 scfm	21.2 scfm



980800087.9

Figure 3.2. RPL Main Stack Sampling Probes

Near-isokinetic sampling conditions are maintained by adjusting the flow rate through both the sampler and the monitor so that the average airflow velocity of air entering the sampling nozzles corresponds to the average velocity of air in the stack at the nozzle locations. Stack emission samples are withdrawn from the stack and through the systems by means of the building vacuum air sampling (VAS) system. Withdrawal rates are controlled by valves located downstream of the sampling and monitoring systems. Flows are measured by rotameters upstream of the control valves. Stack velocities are measured on a quarterly frequency using EPA Method 2 (EPA 1971).

Both sample transport lines extend from the probe assembly to Room 916 where the sampling and monitoring equipment is located. The transport lines are of stainless steel tubing and are heat traced, thermally insulated, and electrically grounded.

Transport efficiency of the collection systems has been calculated. The transport efficiency of the sampling system is greater than 93% for an assumed 1-micron activity median aerodynamic diameters (AMAD) aerosol at nominal sampler and stack flow rates and greater than 97% for the monitoring system.^(a)

3.5.1 Main Stack Particulate Emission Sampling System

Airborne particles are collected on a 47-mm-diameter membrane filter (Gellman Sciences Versapor V-3000TN). The V-3000TN has an estimated retention efficiency for 0.3-micron particles of greater than 91% at face velocities of 180 fpm.

The sample collection filter is replaced twice monthly. The sample filter is stored for a minimum of 7 days after being removed from the sampler to permit decay of radon and thoron daughter radionuclides. The filter is then analyzed for gross alpha and gross beta radioactivity.

Each sample is screened individually for gross alpha and gross beta activity, and then the samples that are collected over a 6-month period (semi-annual) and are combined and analyzed as a single sample for specific radionuclides as determined by the annual inventory assessment. Radioanalytical Application Team (RAT) staff in the RPL analyze the samples using methods described in Chapter 4.0. Sample analysis results are evaluated as described in Section 3.7.

3.5.2 Main Stack Continuous Tritium Emission Sampling System

Tritium as water vapor (HTO) and tritium gas (HT and TT) is sampled continuously using a two-stage sampling system. The sub-sample flow rate to the tritium sampler is a nominal 200 mL/min.

The tritium sample stream is filtered by the record particulate sample collector that removes particles, and flow is measured using a rotameter. Initially, the sample stream is mixed with a nitrogen-hydrogen carrier gas (3% H₂ in N₂). It then enters the first tritium collection unit where silica gel is used to strip water vapor from the gas stream. On exit from the first stage, the now dry sample stream is heated to >180°C in the presence of a palladium catalyst to convert free hydrogen (HT and TT) to water vapor. The sample stream is then cooled to under 40°C and passed through the second silica gel collector to strip out the water vapor generated from the catalytic oxidation of free hydrogen.

The silica gel collection media are normally replaced with fresh media on a monthly basis; however, the exchange may be more frequent if premature collector loading occurs^(b). Following the sampling period, the collection columns are exchanged with new columns and the used columns are sent to an analytical laboratory to determine the tritium content. Tritium emission quantities for the collection period are calculated assuming complete retention of sample in the collection column and multiplying the quantity of tritium collected in the column by the ratio of the stack flow rate to the sampler flow rate

3.5.3 Continuous Particulate Emission Monitoring System

Stack air is continuously monitored for radioactivity associated with particulate matter by an EG&G-Berthold LB-150D alpha-beta-pseudocoincident monitor (Figures 3.4 and 3.5).

The monitor uses an 8-in. diameter glass-fiber filter to collect airborne particles from the stack. The filter is mounted against a sandwich arrangement of gas-flow proportional radiation detectors to count the alpha, beta, and gamma emissions as particles accumulate on the filter.

^(a) Loss calculations were performed using DEPO Version 4.0 (Riehl et al 1996). A 1-micron AMAD polydisperse aerosol was assumed for the calculations, based on the assumption that building operations and controls (HEPA filters) are "normal".

^(b) The collector unit is not allowed to exceed 2/3 of its maximum calculated capacity.

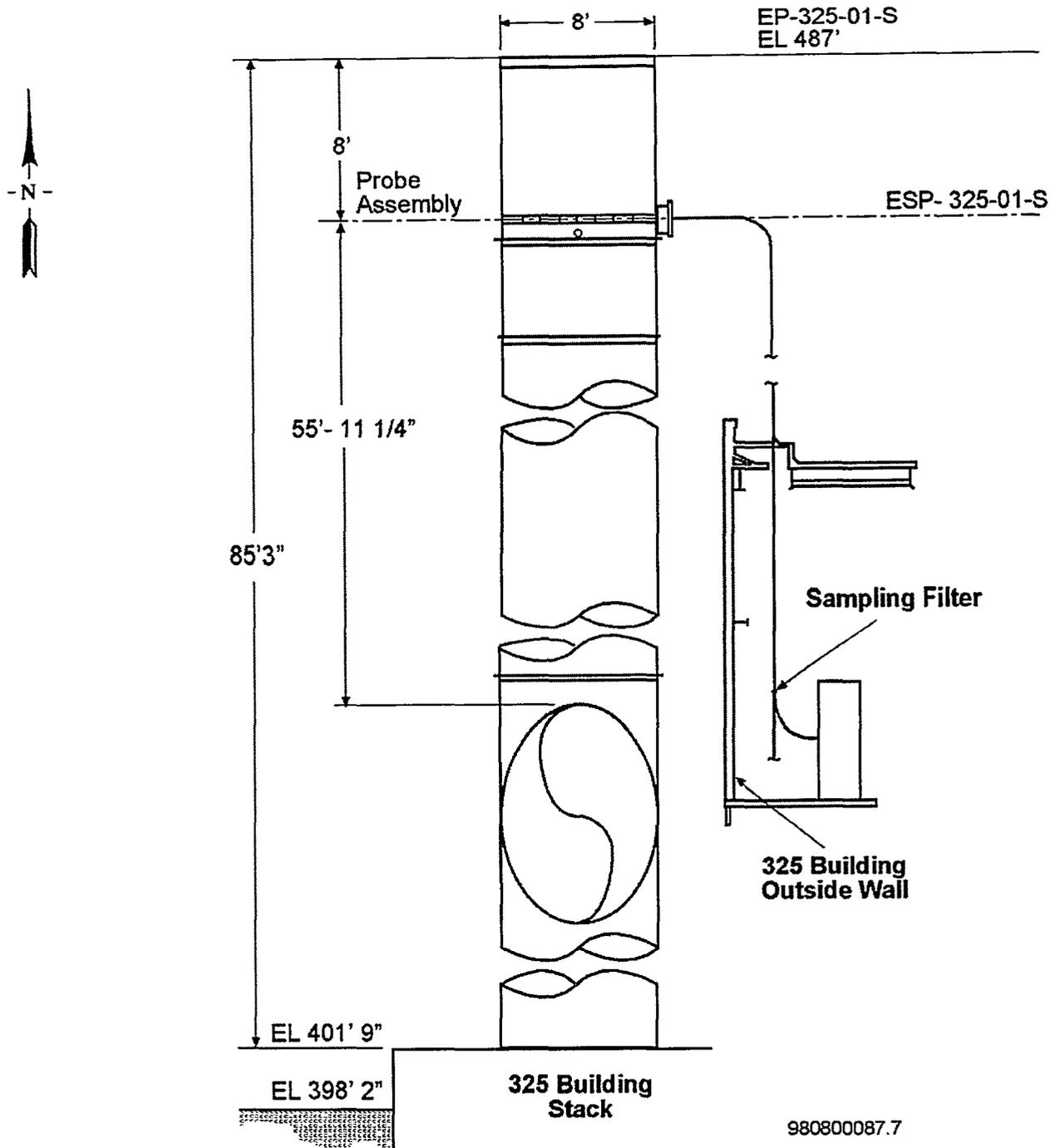


Figure 3.3. RPL Main Stack Sampling System Configuration

The monitoring system accounts for the presence of radioactive material associated with the decay products of naturally occurring radon isotopes by means of a timing gate to identify simultaneous alpha and beta emissions occurring on the filter. This method, referred to as the alpha-beta-pseudocoincidence-difference method (ABPD), uses the nearly simultaneous (pseudocoincident) alpha-

beta decay transitions in the ^{220}Rn and ^{222}Rn decay chains as a means of distinguishing naturally occurring radionuclides from artificial radionuclides deposited on the sample filter^(a).

Local and remote annunciators provide indications of high particulate radionuclide emissions as well as monitor component failures.

3.5.4 Continuous Tritium Monitoring System

Stack air is continuously monitored for tritium by an EG&G-Berthold LB-110 tritium detector and an LB520/1001 tritium analyzer (Figures 3.4 and 3.5). The LB-110 is a windowless, flow-through proportional detector with pulse rise-time discrimination. The discriminator divides individual ionization events into short rise-time events and long rise-time events. Short rise-time events are counted as tritium, while long rise-time events are currently calibrated to ^{85}Kr .

The data from the discriminator are fed to the LB520/1001 analyzer. The analyzer is used to allow for subtracting background, accumulating pulse events, and converting those events to concentration. The analyzer also provides the output for the video display, chart recorder, and printer.

P-10 gas is mixed with the sample stream in a 4:1 ratio and passed through the detector. The P-10 gas is used to maximize sensitivity and minimize interference from other decays.

Local and remote annunciators provide indications of high tritium emissions, monitor component failures, and sample and P-10 flow transients lasting more than 60 seconds.

3.6 Radionuclide Air Sampling and Monitoring System Performance

This section describes the performance capability of the stack sampling and monitoring systems in terms of the offsite dose potentially resulting from a release. The determination of minimum sampler capability and the evaluation of monitor alarm levels is based on a series of assumptions of worst-case-exposure scenarios, resulting in calculations of upper bound doses. Thus, the methods used here to evaluate system capability are not appropriate for assessing actual releases. A realistic assessment of the significance of a monitor reading can be made only by considering the actual operational and environmental conditions at the time of the release.

3.6.1 Stack Radionuclide Sampling System Performance

Performance criteria for sampling are provided in Section 3.2. Two of the criteria concern measurement sensitivity, and the third concerns measurement bias. The criteria for bias is based on conformance of the system to design and operational guidance in ANSI (1969) and DOE (1991). The system description information in Section 3.5 is consistent with the design and operational guidance; thus, the bias criterion is met.

Sensitivity criteria (Section 3.2) for sampling are stated in terms of detectable offsite dose. According to the criteria, compliance sampling shall include measurement of radionuclides that could contribute greater than 10% of the PTE for the release point. Per performance criteria in Section 3.2.1, radionuclides should be detectable at emission levels resulting in an annual, committed effective dose equivalent of 0.01 mrem/year. Typically, measured radionuclides may include ^{137}Cs , ^{90}Sr , ^{238}Pu , $^{239/240}\text{Pu}$, ^{241}Pu , ^{241}Am , ^{243}Am , and tritium depending on the RPL radionuclide inventory. Total alpha activity and total beta activity are also measured to screen for other radionuclides in the stack exhaust.

Annual release quantities associated with an effective dose equivalent of 0.01 mrem/year were calculated from dose factors calculated using the EPA compliance code CAP-88 (Ballinger et al. 1995). These values are shown in Table 3.8.

^(a) Three gas-flow proportional counters in a sandwich configuration independently count the number of alpha, beta, and gamma emissions on the sample collection filter. In addition, alpha and beta emissions that are detected pseudocoincidentally are also counted. The number of pseudocoincident events times a scaling factor is subtracted from the total alpha and beta counts to yield the net event detections attributed to sources other than radon isotopes.

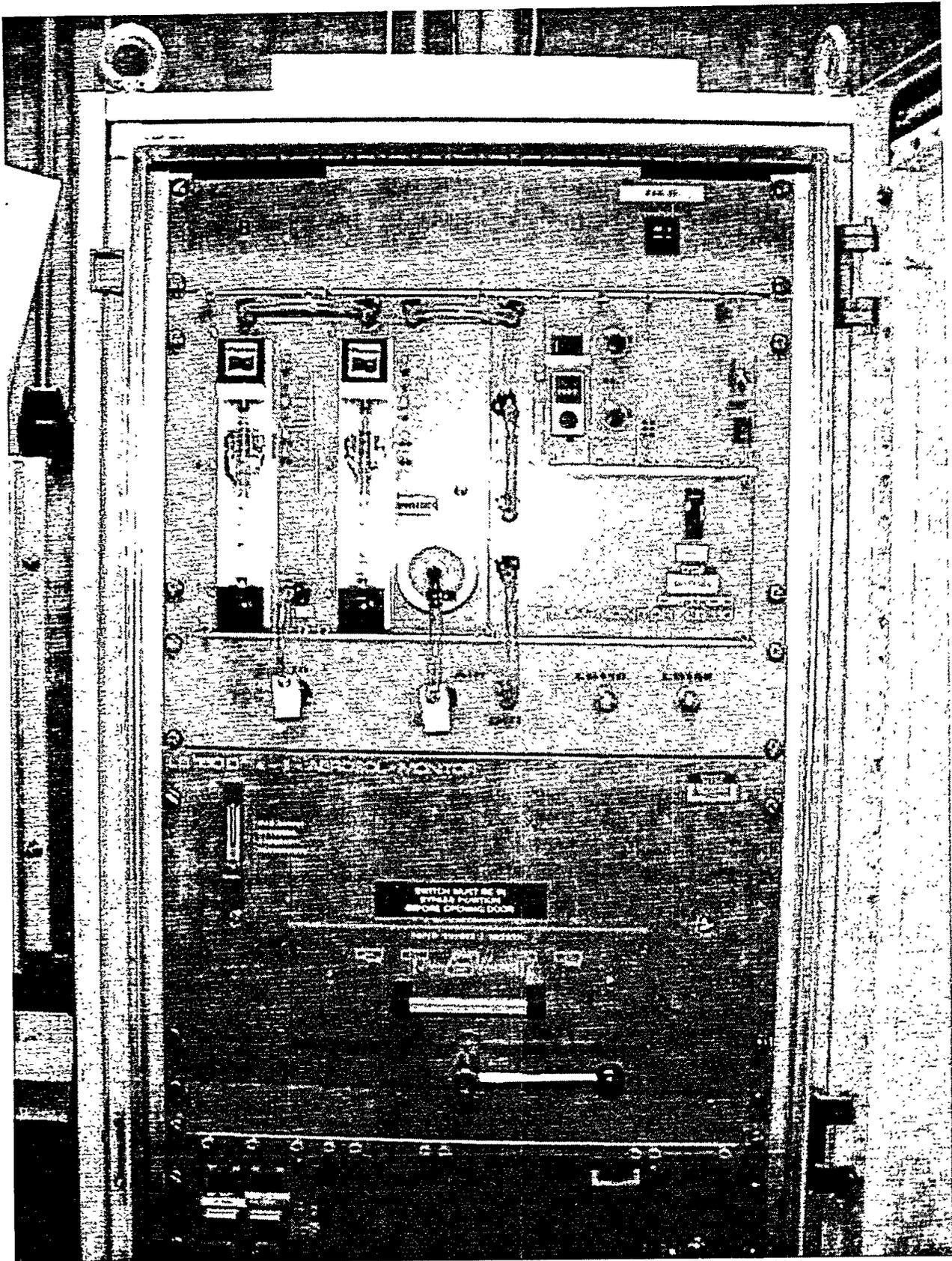


Figure 3.4. EG&G-Berthold Alpha-Beta and Tritium Monitor Detector Units



Figure 3.5. EG&G-Berthold Alpha-Beta and Tritium Monitor Display and Recorder Units

Annual release quantities associated with an effective dose equivalent of 0.01 mrem/year were calculated from dose factors calculated using the EPA compliance code CAP-88 (Ballinger et al. 1995). These values are shown in Table 3.8.

The sensitivity of particulate radionuclide sampling is proportional to the collection efficiency of the sampler, the fraction of the emission quantity collected by the sampler (i.e. sampler efficiency), and the level at which the radionuclide can be detected in the collected sample. Under isokinetic sampling conditions, the RPL particulate sampler will intercept approximately 1/45,000 of the activity emitted via the stack (i.e., ratio of sampling rate to stack flow rate or 3.1 cfm/ 139,000 cfm). Loss of particles in the sampling system due to deposition, plate-out, and filtering efficiency are estimated to be less than 7% for a 1-micron AMAD particulate aerosol^(a). Using the contractual minimum detection level specified in the analytical laboratory statement of work (Table 3.8), the annual minimum detectable releases for specific radionuclides are as shown in Table 3.8. Detailed calculations are provided in Appendix C.

Table 3.8. Detection of Significant Radionuclides in RPL Stack Emissions

Radionuclide	Analytical Limit (pCi/sample) ⁽¹⁾	Detectable Annual Release (Ci)	Emission Resulting in 0.01 mrem/year (Ci) ⁽⁶⁾
Beta Activity	38 ⁽²⁾	6.2E-5	2.0E-3 (as ¹³⁷ Cs)
Alpha Activity	1.0 ⁽²⁾	1.6E-6	5.6E-5 (as ²³⁸ Pu)
⁹⁰ Sr	38 ⁽³⁾	4.0E-6	2.0E-3
¹³⁷ Cs	38 ⁽³⁾	4.0E-6	2.0E-3
²⁴¹ Am	0.7 ⁽³⁾	7.4E-8	3.4E-5
²⁴³ Am	0.7 ⁽³⁾	7.4E-8	3.4E-5
²³⁸ Pu	1 ⁽³⁾	1.1E-7	5.6E-5
^{239/240} Pu	1 ⁽³⁾	1.1E-7	5.0E-5
²⁴¹ Pu	1 ⁽³⁾	1.1E-7	3.1E-3
Tritium (HTO)	61 ⁽⁴⁾	1.4E-2	24
Tritium (HT)	8 ⁽⁵⁾	1.9E-3	2400 ⁽⁷⁾

(1) From RAT Statement of Work
(2) Includes correction for 15% reduction of the alpha and beta emissions originating from the sample that are absorbed by the sample media and surface dirt on the filter (Higby 1984).
(3) Value for a 6-month composited group.
(4) Based on submission of silica gel containing 160 mL of water loading and lab analysis minimum detection level of 1.9 pCi/aliquot for an aliquot size of 5 mL (i.e., 380 pCi/L).
(5) Based on submission of silica gel containing 20 mL of water loading and lab analysis minimum detection level of 1.9 pCi/aliquot for an aliquot size of 5 mL (i.e., 380 pCi/L).
(6) Based on dose per release factors to maximally exposed individual (MEI) calculated using CAP-88 (Ballinger et al. 1995).
(7) Dose factor for noncondensable tritium (HT) is about 100 times that for condensable (HTO) tritium

HTO sampling capability is related to total quantity of water vapor collected in the sample. For a given tritium release rate, the concentration of tritium in water vapor adsorbed on the collector will be inversely proportional to the quantity of water collected on the column (i.e., the water vapor containing tritium as HTO will be diluted by water vapor not containing HTO). The tritium collector is operated to a loading of 160 mL (operating procedures limit loading of collector to 2/3 of maximum rated capacity). Under worst-case sampling conditions (i.e., high humidity), 160 mL of water vapor will be collected in about 4 weeks. Analytical detection levels for tritium are 1.9 pCi for a 5-mL aliquot from the submitted sample. For a 160-mL sample size (i.e., maximum column loading), the worst-case minimum detectable tritium on the collector column would be 61 pCi. At a sampling rate of 200 mL/min (0.007 cfm), the stack to sample ratio is 1.99E7 (139,000 cfm/0.007 cfm). Assuming the sampler is 100% efficient for collection of tritium

^(a) Calculated using DEPO 4.0 (Riehl et al. 1996) assuming a particulate aerosol with an AMAD of 1.0 microns.

vapor, the stack release for each sample period will be $1.98E7$ times the activity of tritium measured on the collector. For 12 sampling periods per year, the minimum annually detectable HTO emission is 0.014 Ci/year ($1.99E7$ times 12 samples/year times 60 pCi/sample).

The water vapor collected on the second (noncondensable forms of tritium) collection column is partially a function of the quantity of hydrogen in the atmosphere. However, because ambient air contains 0.5 ppm of hydrogen, at a 200 mL/min sample rate, the catalytic oxidizer will generate only about 1.5 mL of water over a 2-week period. Quantitative collection of this small amount of adsorbed water vapor is difficult, so additional hydrogen is injected into the sample stream to increase the quantity of collected water vapor to approximately 20 mL. The injection gas is nitrogen-hydrogen gas (3% H_2 in N_2). The addition of this gas mixture at 20 mL/min will generate an additional 20 mL of water loading over a 4-week sampling period. Because the sensitivity of tritium measurement is inversely proportional to the quantity of water loading on the collection column, the operation of the noncondensable tritium column at a water loading of 20 mL will achieve a detection level of $20/160 = 0.125$ times that of the condensable tritium column under full (160 mL) water loading.

From Table 3.8, it is apparent that the capability of the RPL stack sampling system exceeds the minimum criteria for detection of radionuclides in emissions.

3.6.2 Monitoring System Performance

This section describes the performance of the continuous stack monitoring systems for the RPL. The continuous stack monitoring systems notify operations personnel that a potentially "significant" radionuclide emission has occurred from the main building stack (EP-325-01-S).

As described in Section 3.3, emission monitoring systems should be able to detect a non-routine release that could result in an offsite effective dose equivalent of 2 mrem/year (i.e., 20% of the annual airborne radionuclide emission standard; DOE 1990). Alarm annunciation set points for the monitoring systems are maintained at or below the 2 -mrem/year criteria level^(a).

Monitor response to a radionuclide release is a function of the monitor sample collection and detection efficiency as well as the size of the sample. Under isokinetic sampling conditions, the RPL stack monitor will intercept approximately $1/6,200$ of the release. Additionally, it is reasonable to assume that the failure of a filter system may have occurred as part of the accident and that emissions with a failed filter system could result in the presence of relatively large particles in the emission stream. Therefore, losses in the sample line assuming a 10 -micron AED monodisperse aerosol are considered in alarm set points. In addition to these losses, it is assumed that 15% of the alpha and beta emissions originating in the sample are absorbed by the sample media and surface dirt on the filter (Higby 1984). Counting efficiencies based on monitor performance tests are also considered.

At this time, the actual minimum release that could be detected by the continuous particulate monitoring system has not been assessed. However, alarm set points based on an offsite effective dose equivalent of 2 mrem/year are calculated and documented by EM.

3.7 Handling of Radionuclide Air Sampling and Monitoring Data

Results obtained from the record sampling program are used to evaluate existing facility emission levels and to calculate annual emission quantities for compliance determination and reporting purposes.

Particulate samples are collected as described in Section 3.5. Analysis of samples by a laboratory is described in Chapter 4. Data are evaluated using documented and approved procedures. Data evaluation procedures are based on guidance in DOE (1991), *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* and EPA (1980).

^(a) Alarm setpoints below the minimum criteria level are developed in consideration of environmental "as low as reasonably achievable" (ALARA) objectives and existing facility conditions.

Airborne-emission sampling data are reviewed for anomalies and trends. Provisional release estimates are updated throughout the sampling year (calendar year) as data are received. At the completion of the calendar year, data are reviewed, and the provisional release estimate is refined, as necessary, to account for anomalies or missing data as well as a significantly skewed data set. Anomalous data are investigated, and conclusions of the investigation are documented.

Final release quantities include corrections for isokinetic sampling efficiency, sample transport losses, sample self-absorption, decay, counting efficiency, background, and collection media efficiency.

3.8 Calibration and Maintenance of Radionuclide Air Sampling and Monitoring Equipment

Sampling and monitoring equipment, including rotameters, are maintained and calibrated according to predetermined schedules. Stack flow rates are measured using a standard-type pitot tube that is recognized by EPA as a primary calibration standard.

Radiation monitoring equipment is calibrated annually by the Radiation Instrumentation Services of PNNL. This group has responsibility for calibrating all portable radiation protection instrumentation at Hanford.

Continuous, "major", sampling systems are inspected each workday by the PNNL Radiation Protection Section for proper flow rate setting and system operation. "Minor" sampling systems are inspected weekly when during sampling periods. In addition, response and alarm tests are periodically conducted.

3.9 Alternative Sampling Methods for Radionuclide Air Emissions

All sampling and monitoring system components have replacement units available, so downtime is usually limited to a few hours, at most.

Alternative methods exist for assessing impacts of facility emissions. *Workplace air monitoring* systems provide evidence of the presence or absence of radionuclides in room air. Contamination surveys, routinely performed throughout the facility, provide additional evidence of contamination spreads. Air-emission control systems are checked annually for leaks.

An extensive environmental surveillance program is operated for the Hanford Site by PNNL. This program is described in detail in the Hanford Site Environmental Monitoring Plan (DOE 1997). The program performs ambient air sampling around the 300 Area perimeter as well as along the Hanford Site boundary and in adjacent communities. In addition to ambient air sampling, the environmental surveillance program samples groundwater, river water, drinking water, foodstuffs, soil, native vegetation, and aquatic and terrestrial animals. Annual reports issued by the Hanford Environmental Surveillance Program document the results of these samples.

3.10 Liquid Effluent Sampling and Monitoring

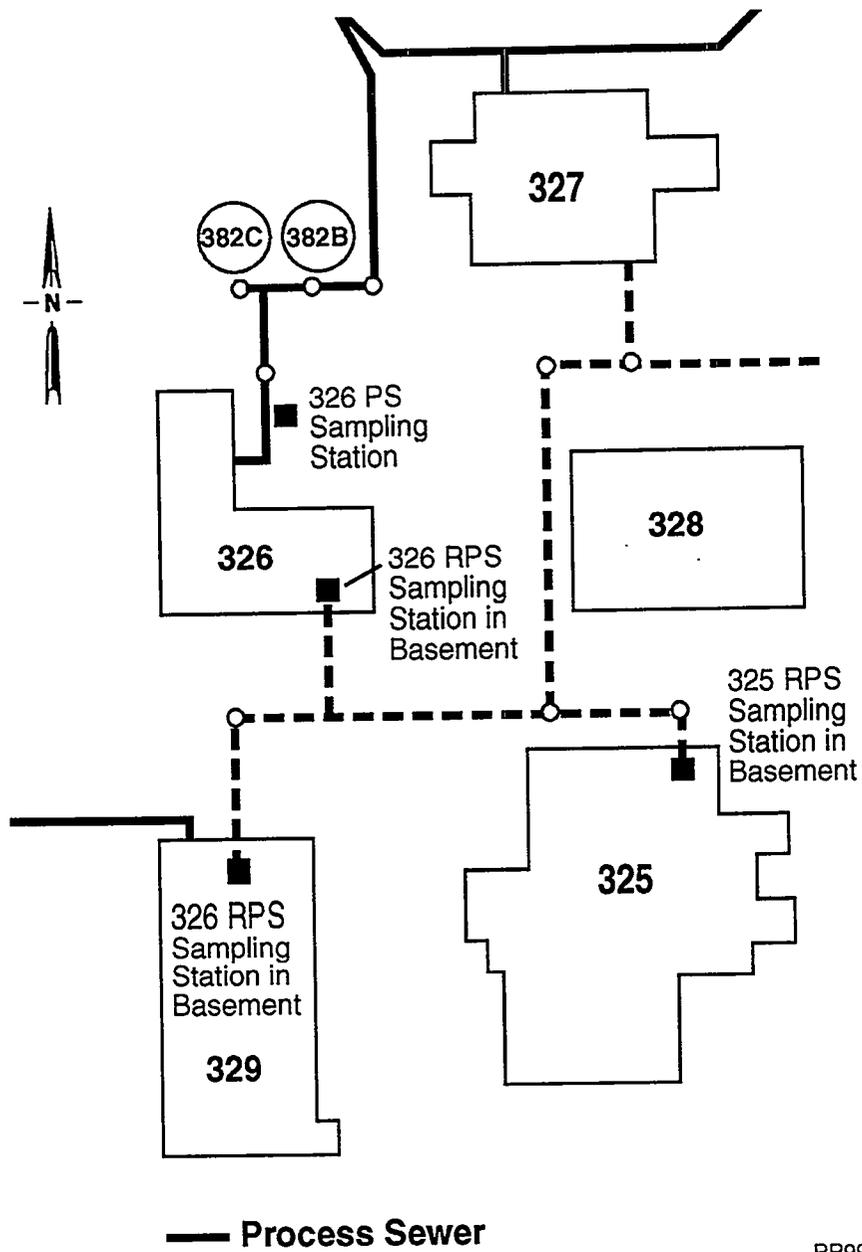
The liquid effluent sampling and monitoring system in the RPL is used to characterize facility effluents and to investigate potential discharges of concern. Administrative controls developed by the TEDF operating contractor specify the following criteria for liquid effluent sampling:

- Sampling is required to characterize waste streams discharged to TEDF if process knowledge is inadequate; process knowledge may be used if the facility has only repetitive, well-characterized operations that are consistent over time.
- Characterization sampling must ensure that a valid sample is obtained.
- The number of characterization samples collected must be sufficient to clearly demonstrate the stream has been adequately characterized.
- Characterization samples shall be analyzed for all classes of constituents not known to be absent from the waste stream.
- Characterization samples shall be collected and handled as specified in a table provided by the TEDF operating contractor. This table lists hold times, minimum sample sizes, sample types

(grab/composite), preservatives, and sample containers for various analyses based on regulatory requirements.

The liquid effluent sampling and monitoring system installed in the RPL is located downstream of the RPS sump which is located in the RPL basement (see Figure 3.6). At this point, all RPS liquid effluents from the building are combined (the RPL has no PS) and can be sampled and monitored as needed to meet the applicable requirement. The refrigerated sampling system has the ability to take grab or flow-composite samples and controls temperature of samples to ensure preservation requirements are met. In addition, PNNL's Effluent Management Group has sampling procedures in place and a contract with an accredited analytical laboratory to ensure that sampling requirements are met.

A schematic of the system is provided in Figure 3.7. As shown, the system can provide pH, conductivity, and flow measurements of the RPS stream discharging from the RPL. Also, the system can obtain liquid effluent samples as needed to characterize waste or diagnose liquid effluent concerns to determine whether they are stemming from the RPL. As noted in Section 3.4.1.2, characterization sampling has been performed using this system and the system is maintained to perform sampling as needed.



RP99010078.3

Figure 3.6 Location of Liquid Effluent Sampling and Monitoring System for RPL

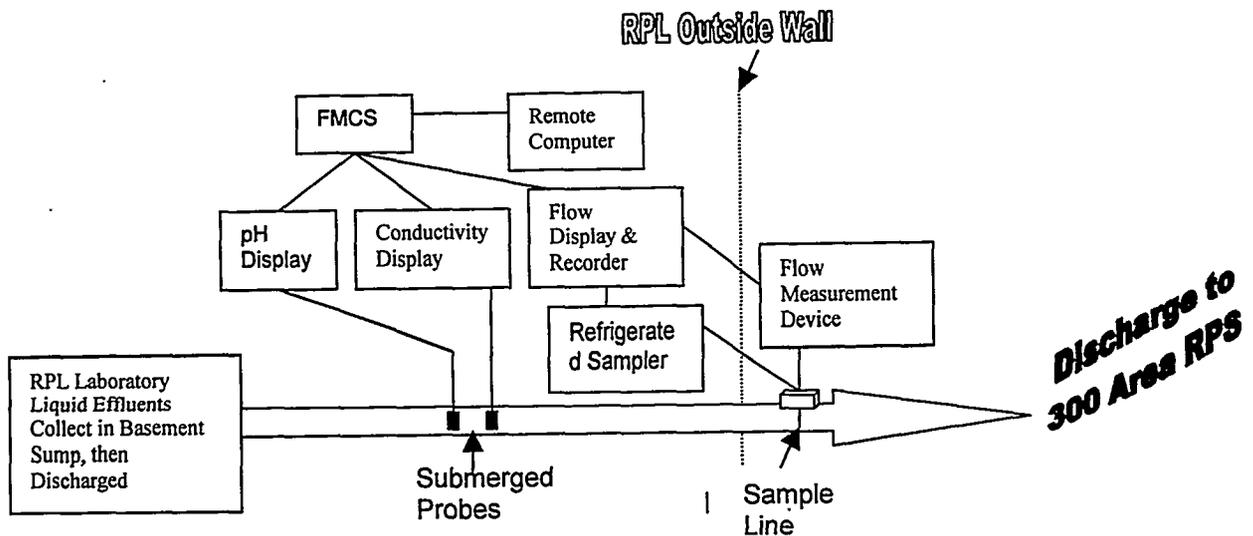


Figure 3.7 Schematic of Liquid Effluent Sampling and Monitoring System for RPL

3.11 References.

- ANSI 1969. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*, ANSI N13.1-1969. American National Standards Institute
- ANSI 1980. *Specifications and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents*, ANSI N42.18 1980b. American National Standards Institute
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- DOE 1987. *General Design Criteria*, DOE 6430.1A, U.S. Department of Energy Order. U.S. Department of Energy. Washington D.C.
- DOE 1988. *General Environmental Protection Program*, DOE 5400.1, U.S. Department of Energy Order. U.S. Department of Energy. Washington D.C.
- DOE 1990. *Radiation Protection of the Public and the Environment*, DOE 5400.5, U.S. Department of Energy Order. U.S. Department of Energy. Washington D.C.
- DOE 1991. *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T. U.S. Department of Energy. Washington D.C.
- DOE 1997. *Environmental Monitoring Plan*, DOE/RL-91-50, Rev 2, United States Department of Energy, Richland Operations Office, Richland, Washington.

- EPA 1971. *Regulations on Standards of Performance for New Stationary Sources, Appendix A: Reference Methods*. 40 CFR 60. Environmental Protection Agency, U.S. Code of Federal Regulations.
- EPA 1980. *Upgrading Environmental Radiation Data*. EPA 520/1-80-012. U.S. Environmental Protection Agency. Washington D.C.
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- McCarthy, M. J. 1990. *Westinghouse Hanford Company Effluent Report for 300, 400, and 1100 Area Operations for Calendar Year 1989*. WHC-EP-0267-1, Westinghouse Hanford Company, Richland, Washington.
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- SBMS, Creating or Modifying Engineering Calculations, Drawings, and Specifications. 1997. Creating or Modifying Engineering Calculations, Drawings, and Specifications. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/91/9100t010.htm>), Pacific Northwest National Laboratory, Richland, Washington.
- SBMS, Managing Liquid Effluents. 1998. Managing Liquid Effluents. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/0q/0q00t010.htm>), Pacific Northwest National Laboratory, Richland, Washington.
- SBMS, Managing Nonradioactive Chemical Waste. 1998. *Managing Nonradioactive Chemical Waste*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/0f/0f00t010.htm>), Pacific Northwest National Laboratory, Richland, Washington.
- SBMS, Event Reporting. 1997. *Event Reporting*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/27/2700t010.htm>). Pacific Northwest National Laboratory, Richland, Washington.
- SBMS, Working with Chemicals. 1997. *Working With Chemicals*. Standards-Based Management System Subject Area (<http://pnl.gov:2080/standard/03/0300t010.htm>), Pacific Northwest National Laboratory, Richland, Washington.
- Thompson, C.J., M.Y. Ballinger, E.G. Damberg, and R.G. Riley. 1997. *Characterization and Monitoring of 300 Area Facility Liquid Waste Streams During 1994 and 1995*. Pacific Northwest National Laboratory, Richland, Washington.
- WAC 1994. *Radiation Protection - Air Emissions*, WAC 246-247, Washington Administrative Code. Washington Department of Health.
- WDOE and WDOH 1999. *Hanford Site Air Operating Permit*, HNF-AOP-97-1. Washington State Department of Ecology and Washington State Department of Health.
- WHC 1989. *Waste Stream Characterization Report*, WHC-EP-0287. Westinghouse Hanford Company. Richland, Washington.

4.0 Laboratory Analyses

This section provides information on the analytical laboratories and procedures used to analyze samples collected in support of the PNNL effluent monitoring program. As stated in previous sections, these samples may contain radioactivity associated with emissions from the RPL main stack. Because liquid discharges from the RPL are sampled by WMHC at the point of collection for final disposal and at the TEDF, and because routine compliance sampling for chemical constituents is currently not performed, analysis of PNNL-collected effluent samples at the RPL is limited to determination of radioactivity in samples collected from the main building stack.

Section 3.5 describes the types of samples collected by the building sampling system for the main building stack. These samples are for particulate radionuclides on filter paper and tritium (tritiated water) on silica gel. The laboratories and procedures used to perform these analyses are described in Section 4.1. Section 4.2 provides a description of procedures employed by PNNL and its supporting analytical laboratories.

4.1 Analytical Procedures

Analytical procedures for alpha and beta particulate radioactivity and isotopic analysis are provided in this section. The principal radionuclides in RPL emissions are described in Section 3.0. These radionuclides are detectable using procedures described in this section. Analyses are performed by the Radioanalytical Application Team (RAT) of the PNNL Radiochemical Processing Group. All analytical work associated with radionuclide sampling is performed according to required methods per PNNL contract and statement of work (SOW) with the analytical laboratory. The SOW is prepared to meet the QA requirements from 40 CFR 61 (EPA 1990).

4.1.1 Determination of Alpha and Beta Activity on Particulate Air Filters

Particulate air filter samples from the RPL Main Stack are collected every 2 weeks, as described in Section 3.5. The samples are initially delivered to a counting laboratory operated by PNNL's Radiation Protection Section. The samples are held at the laboratory to allow for adequate decay of radon daughter radionuclides.

Following the hold time for radon daughter decay, each particulate filter is delivered to the RAT. Analytical services are performed according to documented requirements in a statement of work (SOW).

Samples are received, logged in, classified, and analyzed according to procedures documented as standard operating procedures (SOPs).

The RAT particulate alpha and beta analysis method is documented in RAT SOPs. Samples are counted on an alpha and beta proportional counter. The counters are operated with a full open-energy window and are calibrated using ^{239}Pu and ^{90}Sr sources corrected for self-absorption. As specified in the SOW, required detection levels are 1-pCi/sample alpha and 38-pCi/sample beta activity on a single (2-week sample) filter for Type I and Type II errors of 0.05. For the RPL stack, this equates to a detectable concentration of $8\text{E-}16 \mu\text{Ci}/\text{cm}^3$ alpha and $3\text{E-}14 \mu\text{Ci}/\text{cm}^3$ beta (see Appendix C). Section 3.5 addresses the performance capability of the particulate emission sampling program in terms of detectable offsite dose.

4.1.2 Determination of Tritium in Silica Gel Column

Tritium in air is collected by trapping moisture in a column of silica gel. Following collection, the silica gel is removed from the column, placed in a polyethylene container, capped, and delivered to the RAT for analysis.

As with the particulate alpha and beta analysis, the tritium analysis procedure is documented in RAT SOPs.

The procedure consists of quantitatively desorbing water collected in the silica gel column and counting for tritium using liquid scintillation spectrometry. The water is removed from the silica gel by distillation,

collected using a Gore-Tex membrane and Lachet tube. A 3-mL aliquot is removed from the collected water for liquid scintillation counting. The detection level for tritium in water, as specified in the SOW, is approximately 380 pCi/L of water, assuming a sample size of at least 3 mL. PNNL tritium samplers are designed and operated to provide the required sample size. Sensitivity of the measurement is highly dependent on the water loading of the sampler, with analytical sensitivity indirectly proportional to sampler loading. Assuming that a sampler is fully loaded with adsorbed water, after a 1-month sample period, a stack tritium concentration (HTO) of $7E-12 \mu\text{Ci}/\text{cm}^3$ is detectable. Supporting calculations are provided in Appendix C.

4.1.3 Isotopic Analysis

The record particulate filters analyzed by RAT for alpha and beta, as discussed in Section 4.1.1, are further analyzed for ^{90}Sr , ^{137}Cs , ^{241}Am , ^{243}Am , ^{238}Pu , $^{239/240}\text{Pu}$, and ^{241}Pu . These analyses are performed by RAT on particulate samples composited on a semi-annual basis.

The RAT composite preparation and analysis methods used for the above isotopes are listed in Table 4.1. As specified in the SOW, required detection levels are also listed in Table 4.1.

Before digesting the particulate filters for isotopic analysis, the filters are grouped on a semi-annual basis in preparation for gamma scan analysis. The semi-annual groups of samples are transferred to a standard geometry container for counting on the gamma detectors. Intrinsic Germanium (high-purity germanium [HPGE]) detectors are used to detect isotopes with gamma ray energies between 60 and 2000 KeV.

Table 4.1. Isotopic Separation and Analysis Methods

Method	MDA (pCi/sample)
Air Filter Preparation and Compositing	-NA-
Gamma Analysis Sample Preparation, All Matrices	38 ⁽¹⁾
Electrodeposition Procedure for the Actinides	-NA-
Strontium Determination for 6-month Filter Composites	38
Isotopic Plutonium Determination for 6-month Filter Composites	1
Isotopic Americium/Curium Determination for 6-month Filter Composites	0.7
⁽¹⁾ - Based on ^{137}Cs , will depend on isotope	

Following the gamma scan, the semi-annual groups are digested, and the elements of interest are separated from other elements and the sample matrix by chemistry. The ^{90}Sr content is determined by the chemical separation and counting of a daughter element, ^{90}Y . The strontium is separated from other elements chemically, then ^{90}Y is permitted to grow into equilibrium with the ^{90}Sr . The ^{90}Y is then separated and processed to determine the chemical recovery and counted on a low background beta proportional counter. The quantity of ^{90}Sr is then determined based on the quantity of the daughter ^{90}Y produced.

Plutonium is separated from other elements and the sample matrix by adsorption on an anion exchange column. The plutonium is then processed chemically and electroplated or coprecipitated on rare earth fluorides. Isotopic concentrations of the deposited material is determined by alpha spectrometry. Following the removal of the plutonium, the sample matrix is further processed chemically and the americium and curium removed by passing the sample through a cation exchange column. The americium and curium are eluted from the column and either electroplated or coprecipitated. As with the plutonium, isotopic concentrations of the deposited material are determined by alpha spectrometry.

4.2 Procedures

PNNL's Effluent Management Group (EM) maintains documented technical and operation procedures for all aspects of environmental monitoring. SBMS (Technical and Operations Procedures) contains the requirements for preparation, review, and approval of these procedures. EM procedures incorporate all required elements of the SBMS (Technical and Operations Procedures).

Sampling procedures include identification of applicable staff, identification of possible hazards encountered while collecting samples, emergency contacts, any applicable prerequisites to performing the work, and work instructions. The work instructions address areas such as equipment operation; sample collection media to be used; amount of sample to be collected; and sample preservatives (as needed).

Effluent Management maintains documented chain-of-custody procedures for all samples. Procedures include provisions for transfer of samples between operational staff, to and from regulated storage areas, and to the analytical laboratory. Both PNNL and any offsite analytical services contractor implement chain-of-custody within the Laboratory.

The analytical laboratory maintained documented and approved chain-of-custody procedures for the preliminary analyses of particulate emission samples, for record analysis of particulate air filters, and silica gel collectors. Radiological air samples are stored for 18 months before being discarded.

4.3 References

EPA 1990. *National Emission Standards for Hazardous Air Pollutants*. 40 CFR 61. Environmental Protection Agency, U.S. Code of Federal Regulations. 1990.

SBMS, Technical and Operations Procedures. 1997. *Technical and Operations Procedures*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/74/7400t010.htm>). Pacific Northwest National Laboratory, Richland, Washington.

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5.0 Quality Assurance Requirements

5.1 Quality Assurance Plan

A number of quality assurance (QA) plans were developed to address QA for the different types of effluent monitoring activities performed by PNNL, including: radiological air, chemical air, and water release sampling and monitoring. These plans were integrated into one Effluent Management QA Plan in 1997. This plan addresses QA for all PNNL effluent management activities. The QA program described by the plan is based on the following general requirements and guidance:

- DOE Order 5700.6C, *Quality Assurance* (DOE 1991a)
- 10 CFR 830.120 *Quality Assurance* (DOE 1994)
- PNNL Standards-Based Management System Subject Area, *Quality Assurance Planning* (SBMS, QA Planning)
- DOE Order 5400.1, *General Environmental Protection Program* (DOE 1988)
- U.S. Environmental Protection Agency (EPA) QAMS-005/80, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA 1980)
- American National Standards Institute/American Society for Quality Control (ANSI/ASQC) E4-1994, *American National Standard Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs* (ANSI/ASQC 1994)
- DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE 1991b).

In addition, QA requirements specified in permits and regulations, including 40 CFR 61 (EPA 1990), for PNNL effluent sampling or monitoring activities are incorporated into the QA Plan.

5.2 Internal and External Plan Review

DOE 5400.1 (DOE 1988) states that the Environmental Monitoring Plan (EMP) will be reviewed annually and updated every 3 years. As a support document to the EMP, the FEMP will also be updated every 3 years. At a minimum, the FEMP assessment will be performed annually.

5.3 References

ANSI/ASQC 1994, *American National Standard Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*. E4-1994. American National Standards Institute/American Society for Quality Control.

DOE 1988. *General Environmental Protection Program*. DOE Order 5400.1. U.S. Department of Energy Order. U.S. Department of Energy. Washington D.C..

DOE 1991a. *Quality Assurance*. DOE 5700.6C. U.S. Department of Energy Order. U.S. Department of Energy. Washington D.C..

DOE 1991b. DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. U.S. Department of Energy. Washington D.C..

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EPA 1990. *National Emission Standards for Hazardous Air Pollutants*. 40 CFR 61. Environmental Protection Agency, U.S. Code of Federal Regulations. 1990.

SBMS, QA Planning 1997. *Quality Assurance Planning*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/87/8700T010.htm>). Pacific Northwest National Laboratory, Richland, Washington.

6.0 Program Implementation Procedures

The Hanford Site Environmental Monitoring Plan (EMP) (DOE 1997) documents the effluent-monitoring and environmental surveillance programs for the Hanford Site.

6.1 Interface with the Near-facility Environmental Monitoring Program

The EMP divides the effluent-monitoring coverage into two areas, the FEMPs and the Near-Facility Environmental Monitoring Program. The FEMPs cover the monitoring of effluents from facilities at the facility. PNNL's Effluent Management Project maintains implementation procedures for all PNNL facility-monitoring activities. These procedures meet the PNNL requirements for technical and operating procedures (SBMS, Technical and Operations Procedures) and ensure that facility effluent sampling and monitoring is conducted compliantly. The Near-Facility program monitors air, surface water, groundwater, soil, sediment, vegetation, and biota around site facilities to evaluate the adequacy of effluent control at various facilities at the Hanford Site. The program is conducted by Waste Management Federal Services, Inc. Northwest Operations.

6.2 Interface with the Operational Environmental Surveillance Program

Environmental surveillance of the 300 Area and the surrounding onsite and offsite areas is performed by the PNNL Hanford Site Surface Environmental Surveillance Project and the PNNL Site-Wide Groundwater Monitoring Project. These projects are notified in the event of actual or apparent new or off-normal discharges to the soil, surface waters, or air so they can assist in assessing their environmental and compliance significance. The data from these programs are also useful to verify the occurrence or nonoccurrence of facility releases. These surveillance projects are described in detail in DOE (1997).

6.3 References

DOE 1997. *Environmental Monitoring Plan, United States Department of Energy, Richland Operations Office*. DOE/RL-91-50, Rev. 2, U. S. Department of Energy, Richland Washington.

SBMS, Technical and Operations Procedures. 1997. *Technical and Operations Procedures*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/74/7400t010.htm>). Pacific Northwest National Laboratory, Richland, Washington.

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7.0 Reporting

This section describes the compliance reporting and notification requirements related to facility effluent monitoring activities for the RPL. It also identifies the requirements and provides an overview of the procedural steps for the notification, investigation, and reporting of all environmental off-normal events for PNNL operations.

7.1 Routine Effluent Monitoring Reports

On a periodic basis, effluent monitoring data are gathered by PNNL on specific DOE Richland Operations Office (DOE-RL) facilities for compilation and reporting to DOE and various regulatory agencies.

The following effluent monitoring reports are submitted to regulatory agencies:

Airborne Effluent

- An Annual NESHAP Air Emissions Report for the Hanford Site providing the required annual emissions measurements and climatological data is submitted to the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Health (WDOH) for the Hanford Site radioactive airborne emissions;
- The Annual Radioactive Effluent and Onsite Discharge Data Report is submitted to DOE-Headquarters, the EPA, and WDOH through DOE-RL after compilation by EG&G Idaho; and
- Semiannual Reports providing updates of compliance related activities under the Hanford Site Air Operating Permit (AOP) (WDOE and WDOH to be issued in 1999) are submitted to WDOE.
- The Annual Compliance Certification is provided to WDOE as to the continuous or intermittent compliance of activities under the AOP.

Liquid Effluent

- WDOE is provided an annual report on significant discharges of hydrotest, maintenance, or construction wastewater discharged to ground as required by permit ST-4508 (WDOE 1997).
- WDOE is provided an annual inventory of miscellaneous liquid effluent discharges to ground as required by WDOE Consent Order DE 91NM-177 (WDOE 1991).

Other

- WDOE is provided with a monthly status report of all reportable spills from the previous month through DOE-RL.

7.2 Non-Routine Notifications and Reports

There are a number of reports, including notification reports, that are required with respect to effluent monitoring activities.

- A Notice of Construction (NOC) must be provided to WDOH and/or WDOE and/or the Benton Clean Air Authority (BCAA), depending on emissions type, whenever a new emission unit is to be created, or if there is to be significant modification to an existing emission unit.
- A Notice of Transient or Abnormal Conditions must be provided to WDOH as soon as practicable in accordance with AOP requirements. A Notification Follow-up Report may also be requested in addition to the initial notification.
- Report of Closure shall be submitted to WDOH whenever an emission unit covered under WAC 246-247 (WAC 1994) ceases emission.
- Notification of Renovation/Demolition Activities Involving Asbestos must be provided to the BCAA anytime work involving renovation or demolition activities in a facility with asbestos is planned.

7.3 Event Notification and Reporting

"Events" or conditions may adversely affect DOE or contractor personnel, the public, property, the environment, or the DOE mission. Staff who discover an event that requires mitigation must notify the Battelle single-point-contact to begin the response and mitigation process. Managers who are notified of events within their domain participate in the recovery, evaluation, analysis, and corrective action of the event. These two processes, staff notification and management participation, are described in a PNNL Standards-Based Management System (SBMS) Subject Area (SBMS, Event Reporting). The Subject Area incorporates requirements from DOE 232.1A, "Occurrence Reporting and Processing of Operations Information" (DOE 1997) and associated DOE-RL Directives (RLIDS).

7.4 References

SBMS, Event Reporting. 1997. *Event Reporting*. Standards-Based Management System Subject Area (<http://sbms.pnl.gov:2080/standard/27/2700t010.htm>). Pacific Northwest National Laboratory, Richland, Washington.

DOE 1997. *Occurrence Reporting and Processing of Operations Information*, DOE 232.1A. U.S. Department of Energy Order. U.S. Department of Energy. Washington, D.C.

WAC 1994. *Radiation Protection - Air Emissions*, WAC 246-247, Washington Administrative Code. Washington Department of Health.

WDOE 1991. *Consent Order in the Matter of the Compliance by United States Department of Energy with Chapter 70.105 and 90.48 RCW and the Rules and Regulations of the Department of Ecology*, DE 91NM-177. Washington State Department of Ecology

WDOE 1997. *State Waste Discharge Permit for the Discharge of Hydrotest, Maintenance, and Construction Discharges*, ST-4508. Washington State Department of Ecology

WDOE and WDOH 1999. *Hanford Site Air Operating Permit*, HNF-AOP-97-1. Washington State Department of Ecology and Washington State Department of Health

Appendix A

Projection of Offsite Emission Dose

DOE Order 5400.1 states that Environmental Monitoring Plans (EMP) "shall be prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials" (DOE Order 5400.1, IV-2). To support the EMP, Facility Effluent Monitoring Plans (FEMPs) are being prepared for those facilities that have the potential to release significant pollutants or hazardous materials. A methodology has been developed to determine whether potential releases of radioactive material are significant. This method is that same as that used to determine whether monitoring is required for the National Emission Standards for Hazardous Air Pollutants (NESHAPs - U.S. Code of Federal Regulations, Title 40 Part 161, Subparts H and I) and is described in *Radionuclide Monitoring Requirements at Pacific Northwest National Laboratory - 1995*. (Ballinger et al. 1995, PNL-10855).

The first step in the method (called the FEMP Determination when used to determine whether or not a FEMP is needed for a facility) is to obtain a listing of the facility inventory. The inventory includes the radionuclide, isotope, quantity, and form. Form can be gas, liquid or powder, solid (nondispersible), contained (in sealed sourced or DOT containers), or exempt (sealed sources meeting certain criteria). At PNNL, radioactive source and material information is maintained using three separate inventory systems: (1) facilities management radioactive materials inventory, (2) composite radioactive materials inventory, and (3) nuclear materials inventory. An identifier on the inventory listing indicates the inventory system that the information was obtained from. Additional detail on the FEMP Determination method is provided in PNL-10855. A table is provided showing a listing by nuclide if the radioactive material inventory in the RPL. The table shows the total activity and the percent contribution to the total unabated Potential-to-Emit for the facility.

Table A.1.
(Sheet 1 of 3)

FEMP Dose Contribution by Nuclide for: 325 Building

Total PTE Dose: 1.34E+02 mrem/yr

Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total	Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total
Ac-225	7.80E-13	2.42E-15	0.00%	Co-60	7.55E+01	7.17E-03	0.01%
Ac-227	4.50E-03	1.49E-03	0.00%	Cs-134	9.20E+00	1.26E-02	0.01%
Ag-108	5.54E-12	2.72E-14	0.00%	Cs-135	6.62E-07	7.95E-11	0.00%
Ag-108m	6.23E-11	3.05E-13	0.00%	Cs-137	5.07E+03	1.72E+00	1.28%
Ag-109m	4.54E-11	2.50E-23	0.00%	Es-254	2.05E-15	5.94E-16	0.00%
Ag-110	2.10E-08	1.35E-21	0.00%	Eu-150	3.03E-11	1.49E-13	0.00%
Ag-110m	1.58E-06	1.52E-09	0.00%	Eu-152	1.52E-01	5.62E-04	0.00%
Am-241	3.40E+01	4.29E+00	3.19%	Eu-154	1.70E+01	4.54E-02	0.03%
Am-242	2.60E-05	7.01E-10	0.00%	Eu-155	5.08E+00	5.63E-04	0.00%
Am-242m	1.67E-01	3.04E-02	0.02%	Fe-55	9.17E-04	5.57E-09	0.00%
Am-243	2.94E+00	4.97E-01	0.37%	Fe-59	2.10E-04	1.32E-08	0.00%
Am-245	1.87E-15	9.14E-18	0.00%	Fr-221	7.80E-13	3.82E-19	0.00%
At-217	7.80E-13	2.26E-13	0.00%	Fr-223	1.43E-13	1.18E-19	0.00%
Ba-133	3.01E-03	2.47E-06	0.00%	Gd-148	1.02E-06	2.97E-07	0.00%
Ba-137m	5.39E+00	8.09E-08	0.00%	Gd-153	1.10E-05	5.40E-08	0.00%
Be-10	4.16E-12	2.04E-14	0.00%	H-3	1.40E+04	5.00E+00	3.72%
Bi-210	8.05E-01	7.97E-08	0.00%	Ho-166m	1.17E-08	1.88E-10	0.00%
Bi-211	1.03E-11	3.31E-19	0.00%	I-125	9.79E-07	2.74E-09	0.00%
Bi-212	4.96E-08	6.45E-13	0.00%	I-129	1.04E-06	2.38E-08	0.00%
Bi-213	7.80E-13	3.82E-19	0.00%	K-40	1.30E-01	4.29E-04	0.00%
Bi-214	1.09E+00	4.47E-10	0.00%	Kr-81	1.07E-12	5.26E-15	0.00%
Bk-249	1.29E-10	6.30E-13	0.00%	Kr-85	3.10E+01	9.33E-06	0.00%
Bk-250	2.05E-15	5.94E-16	0.00%	Mn-54	4.23E-04	5.79E-08	0.00%
C-14	2.62E-02	5.10E-08	0.00%	Na-22	1.07E-05	0.00E+00	0.00%
Cd-109	1.04E-04	1.25E-08	0.00%	Nb-93m	3.13E-05	8.75E-10	0.00%
Cd-113m	6.41E-05	3.14E-07	0.00%	Nb-94	2.44E-10	3.90E-12	0.00%
Ce-142	3.77E-11	1.85E-13	0.00%	Nb-95	2.24E-14	1.44E-18	0.00%
Ce-144	6.49E+00	1.57E-04	0.00%	Nb-95m	2.00E-06	9.20E-12	0.00%
Cf-249	2.18E-10	6.32E-11	0.00%	Nd-144	2.32E-15	6.74E-16	0.00%
Cf-250	8.33E-10	2.42E-10	0.00%	Ni-63	3.72E-02	2.91E-07	0.00%
Cf-251	8.47E-12	2.46E-12	0.00%	Np-235	3.59E-11	1.76E-13	0.00%
Cf-252	1.48E-03	4.78E-07	0.00%	Np-236	7.55E-12	2.19E-12	0.00%
Cl-36	1.26E-02	2.77E-03	0.00%	Np-237	5.31E-02	8.87E-03	0.01%
Cm-242	1.38E-01	8.15E-04	0.00%	Np-238	1.30E-07	2.22E-12	0.00%
Cm-243	7.46E-02	9.19E-03	0.01%	Np-239	5.81E-05	1.98E-10	0.00%
Cm-244	3.03E+00	2.96E-01	0.22%	Np-240m	2.05E-12	7.58E-20	0.00%
Cm-245	1.30E-06	3.89E-07	0.00%	Pa-231	2.97E-11	8.01E-12	0.00%
Cm-246	6.08E-07	1.76E-07	0.00%	Pa-233	4.37E-07	1.53E-11	0.00%
Cm-247	3.16E-12	8.52E-13	0.00%	Pa-234	4.89E-10	8.31E-16	0.00%
Cm-248	1.50E-11	1.65E-11	0.00%	Pa-234m	3.76E-07	1.69E-17	0.00%
Co-57	1.51E-02	7.81E-09	0.00%	Pb-209	7.80E-13	3.35E-20	0.00%

Table A.1.
(Sheet 2 of 3)

Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total	Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total
Pb-210	8.12E-01	5.12E-05	0.00%	Sm-151	2.67E+00	3.54E-05	0.00%
Pb-211	1.20E-04	4.08E-13	0.00%	Sn-113	1.01E-05	4.06E-10	0.00%
Pb-212	4.96E-08	4.02E-12	0.00%	Sn-119m	3.56E-08	1.75E-10	0.00%
Pb-214	1.09E+00	3.93E-10	0.00%	Sn-121m	6.90E-02	3.38E-04	0.00%
Pd-107	2.09E-07	1.78E-12	0.00%	Sn-123	2.55E-10	2.55E-16	0.00%
Pm-146	1.08E-06	5.28E-09	0.00%	Sn-126	1.22E-06	1.10E-09	0.00%
Pm-147	2.79E+01	5.22E-04	0.00%	Sr-85	3.00E-06	1.47E-08	0.00%
Po-209	1.15E-08	3.35E-09	0.00%	Sr-89	9.06E-19	6.89E-23	0.00%
Po-210	6.33E-01	1.33E-05	0.00%	Sr-90	9.97E+03	1.50E+00	1.11%
Po-211	2.90E-14	8.40E-15	0.00%	Ta-182	1.27E-01	5.52E-06	0.00%
Po-212	3.18E-08	9.22E-09	0.00%	Tb-160	8.82E-16	1.41E-19	0.00%
Po-213	7.63E-13	2.21E-13	0.00%	Tc-95m	3.04E-04	1.49E-06	0.00%
Po-214	1.09E+00	3.16E-04	0.00%	Tc-98	1.08E-11	5.31E-14	0.00%
Po-215	1.03E-11	3.00E-12	0.00%	Tc-99	2.56E-01	3.58E-05	0.00%
Po-216	4.96E-08	1.44E-08	0.00%	Tc-99m	2.00E-02	9.80E-05	0.00%
Po-218	1.09E+00	3.38E-12	0.00%	Te-123m	1.25E-12	6.14E-15	0.00%
Pr-144	2.13E-01	5.95E-09	0.00%	Te-125m	5.70E-01	1.33E-05	0.00%
Pr-144m	3.90E-06	2.46E-14	0.00%	Te-127	5.80E-11	1.10E-17	0.00%
Pu(12%)	6.24E+01	9.81E+00	7.31%	Te-127m	5.92E-11	5.04E-15	0.00%
Pu(24%)	7.27E+01	1.02E+01	7.57%	Th-227	1.02E-11	5.61E-14	0.00%
Pu(6%)	4.79E+01	9.58E+00	7.13%	Th-228	4.96E-08	5.95E-09	0.00%
Pu-236	1.71E-07	7.53E-09	0.00%	Th-229	1.60E-03	5.12E-04	0.00%
Pu-238	2.13E+04	8.27E+01	61.58%	Th-230	1.09E+00	1.32E-04	0.00%
Pu-239	5.43E+01	3.96E+00	2.95%	Th-231	1.18E-08	6.40E-15	0.00%
Pu-240	1.42E-01	2.70E-02	0.02%	Th-232	1.81E-03	3.08E-04	0.00%
Pu-241	1.38E+01	4.38E+00	3.26%	Th-234	3.76E-07	3.72E-11	0.00%
Pu-242	3.74E-06	6.72E-07	0.00%	Tl-204	6.57E-04	3.22E-06	0.00%
Pu-243	3.16E-12	3.47E-19	0.00%	Tl-207	1.03E-11	1.13E-20	0.00%
Pu-244	2.05E-12	3.69E-13	0.00%	Tl-208	1.79E-08	2.51E-15	0.00%
Ra-223	1.03E-11	6.83E-14	0.00%	Tl-209	1.68E-14	6.57E-22	0.00%
Ra-224	4.96E-08	9.93E-11	0.00%	Tm-170	2.63E-14	1.29E-16	0.00%
Ra-225	7.80E-13	3.67E-15	0.00%	Tm-171	2.33E-10	1.14E-12	0.00%
Ra-226	1.09E+00	2.19E-05	0.00%	U(20%)	4.22E-01	2.49E-02	0.02%
Ra-228	2.80E-04	2.21E-06	0.00%	U(90%)	2.02E-02	6.29E-04	0.00%
Rb-87	2.71E-11	7.05E-15	0.00%	U(Dep)	1.49E-02	4.20E-04	0.00%
Rh-102	2.36E-07	1.16E-09	0.00%	U(Nat)	3.78E-02	8.12E-04	0.00%
Rh-106	1.77E+02	4.95E-10	0.00%	U-232	5.49E-05	1.32E-05	0.00%
Rn-219	1.03E-11	1.45E-48	0.00%	U-233	5.35E-01	3.19E-02	0.02%
Rn-220	4.96E-08	2.73E-17	0.00%	U-234	4.04E-06	7.28E-08	0.00%
Rn-222	1.09E+00	1.31E-09	0.00%	U-235	3.34E-07	1.64E-08	0.00%
Ru-106	2.08E+00	3.09E-04	0.00%	U-236	5.66E-07	1.76E-08	0.00%
Sb-124	3.18E-18	7.00E-22	0.00%	U-237	2.59E-06	2.84E-11	0.00%
Sb-125	2.53E+00	8.70E-04	0.00%	U-238	6.00E-02	3.87E-06	0.00%
Sb-126	1.71E-07	1.56E-11	0.00%	U-240	2.05E-12	2.25E-18	0.00%
Sb-126m	1.22E-06	3.67E-13	0.00%	Y-90	1.73E+04	1.90E-01	0.14%
Se-75	1.02E-01	0.00E+00	0.00%	Y-91	3.05E-16	2.99E-20	0.00%

Table A.1.
(Sheet 3 of 3)

Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total	Nuclide	Inventory (Ci)	Dose (mrem/yr)	% Total
Se-79	4.33E-06	1.68E-09	0.00%	Zn-65	1.00E-04	4.30E-11	0.00%
Sm-145	1.00E-06	4.90E-09	0.00%	Zr-93	2.39E-06	7.66E-11	0.00%
Sm-146	6.00E-13	1.74E-13	0.00%	Zr-95	6.90E-04	8.97E-08	0.00%
Sm-147	5.62E-12	2.02E-13	0.00%				

Appendix B

Nonradioactive Hazardous Materials Characterization

DOE Order 5400.1 states that Environmental Monitoring Plans (EMP) "shall be prepared for each site, facility, or process that uses, generates, releases, or manages significant pollutants or hazardous materials" (DOE Order 5400.1, IV-2). The Facility Effluent Monitoring Plans (FEMPs) being prepared to support the EMP include the consideration of nonradioactive hazardous materials.

A listing of the chemicals used in the building is obtained using the PNL Chemical Management System (CMS). The inventory information includes the location, chemical name, and quantity. In some cases the manufacturer and individual container quantities are also tracked. In addition, the CMS data includes the reportable quantity (RQ) of the chemical. RQs are obtained from 40 CFR 302 and are the amounts which, if released to the environment from a facility, require notification to the National Response Center. To characterize the relative hazard of the building, a summary table, Table B.1, is prepared showing those chemicals that are reported to be present in greater than RQ amounts. Table B.2 provides a list of all chemicals found in the RPL which have an RQ amount.

Table B.1.

CMS Reportable Quantity Inventory Listing For: 325-RADIOCHEMICAL PROCESSING LABORATORY Above 100 % of Reportable Quantity

RQ Grp	Chemical Name	CAS No.	Quantity	RQ Value
QX	ARSENENOUS ACID, SODIUM SALT (9CI)	7784-46-5	2.00 LB	1 LB
QX	ARSENIC	7440-38-2	2.51 LBS	1 LB
QX	ARSENIC TRIOXIDE	1327-53-3	2.07 LBS	1 LB
QX	MERCURY	7439-97-6	10.44 LBS	1 LB
QX	SILVER CYANIDE	506-64-9	2.00 LBS	1 LB
QX	SILVER NITRATE	7761-88-8	38.03 LBS	1 LB
QX	SODIUM ARSENATE	7631-89-2	3.00 LBS	1 LB
QA	CARBON TETRACHLORIDE	56-23-5	18.21 LBS	10 LBS
QA	CHLOROFORM	67-66-3	17.74 LBS	10 LBS
QA	CUPRIC SULFATE	7758-98-7	14.00 LBS	10 LBS
QA	LEAD	7439-92-1	15.22 LBS	10 LBS
QA	NITRIC OXIDE	10102-43-9	18.37 LBS	10 LBS
QA	POTASSIUM DICHROMATE	7778-50-9	12.38 LBS	10 LBS
QB	SODIUM NITRITE	7632-00-0	199.27 LBS	100 LBS
QC	SODIUM HYDROXIDE	1310-73-2	1,262.26 LBS	1000 LBS

Last updated 11/25/98.

Send questions or comments to the CMS Support Team.

Table B.2.
(Sheet 1 of 4)

CMS Reportable Quantity Inventory Listing For: 325-RADIOCHEMICAL PROCESSING LABORATORY Above 0 % of Reportable Quantity

RQ Grp	Chemical Name	CAS No.	Quantity	RQ Value
QX	ARSENENOUS ACID, SODIUM SALT (9CI)	7784-46-5	2.00 LBS	1 LB
QX	ARSENIC	7440-38-2	2.51 LBS	1 LB
QX	ARSENIC TRIOXIDE	1327-53-3	2.07 LBS	1 LB
QX	CHLORDANE	57-74-9	0.00 LBS	1 LB
QX	DDT	50-29-3	0.01 LBS	1 LB
QX	MERCURY	7439-97-6	10.44 LBS	1 LB
QX	SILVER CYANIDE	506-64-9	2.00 LBS	1 LB
QX	SILVER NITRATE	7761-88-8	38.03 LBS	1 LB
QX	SODIUM ARSENATE	7631-89-2	3.00 LBS	1 LB
QA	2,4,6-TRICHLOROPHENOL	88-06-2	0.02 LBS	10 LBS
QA	2-NITROPROPANE	79-46-9	0.01 LBS	10 LBS
QA	AMMONIUM BICHROMATE	7789-09-5	4.50 LBS	10 LBS
QA	AMMONIUM CHROMATE	7788-98-9	1.00 LBS	10 LBS
QA	BENZENE	71-43-2	8.20 LBS	10 LBS
QA	BERYLLIUM	7440-41-7	1.10 LBS	10 LBS
QA	CADMIUM	7440-43-9	5.25 LBS	10 LBS
QA	CADMIUM CHLORIDE	10108-64-2	2.00 LBS	10 LBS
QA	CARBON TETRACHLORIDE	56-23-5	18.21 LBS	10 LBS
QA	CHLOROFORM	67-66-3	17.74 LBS	10 LBS
QA	CHROMIUM (VI) OXIDE	1333-82-0	2.00 LBS	10 LBS
QA	COPPER (I) CYANIDE	544-92-3	1.00 LBS	10 LBS
QA	COPPER(II) CHLORIDE	7447-39-4	1.00 LBS	10 LBS
QA	CUPRIC SULFATE	7758-98-7	14.00 LBS	10 LBS
QA	CYANIDES, AS CN	57-12-5	0.04 LBS	10 LBS
QA	LEAD	7439-92-1	15.22 LBS	10 LBS
QA	LEAD CHLORIDE	7758-95-4	6.70 LBS	10 LBS
QA	LEAD FLUORIDE	7783-46-2	1.88 LBS	10 LBS
QA	LEAD IODIDE	10101-63-0	1.10 LBS	10 LBS
QA	LEAD NITRATE	10099-74-8	8.11 LBS	10 LBS
QA	LEAD SULFIDE	1314-87-0	2.10 LBS	10 LBS
QA	MERCURIC SULFATE	7783-35-9	1.00 LBS	10 LBS
QA	MERCURY (I) NITRATE	10415-75-5	1.75 LBS	10 LBS
QA	NITRIC OXIDE	10102-43-9	18.37 LBS	10 LBS
QA	NITROGEN DIOXIDE	10102-44-0	0.00 LBS	10 LBS
QA	POTASSIUM CHROMATE	7789-00-6	3.00 LBS	10 LBS
QA	POTASSIUM CYANIDE	151-50-8	0.50 LBS	10 LBS
QA	POTASSIUM DICHROMATE	7778-50-9	12.38 LBS	10 LBS
QA	SELENIUM(IV) OXIDE	7446-08-4	0.29 LBS	10 LBS
QA	SODIUM CHROMATE	7775-11-3	2.00 LBS	10 LBS
QA	SODIUM CYANIDE	143-33-9	0.47 LBS	10 LBS
QA	SODIUM DICHROMATE	10588-01-9	9.00 LBS	10 LBS
QA	THIOACETAMIDE	62-55-5	0.44 LBS	10 LBS
QA	THIOUREA	62-56-6	3.20 LBS	10 LBS

Table B.2.
(Sheet 2 of 4)

RQ Grp	Chemical Name	CAS No.	Quantity	RQ Value
QB	1,2,4-TRICHLOROENZENE	120-82-1	0.87 LBS	100 LBS
QB	1,2-DICHLOROENZENE	95-50-1	0.03 LBS	100 LBS
QB	3-METHYLPHENOL	108-39-4	0.01 LBS	100 LBS
QB	3-NITROPHENOL	554-84-7	0.06 LBS	100 LBS
QB	4-NITROPHENOL	100-02-7	0.06 LBS	100 LBS
QB	AMMONIA	7664-41-7	0.09 LBS	100 LBS
QB	AMMONIUM FLUORIDE	12125-01-8	8.20 LBS	100 LBS
QB	AMMONIUM HYDROGEN DIFLUORIDE	1341-49-7	8.00 LBS	100 LBS
QB	AMMONIUM SULFIDE	12135-76-1	3.08 LBS	100 LBS
QB	BROMOFORM	75-25-2	15.94 LBS	100 LBS
QB	BRUCINE	357-57-3	0.06 LBS	100 LBS
QB	CARBON DISULFIDE	75-15-0	3.96 LBS	100 LBS
QB	CHLOROACETIC ACID	79-11-8	1.22 LBS	100 LBS
QB	CHLOROBENZENE	108-90-7	1.15 LBS	100 LBS
QB	CUPRIC ACETATE	142-71-2	1.00 LBS	100 LBS
QB	CUPRIC NITRATE	3251-23-8	0.53 LBS	100 LBS
QB	ETHYL ETHER	60-29-7	1.57 LBS	100 LBS
QB	ETHYLENE DICHLORIDE	107-06-2	14.93 LBS	100 LBS
QB	FERROUS CHLORIDE	7758-94-3	1.05 LBS	100 LBS
QB	FORMALDEHYDE	50-00-0	5.71 LBS	100 LBS
QB	HYDROFLUORIC ACID		22.70 LBS	100 LBS
QB	IODOMETHANE	74-88-4	1.26 LBS	100 LBS
QB	NICKEL	7440-02-0	2.46 LBS	100 LBS
QB	NICKEL (II) SULFATE	7786-81-4	1.25 LBS	100 LBS
QB	NICKEL NITRATE	14216-75-2	0.99 LBS	100 LBS
QB	NICKEL(II) CHLORIDE	7718-54-9	6.50 LBS	100 LBS
QB	NICKELOUS AMMONIUM SULFATE	15699-18-0	0.25 LBS	100 LBS
QB	POTASSIUM PERMANGANTE	7722-64-7	31.44 LBS	100 LBS
QB	SELENIUM	7782-49-2	0.56 LBS	100 LBS
QB	SODIUM BIFLUORIDE	1333-83-1	2.00 LBS	100 LBS
QB	SODIUM HYPOCHLORITE	7681-52-9	5.74 LBS	100 LBS
QB	SODIUM NITRITE	7632-00-0	199.27 LBS	100 LBS
QB	THALLIUM CHLORIDE	7791-12-0	0.06 LBS	100 LBS
QB	URANYL NITRATE HEXAHYDRATE	13520-83-7	1.94 LBS	100 LBS
QB	XYLENE	1330-20-7	8.38 LBS	100 LBS
QC	1,1,1-TRICHLOROETHANE	71-55-6	15.97 LBS	1000 LBS
QC	2,2,4-TRIMETHYLPENTANE, KIT	540-84-1	25.47 LBS	1000 LBS
QC	ACETALDEHYDE	75-07-0	0.02 LBS	1000 LBS
QC	AMMONIUM HYDROXIDE	1336-21-6	36.54 LBS	1000 LBS
QC	ANTIMONY TRIOXIDE	1309-64-4	5.91 LBS	1000 LBS
QC	ANTIMONY(V) CHLORIDE	7647-18-9	0.25 LBS	1000 LBS
QC	CHROMIUM(II)CHLORIDE	10049-05-5	1.04 LBS	1000 LBS
QC	COBALT(II)BROMIDE	7789-43-7	0.22 LBS	1000 LBS
QC	CYCLOHEXANE	110-82-7	15.76 LBS	1000 LBS
QC	DIAMMONIUM HEXAFLUOROSILICATE	16919-19-0	2.55 LBS	1000 LBS
QC	FERRIC NITRATE CRYSTALLINE AR GD	10421-48-4	9.83 LBS	1000 LBS
QC	FERRIC SULFATE	10028-22-5	9.20 LBS	1000 LBS
QC	FERROUS AMMONIUM SULFATE HEXAHYDRATE	10045-89-3	2.20 LBS	1000 LBS
QC	HYDROGEN PEROXIDE	7722-84-1	10.95 LBS	1000 LBS
QC	IRON(II) SULFATE	7720-78-7	6.00 LBS	1000 LBS
QC	IRON(III) CHLORIDE	7705-08-0	12.20 LBS	1000 LBS

Table B.2.
(Sheet 3 of 4)

RQ Grp	Chemical Name	CAS No.	Quantity	RQ Value
QC	METHYLENE CHLORIDE	75-09-2	303.52 LBS	1000 LBS
QC	N-BUTYLAMINE	109-73-9	0.11 LBS	1000 LBS
QC	NITRIC ACID	7697-37-2	478.01 LBS	1000 LBS
QC	NITROBENZENE	98-95-3	1.27 LBS	1000 LBS
QC	OSIUM TETROXIDE	20816-12-0	0.00 LBS	1000 LBS
QC	PHENOL	108-95-2	0.23 LBS	1000 LBS
QC	POTASSIUM HEXAFLUOROZIRCONATE	16923-95-8	0.11 LBS	1000 LBS
QC	POTASSIUM HYDROXIDE	1310-58-3	68.24 LBS	1000 LBS
QC	PYRIDINE SILYLATION GRADE	110-86-1	4.32 LBS	1000 LBS
QC	SILVER	7440-22-4	0.47 LBS	1000 LBS
QC	SODIUM AZIDE	26628-22-8	0.22 LBS	1000 LBS
QC	SODIUM FLUORIDE	7681-49-4	19.64 LBS	1000 LBS
QC	SODIUM HYDROXIDE	1310-73-2	1,262.26 LBS	1000 LBS
QC	SULFURIC ACID	7664-93-9	142.07 LBS	1000 LBS
QC	TETRAHYDROFURAN	109-99-9	0.41 LBS	1000 LBS
QC	TITANIUM TETRACHLORIDE	7550-45-0	0.26 LBS	1000 LBS
QC	TOLUENE	108-88-3	37.79 LBS	1000 LBS
QC	VANADIUM PENTAOXIDE	1314-62-1	1.29 LBS	1000 LBS
QC	ZINC ACETATE	557-34-6	1.00 LBS	1000 LBS
QC	ZINC BROMIDE	7699-45-8	1.00 LBS	1000 LBS
QC	ZINC CARBONATE	3486-35-9	1.10 LBS	1000 LBS
QC	ZINC CHLORIDE	7646-85-7	4.00 LBS	1000 LBS
QC	ZINC NITRATE	7779-88-6	5.00 LBS	1000 LBS
QC	ZINC SULFATE	7733-02-0	7.00 LBS	1000 LBS
QD	ACETIC ACID	64-19-7	57.03 LBS	5000 LBS
QD	ACETIC ANHYDRIDE	108-24-7	1.22 LBS	5000 LBS
QD	ACETONE	67-64-1	117.87 LBS	5000 LBS
QD	ACETONITRILE	75-05-8	34.24 LBS	5000 LBS
QD	ALUMINUM SULPHATE	10043-01-3	5.54 LBS	5000 LBS
QD	AMMONIUM ACETATE	631-61-8	7.63 LBS	5000 LBS
QD	AMMONIUM BICARBONATE	1066-33-7	1.00 LBS	5000 LBS
QD	AMMONIUM CARBONATE	506-87-6	9.20 LBS	5000 LBS
QD	AMMONIUM CHLORIDE	12125-02-9	7.22 LBS	5000 LBS
QD	AMMONIUM CITRATE, DIBASIC	3012-65-5	5.25 LBS	5000 LBS
QD	AMMONIUM FLUOROBORATE	13826-83-0	5.00 LBS	5000 LBS
QD	AMMONIUM SULFAMATE	7773-06-0	0.06 LBS	5000 LBS
QD	AMMONIUM TARTRATE	14307-43-8	3.00 LBS	5000 LBS
QD	AMMONIUM THIOCYANATE	1762-95-4	5.10 LBS	5000 LBS
QD	ANILINE	62-53-3	0.22 LBS	5000 LBS
QD	ANTHRACENE	120-12-7	0.06 LBS	5000 LBS
QD	ANTIMONY	7440-36-0	1.58 LBS	5000 LBS
QD	BENZOIC ACID	65-85-0	2.20 LBS	5000 LBS
QD	CHROMIUM	7440-47-3	0.46 LBS	5000 LBS
QD	COPPER	7440-50-8	26.13 LBS	5000 LBS
QD	DI-N-OCTYL PHTHALATE	117-84-0	1.10 LBS	5000 LBS
QD	DICHLORODIFLUOROMETHANE	75-71-8	0.04 LBS	5000 LBS
QD	ETHYL ACETATE	141-78-6	8.73 LBS	5000 LBS
QD	ETHYLENE GLYCOL	107-21-1	2.33 LBS	5000 LBS
QD	ETHYLENEDIAMINE	107-15-3	1.98 LBS	5000 LBS
QD	FORMIC ACID	64-18-6	31.09 LBS	5000 LBS
QD	HEXANE	110-54-3	87.99 LBS	5000 LBS

Table B.2.
(Sheet 4 of 4)

RQ Grp	Chemical Name	CAS No.	Quantity	RQ Value
QD	HYDROCHLORIC ACID		93.98 LBS	5000 LBS
QD	ISOBUTYL ALCOHOL	78-83-1	0.72 LBS	5000 LBS
QD	ISOBUTYRIC ACID	79-31-2	0.22 LBS	5000 LBS
QD	METHYL ALCOHOL	67-56-1	197.61 LBS	5000 LBS
QD	METHYL ETHYL KETONE	78-93-3	1.68 LBS	5000 LBS
QD	METHYL ISOBUTYL KETONE	108-10-1	10.49 LBS	5000 LBS
QD	N-BUTYL ALCOHOL	71-36-3	4.44 LBS	5000 LBS
QD	PENTYL ACETATE	628-63-7	10.45 LBS	5000 LBS
QD	PHOSPHORIC ACID	7664-38-2	29.17 LBS	5000 LBS
QD	PROPYLAMINE	107-10-8	0.90 LBS	5000 LBS
QD	SODIUM PHOSPHATE DIBASIC	7558-79-4	8.29 LBS	5000 LBS
QD	SODIUM PHOSPHATE, TRIBASIC	7601-54-9	4.00 LBS	5000 LBS
QD	TRIETHYLAMINE	121-44-8	0.59 LBS	5000 LBS
QD	ZIRCONIUM NITRATE	13746-89-9	0.06 LBS	5000 LBS

Last updated 11/25/98.

Send questions or comments to the CMS Support Team.

Appendix C

Supporting Calculations

	Particles	Composite Samples	Tritium	
Lab Corr Factor	0.85	1	1	
Op Factor	1	1	1	
Media Factor	0.91	0.91	1	
Sampler Flow	3.10 cfm	3.10 cfm	0.007063 cfm	(200 mL.min)
Stack Flow	139,000 cfm	139,000 cfm	139,000 cfm	
Transp. Factor	0.93	0.93	1	

Detectable Release =
$$\frac{(MDA / Yr \text{ fraction}) \times (\text{stack flow/sample flow}) \times 1E-12}{\text{Lab Corr. factor} \times \text{Op. Factor} \times \text{Transport Factor} \times \text{Media Factor}}$$

Radionuclide	MDA (pCi/sample)	Detectable Annual Release (Ci)	Unit Dose mrem/yr/Ci	Emission for 0.01 mrem/yr (Ci)	Yr Fraction	
Beta Activity	38	6.2E-05	4.9	2.0E-03	3.85E-02	2 wk sample
Alpha Activity	1	1.6E-06	180	5.6E-05	3.85E-02	2 wk sample
Sr-90	38	4.0E-06	4.9	2.0E-03	5.00E-01	6 mo. Sample
Cs-137	38	4.0E-06	4.9	2.0E-03	5.00E-01	6 mo. Sample
Am-241	0.7	7.4E-08	290	3.4E-05	5.00E-01	6 mo. Sample
Am-243	0.7	7.4E-08	290	3.4E-05	5.00E-01	6 mo. Sample
Pu-238	1	1.1E-07	180	5.6E-05	5.00E-01	6 mo. Sample
Pu-239/240	1	1.1E-07	200	5.0E-05	5.00E-01	6 mo. Sample
Pu-241	1	1.1E-07	3.2	3.1E-03	5.00E-01	6 mo. Sample
Tritium (HTO)	61	1.4E-02	4.10E-04	2.4E+01	8.33E-02	1 mo. Sample
Tritium (HT)	8	1.9E-03	4.10E-06	2.4E+03	8.33E-02	1 mo. Sample

Minimum Detectable Particulate Concentration

Detectable Concentration =
$$\frac{(MDA) \times 1E-12}{\text{Lab Corr. factor} \times \text{Transport Factor} \times \text{Media Factor} \times \text{sampler flow} \times \text{time}}$$

3.1 CFM =	87782.7	cm3/min			
time (2 weeks) =	20160	min			
	Alpha	7.9E-22	Ci/cm3 =	7.9E-16	uCi/cm3
	Beta	3.0E-20	Ci/cm3 =	3.0E-14	uCi/cm3

Minimum Detectable Tritium Concentration

Lab DL	380 pCi/l of water
Air Sample Rate	200 mL/min
Nominal Water Volume collected during Sample Period	0.160 liters of water
Nominal Sample Period (30 days)	43200 minutes

MDC for tritium =
$$\text{Lab DL} \times 1e-12 \times (\text{Total Water Volume}) / (\text{Air Sample Rate}) \times (\text{Sample Period})$$

MDC for Tritium (HTO)	7.04E-18 Ci/mL	7.04E-12 nCi/cc
MDC for Tritium (HT)	8.80E-19 Ci/mL	8.80E-13 nCi/cc

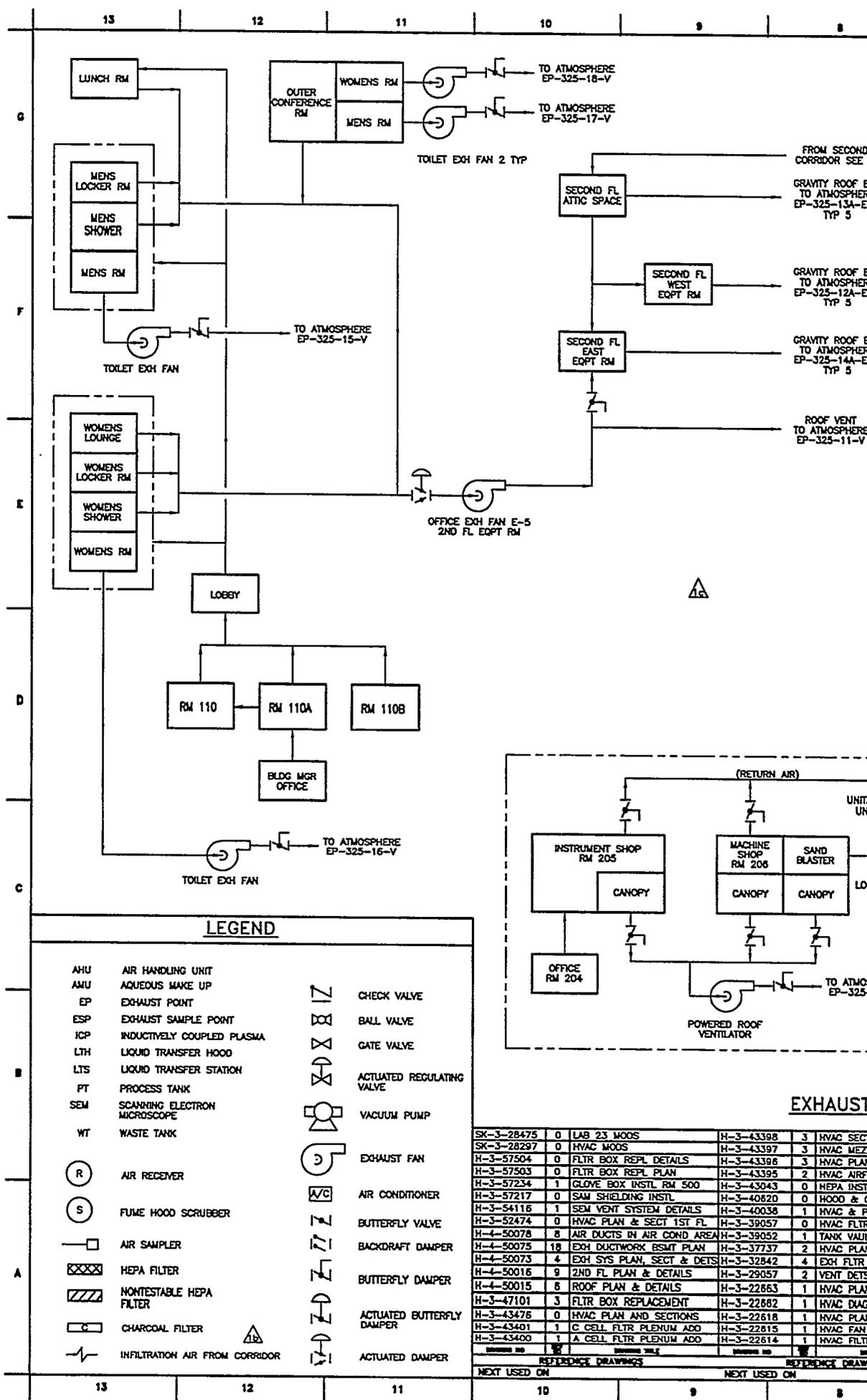
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Appendix D

Facility Effluent Pathway Drawings

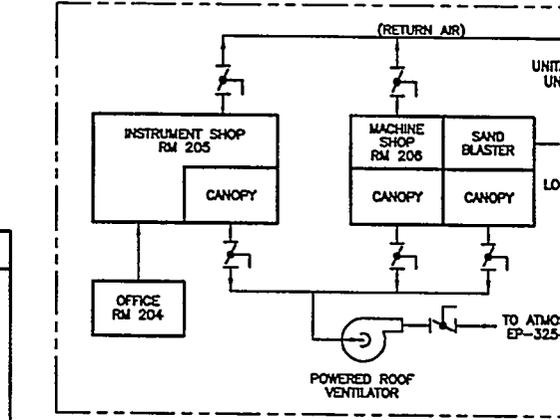
Current copies of the Essential Drawings related to effluent pathways are included in this appendix. These drawings are current as of publishing this document. The official up-to-date version can be obtained from Battelle Engineering Files.

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LEGEND

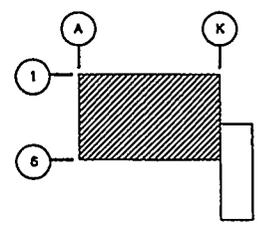
- | | | | |
|-----|--------------------------------|--|---------------------------|
| AHU | AIR HANDLING UNIT | | CHECK VALVE |
| AMU | AQUEDUS MAKE UP | | BALL VALVE |
| EP | EXHAUST POINT | | GATE VALVE |
| ESP | EXHAUST SAMPLE POINT | | ACTUATED REGULATING VALVE |
| ICP | INDUCTIVELY COUPLED PLASMA | | VACUUM PUMP |
| LTH | LIQUID TRANSFER HOOD | | EXHAUST FAN |
| LTS | LIQUID TRANSFER STATION | | AIR CONDITIONER |
| PT | PROCESS TANK | | BUTTERFLY VALVE |
| SEM | SCANNING ELECTRON MICROSCOPE | | BACKDRAFT DAMPER |
| WT | WASTE TANK | | BUTTERFLY DAMPER |
| | AIR RECEIVER | | ACTUATED BUTTERFLY DAMPER |
| | FUME HOOD SCRUBBER | | ACTUATED DAMPER |
| | AIR SAMPLER | | |
| | HEPA FILTER | | |
| | NONTESTABLE HEPA FILTER | | |
| | CHARCOAL FILTER | | |
| | INFILTRATION AIR FROM CORRIDOR | | |



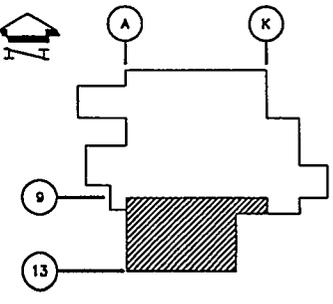
EXHAUST

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SK-3-28297	0	HVAC WOODS	H-3-43397	3
H-3-57504	0	FLTR BOX REPL DETAILS	H-3-43396	3
H-3-57503	0	FLTR BOX REPL PLAN	H-3-43395	2
H-3-57234	1	GLOVE BOX INSTL RM 500	H-3-43043	0
H-3-57217	0	SEM SHIELDING INSTL	H-3-40820	0
H-3-54116	1	SEM VENT SYSTEM DETAILS	H-3-40038	1
H-3-52474	0	HVAC PLAN & SECT 1ST FL	H-3-39057	0
H-4-50078	8	AIR DUCTS IN AIR COND AREA	H-3-39052	1
H-4-50075	18	EXH DUCTWORK BSMT PLAN	H-3-37737	2
H-4-50073	4	EXH SYS PLAN, SECT & DETS	H-3-32842	4
H-4-50016	9	2ND FL PLAN & DETAILS	H-3-29057	2
H-4-50015	6	ROOF PLAN & DETAILS	H-3-22863	1
H-3-47101	3	FLTR BOX REPLACEMENT	H-3-22862	1
H-3-43476	0	HVAC PLAN AND SECTIONS	H-3-22618	1
H-3-43401	1	C CELL FLTR PLENUM ADD	H-3-22615	1
H-3-43400	1	A CELL FLTR PLENUM ADD	H-3-22614	1

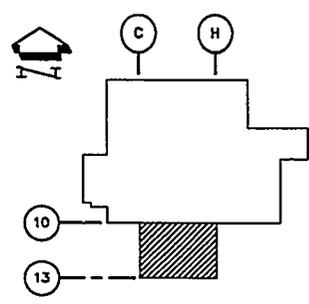
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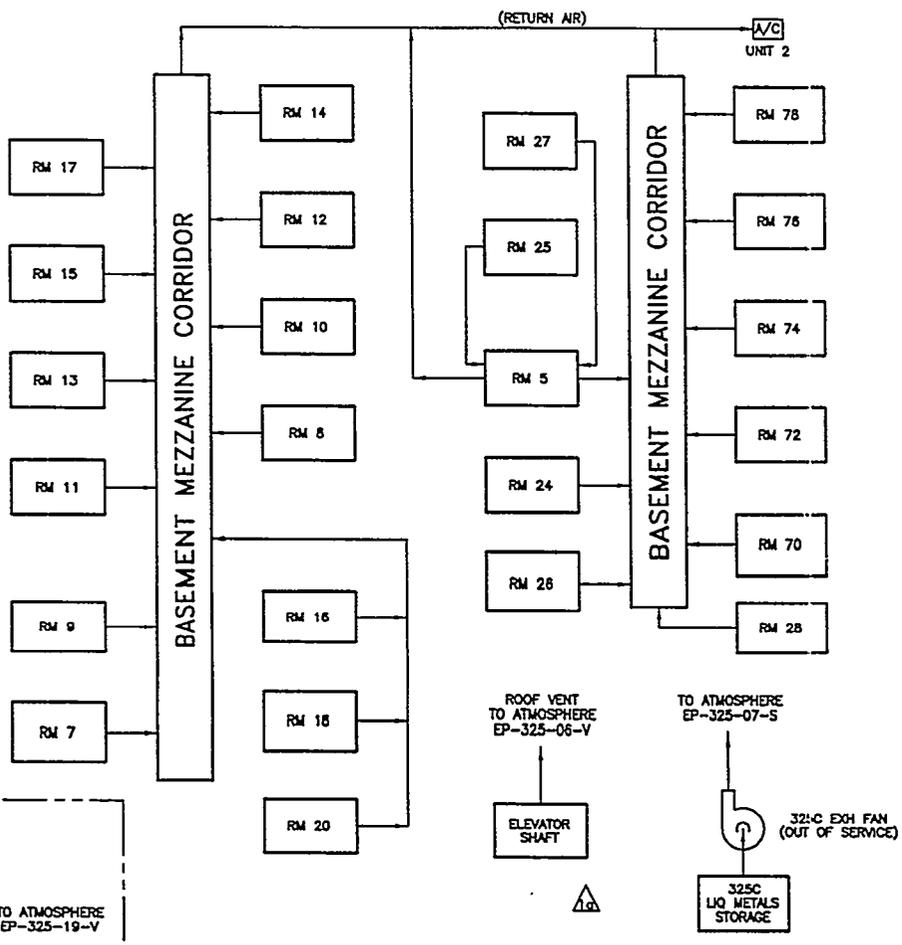
SECOND FL PLAN



FIRST FL PLAN



BASEMENT PLAN



EXHAUST FLOW DIAGRAM

NO.	DESCRIPTION	DATE	BY	CHKD BY
1	HVAC PLAN GENL NOTES			
2	HVAC AIR FLOW DIAGRAM			
3	HVAC 2ND FL PLAN & SECT			
4	HVAC 1ST & 2ND FL PLAN			
5	HVAC FLOW & CONT DIAG			
6	HVAC BSMT PLAN & DETAILS			
7	HVAC BSMT PLAN & DETAILS			
8	HVAC PLAN & DETAILS			
9	HVAC PLANS & DETAILS			
10	HEATING & VENT EL & DETS			
11	SPLY & EXH H RAD FACIL			
12	HVAC EXH HIGH RAD FACIL			
13	HVAC SPLY HIGH RAD FACIL			
14	HVAC CERUIM RCVY FACIL			
15	HVAC CERUIM RCVY FACIL			
16	HVAC CERUIM RCVY FACIL			
17	PIPING PLAN VAULT AREA			

NO.	DESCRIPTION	DATE	BY	CHKD BY
1	DELETED NOTE			
2	REVISED PER FWP#03386, SYMBOL PER FWP#03370, INFILTRATION FROM CORRIDOR PER FWP# 03281, b)ADDED			
3	UPDATED BASEMENT MEZZANINE			

U. S. DEPARTMENT OF ENERGY
 RICHLAND OPERATIONS OFFICE
 PACIFIC NORTHWEST LABORATORY
 OPERATED BY BATTELLE MEMORIAL INSTITUTE

EXHAUST FLOW DIAGRAM
 NON RAD AREAS

EPFLUENT SYSTEM DIAGRAMS

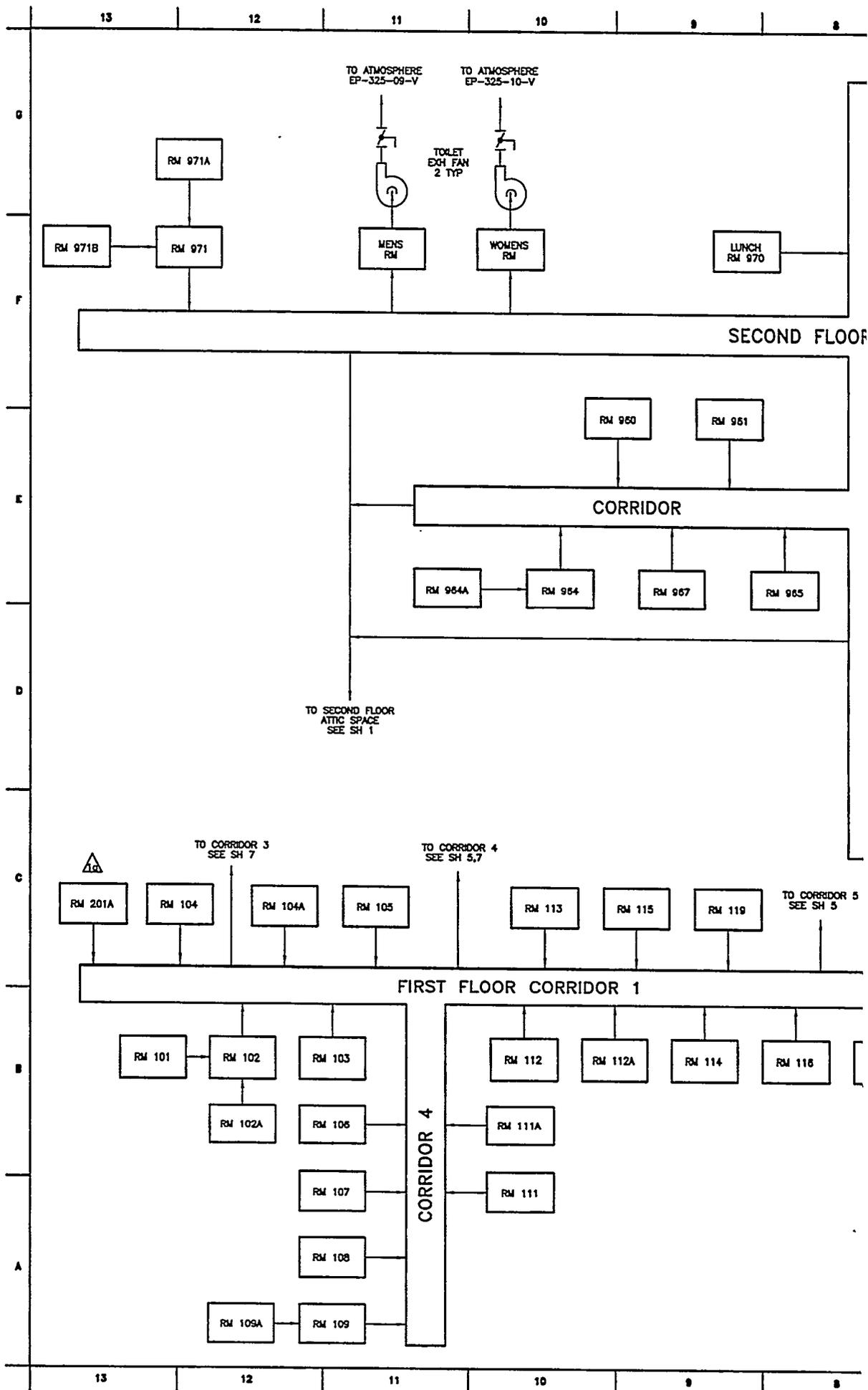
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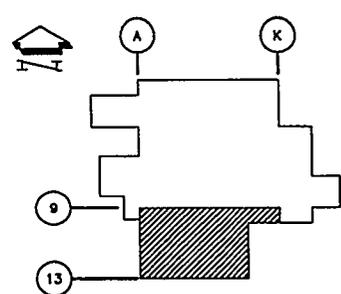
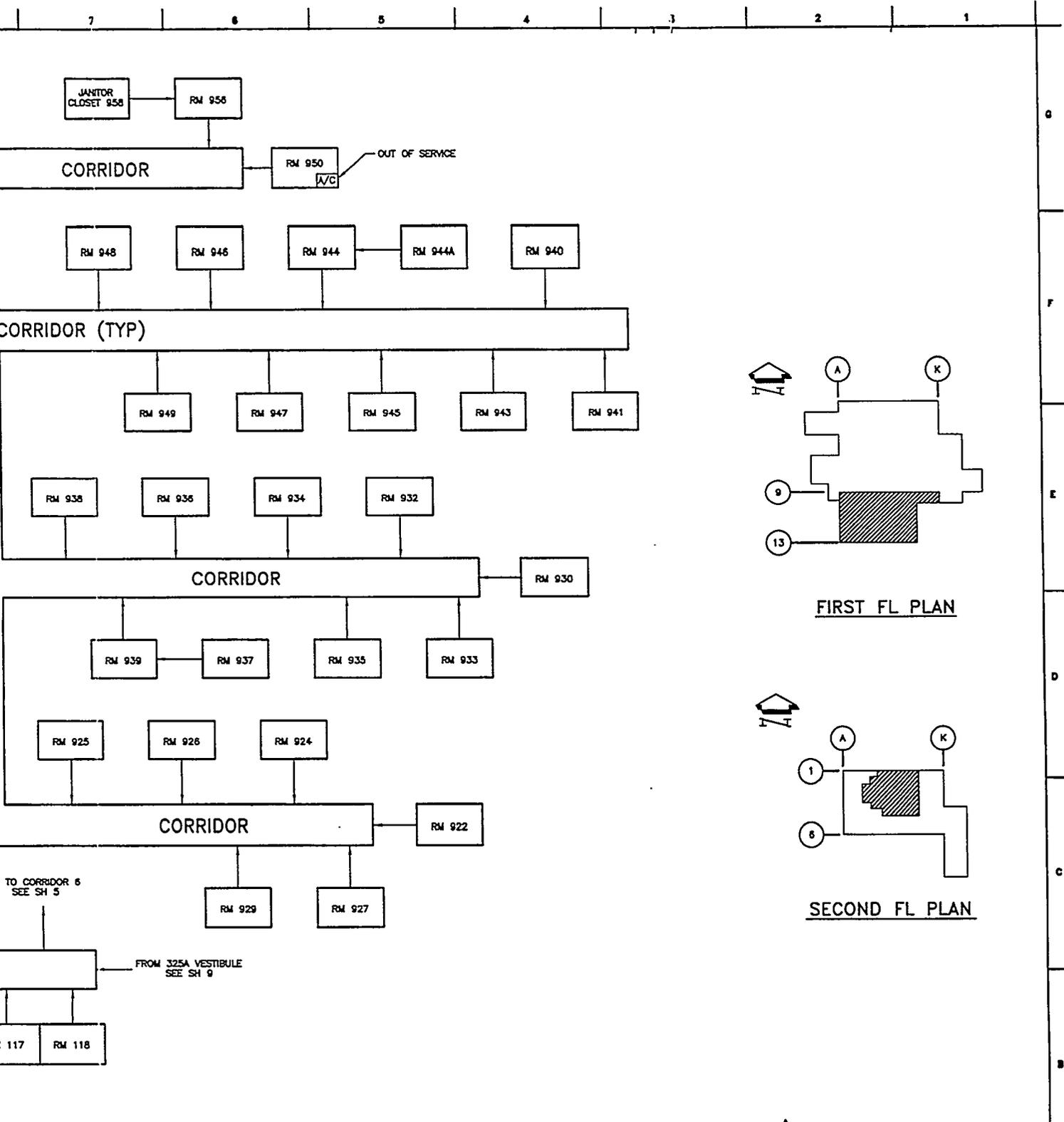
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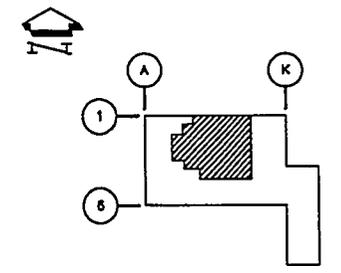


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FIRST FL PLAN

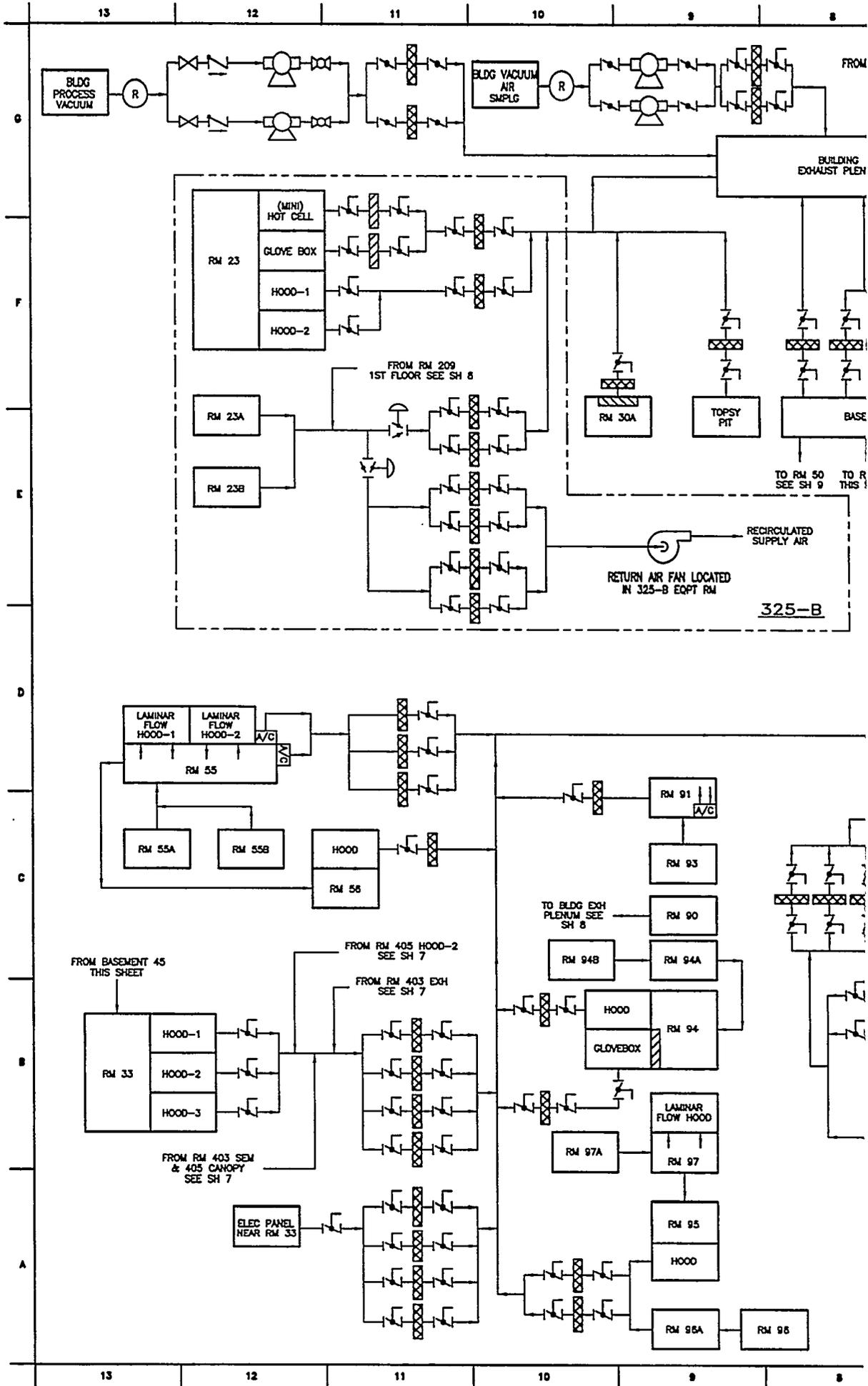


SECOND FL PLAN

EXHAUST FLOW DIAGRAM



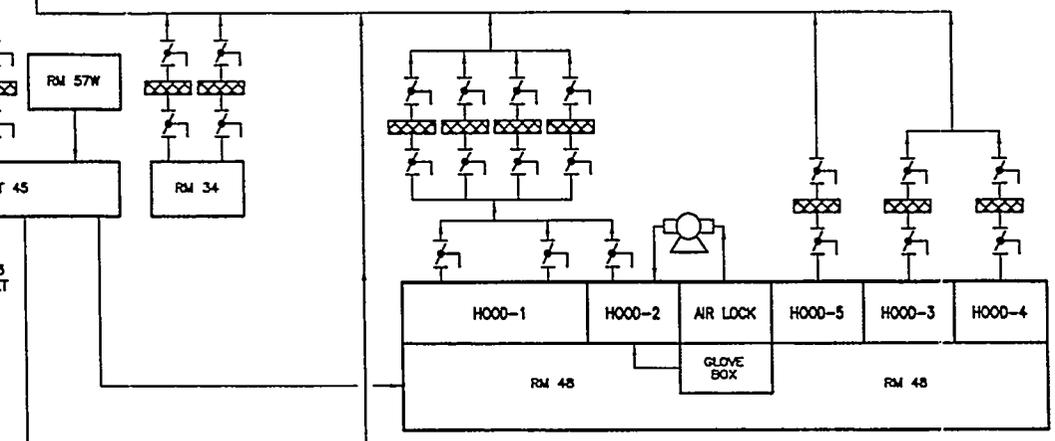
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FOR PNL		DATE	10/1/78																																																																				
<table border="1"> <tr> <td>PROJECT NO.</td> <td>7001</td> <td>325</td> <td>7001</td> <td>325</td> <td>7001</td> <td>325</td> </tr> <tr> <td>SCALE</td> <td>AS SHOWN</td> <td>AS SHOWN</td> <td>AS SHOWN</td> <td>AS SHOWN</td> <td>AS SHOWN</td> <td>AS SHOWN</td> </tr> <tr> <td>DATE</td> <td>10/2/78</td> <td>10/2/78</td> <td>10/2/78</td> <td>10/2/78</td> <td>10/2/78</td> <td>10/2/78</td> </tr> </table>												PROJECT NO.	7001	325	7001	325	7001	325	SCALE	AS SHOWN	AS SHOWN	DATE	10/2/78	10/2/78	10/2/78	10/2/78	10/2/78	10/2/78																																											
PROJECT NO.	7001	325	7001	325	7001	325																																																																	
SCALE	AS SHOWN	AS SHOWN	AS SHOWN	AS SHOWN	AS SHOWN	AS SHOWN																																																																	
DATE	10/2/78	10/2/78	10/2/78	10/2/78	10/2/78	10/2/78																																																																	
<table border="1"> <tr> <td>U. S. DEPARTMENT OF ENERGY</td> <td colspan="5">PACIFIC NORTHWEST LABORATORY</td> </tr> <tr> <td colspan="6">OPERATED BY METRILE MECHANICAL INSTITUTE</td> </tr> <tr> <td colspan="6">EXHAUST FLOW DIAGRAM</td> </tr> <tr> <td colspan="6">EFFLUENT SYSTEM DIAGRAMS</td> </tr> <tr> <td colspan="6">H-3-70230</td> </tr> <tr> <td colspan="6">SHEET 2 OF 9</td> </tr> </table>												U. S. DEPARTMENT OF ENERGY	PACIFIC NORTHWEST LABORATORY					OPERATED BY METRILE MECHANICAL INSTITUTE						EXHAUST FLOW DIAGRAM						EFFLUENT SYSTEM DIAGRAMS						H-3-70230						SHEET 2 OF 9																													
U. S. DEPARTMENT OF ENERGY	PACIFIC NORTHWEST LABORATORY																																																																						
OPERATED BY METRILE MECHANICAL INSTITUTE																																																																							
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H-3-70230																																																																							
SHEET 2 OF 9																																																																							
<table border="1"> <tr> <td>REFERENCE DRAWINGS</td> <td>CHECKED</td> <td>3D:JBM:ACD2:13.0:SS</td> <td>ORFILE</td> <td>C070230B</td> </tr> <tr> <td>NEXT USED ON</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>												REFERENCE DRAWINGS	CHECKED	3D:JBM:ACD2:13.0:SS	ORFILE	C070230B	NEXT USED ON																																																						
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NEXT USED ON																																																																							



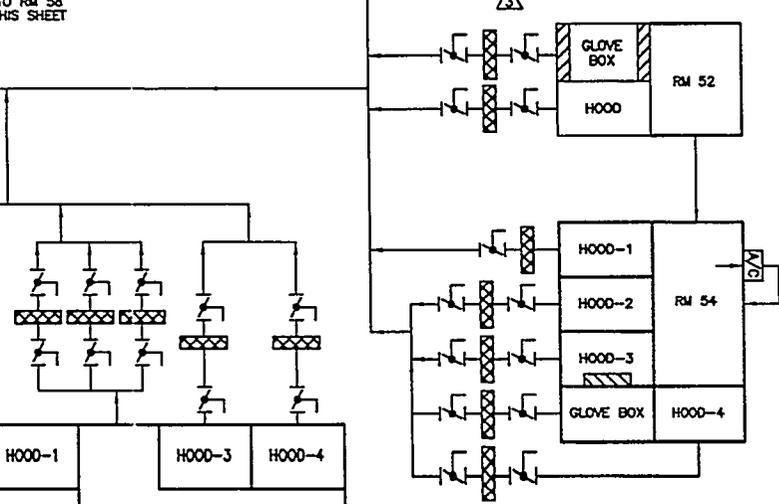
-A ADDITION SH 9

TO FILTER ADDITION EXH TUNNEL SEE SH 4

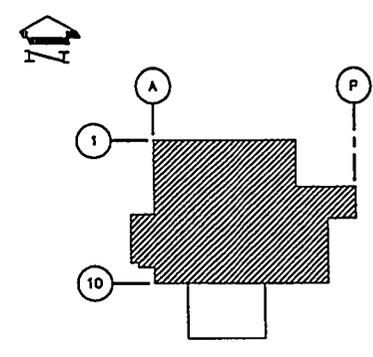
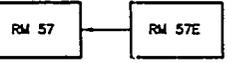
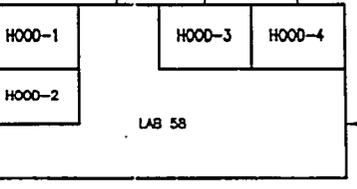
FROM 1ST FLOOR SEE SH 5,6,7,8



TO RM 58 THIS SHEET



FROM BSMT 45 THIS SHEET



BASEMENT PLAN

EXHAUST FLOW DIAGRAM

PRE-RELEASE 10-03-81 DATE

REV	BY	DATE	DESCRIPTION	NO
1	M	9/25/76	LSR	3
2	M	3/23/78	JLG SOB	2
3	M	8/21/78	JES SOB	1
4	M	8/22/78	JES SOB	1

NO	DATE	BY	DESCRIPTION
1	10/2/76	JW LEEPER	REV PER FMP D01385-EDP01
2	10/2/76	JW LEEPER	REV PER FMP D00284-01-0-01
3	10/2/76	JW LEEPER	REV PER FMP D00284-01-0-01

U. S. DEPARTMENT OF ENERGY
 RICHARD OWENSON OFFICE
 PACIFIC NORTHWEST LABORATORY
 OPERATED BY BETHLEHEM STEEL INSTITUTE

EXHAUST FLOW
 DIAGRAM
 BASEMENT RAD AREAS

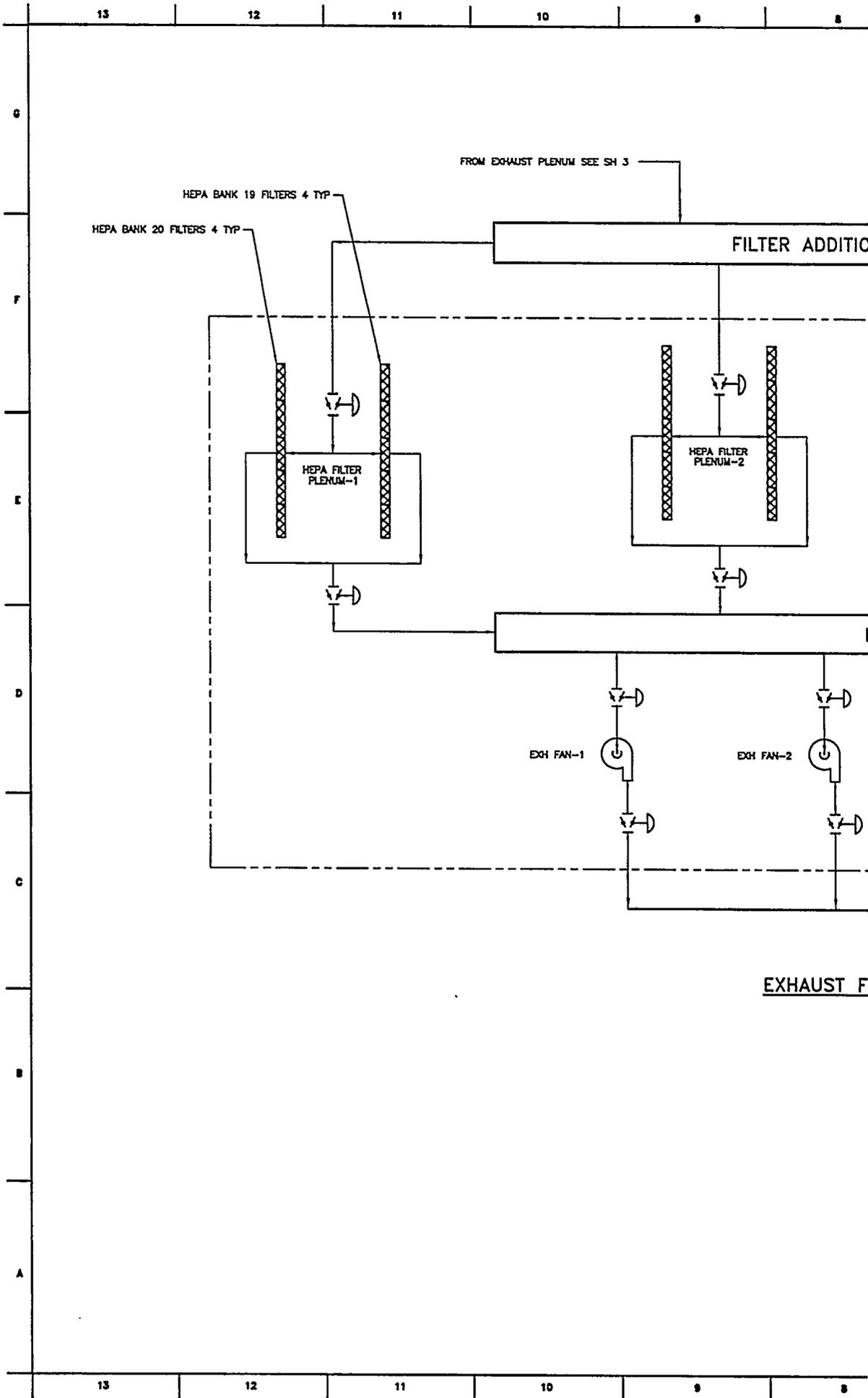
EFFLUENT SYSTEM DIAGRAMS

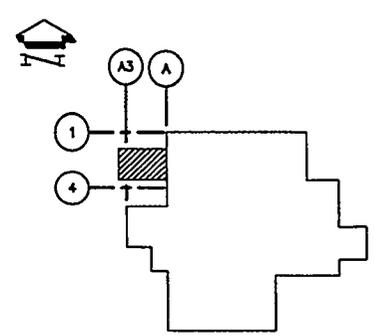
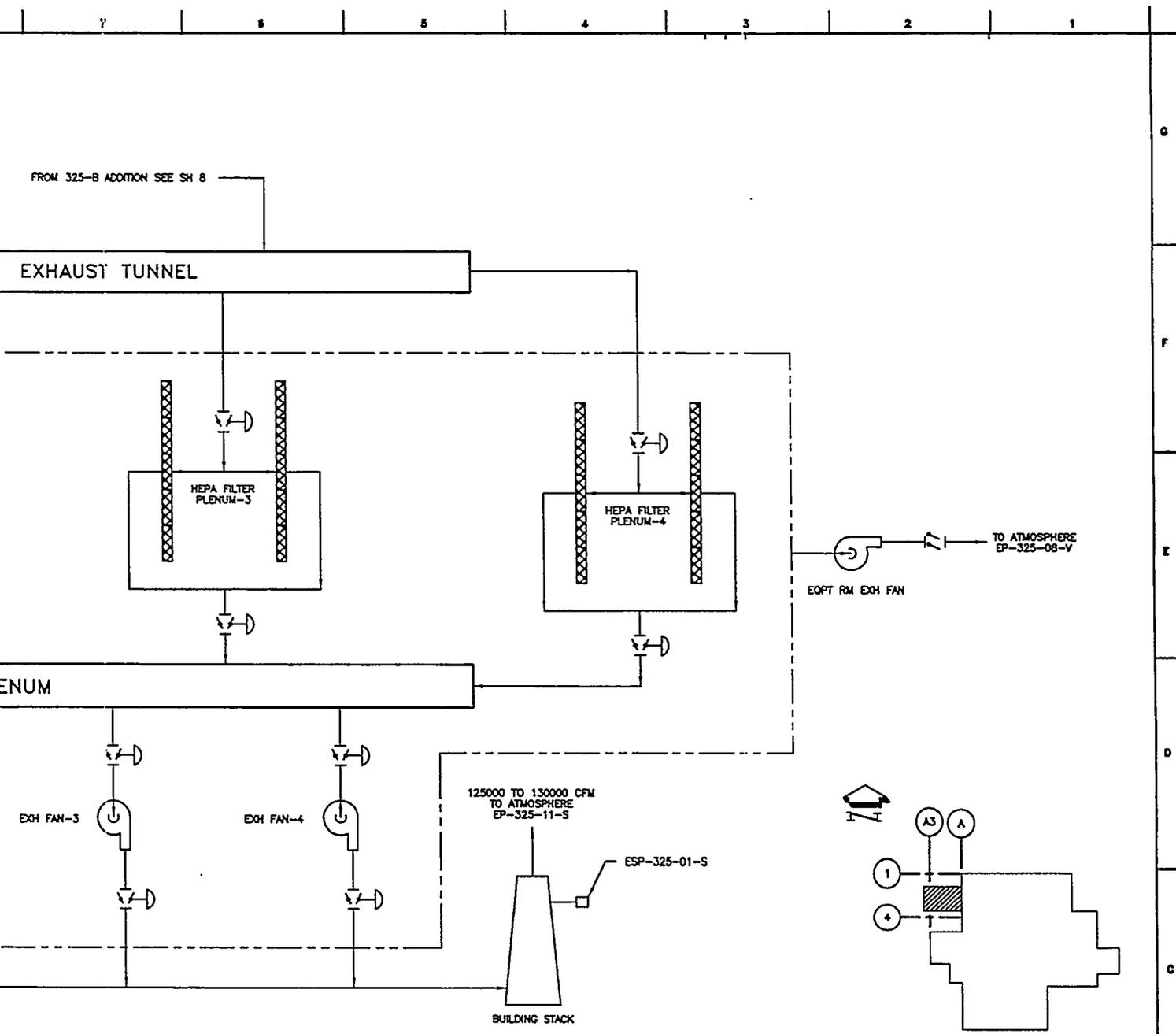
7001 8900
 325 3255
 H-3-70230

DATE 10/2/76
 SHEET 3 OF 9

LINKING NO	ISSUING TITLE

REVISIONS
 CHGCODE 30:EM:ACD2:13.0:SS
 CHGPLE C070230C





FLOW DIAGRAM

FIRST FL PLAN

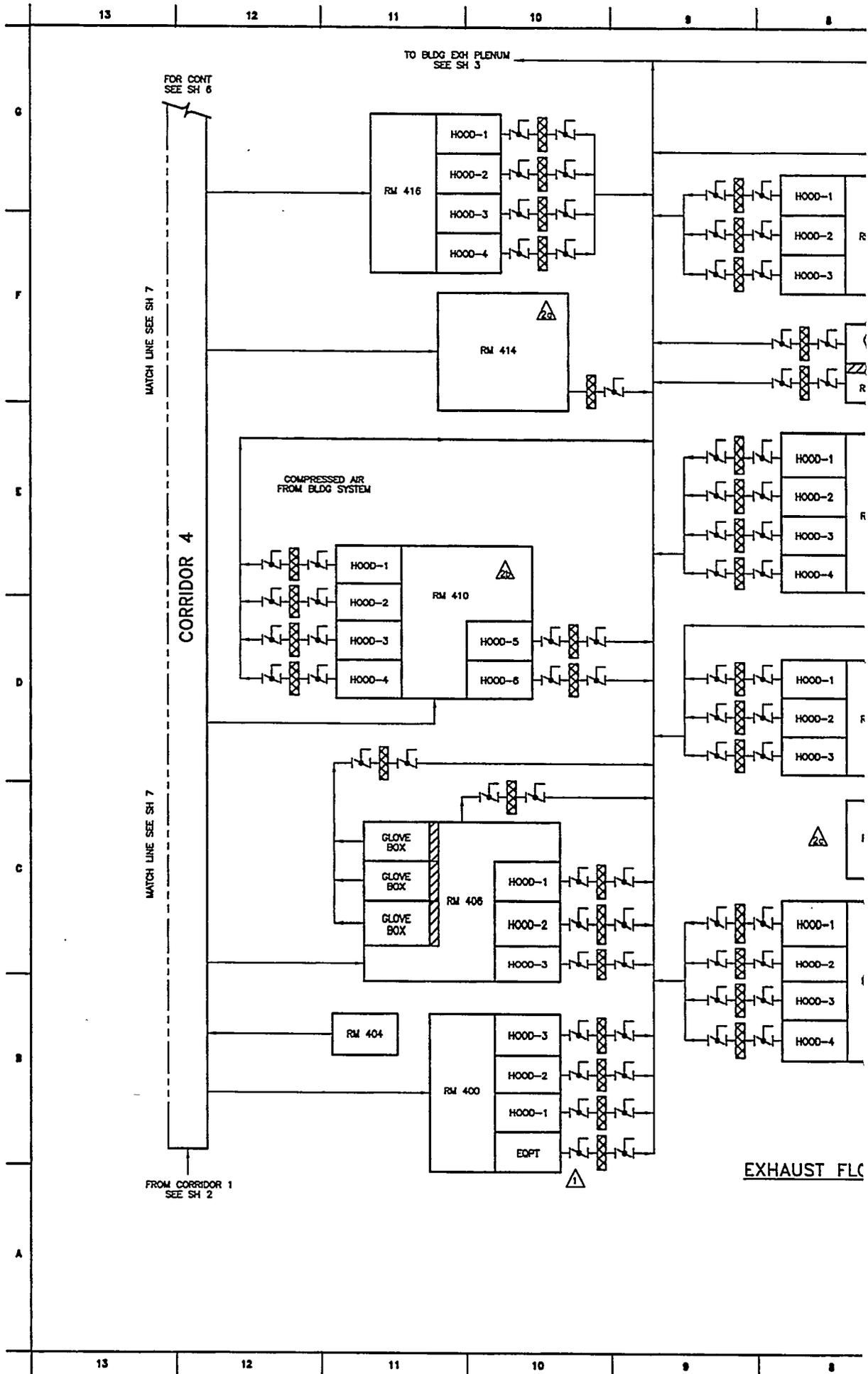
DO NOT REVISE WITHOUT
PRIOR AUTHORIZATION FROM
PNL RADIOLOGICAL ENGINEERING

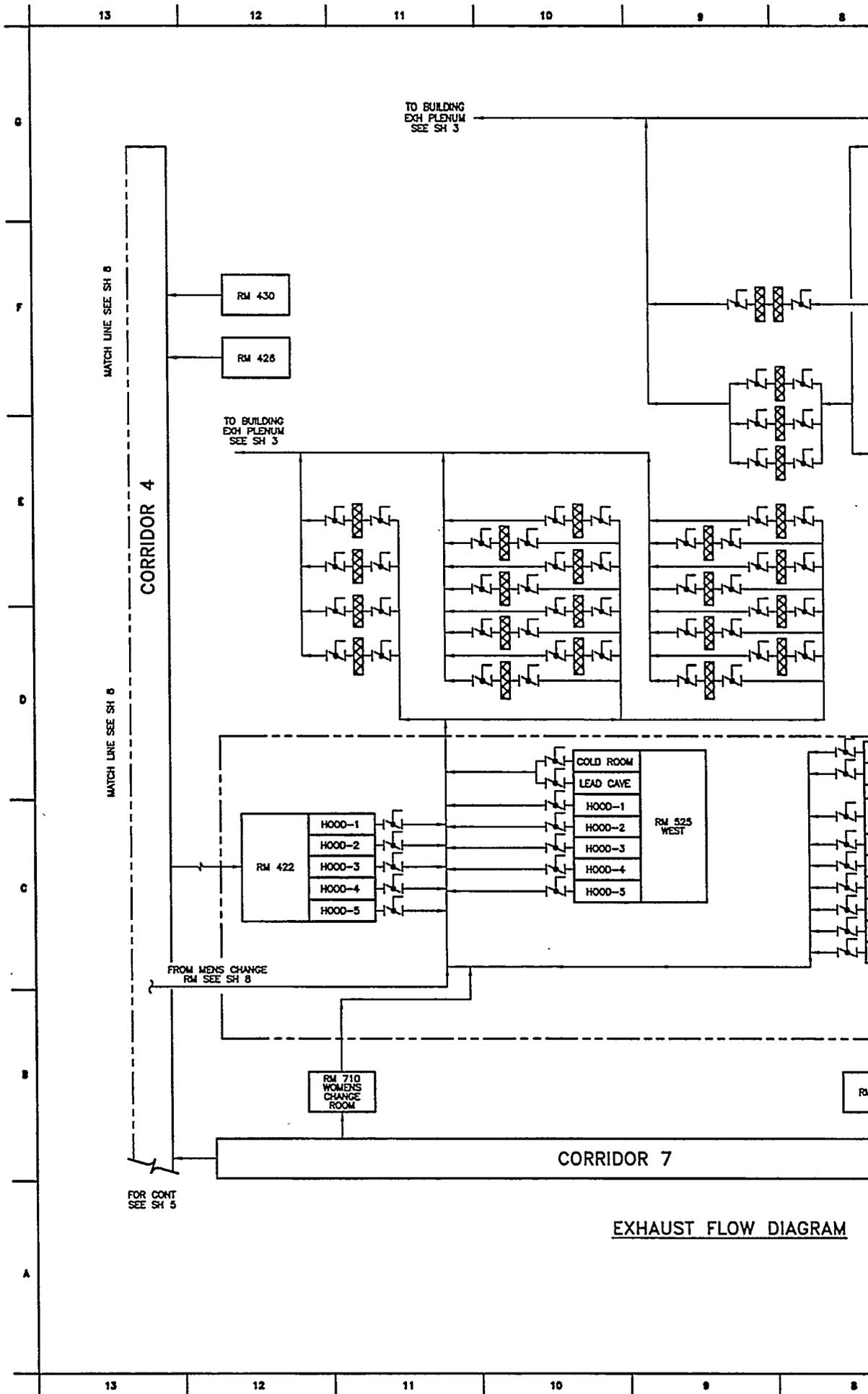
IMP # 90-163

JE SANDBERG		DATE	U. S. DEPARTMENT OF ENERGY	
U SILVER		1/14/71	ISLAND OPERATIONS OFFICE	
R SCOTT SPENCER		10/2/71	PACIFIC NORTHWEST LABORATORY	
JW LEPPER		10/2/71	OPERATED BY BETHLEHEM MEDICAL INSTITUTE	
ER GERK		10/2/71	EXHAUST FLOW	
			DIAGRAM	
			FILTER ADDITION	
			EFFLUENT SYSTEM DIAGRAMS	
AG COUCH		10/2/71	7001	325
BY JW LEPPER			8900	H-3-70230
FOR PNL		DATE 10/2/71	F	0
			SCALE NONE	SHEET 4 OF 9

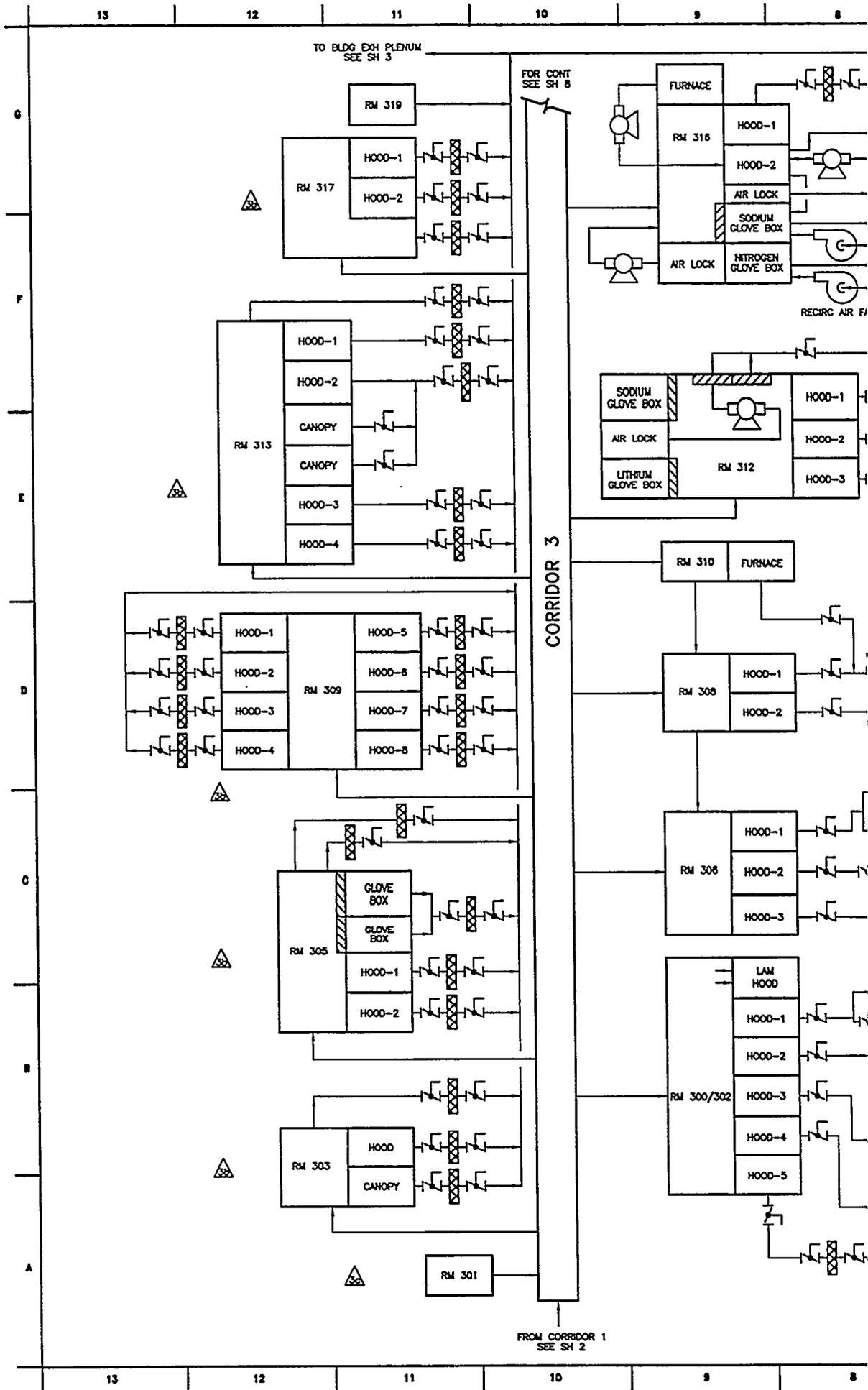
REV	BY	DATE	APP'D BY	CHK'D BY	REV BY	DESCRIPTION

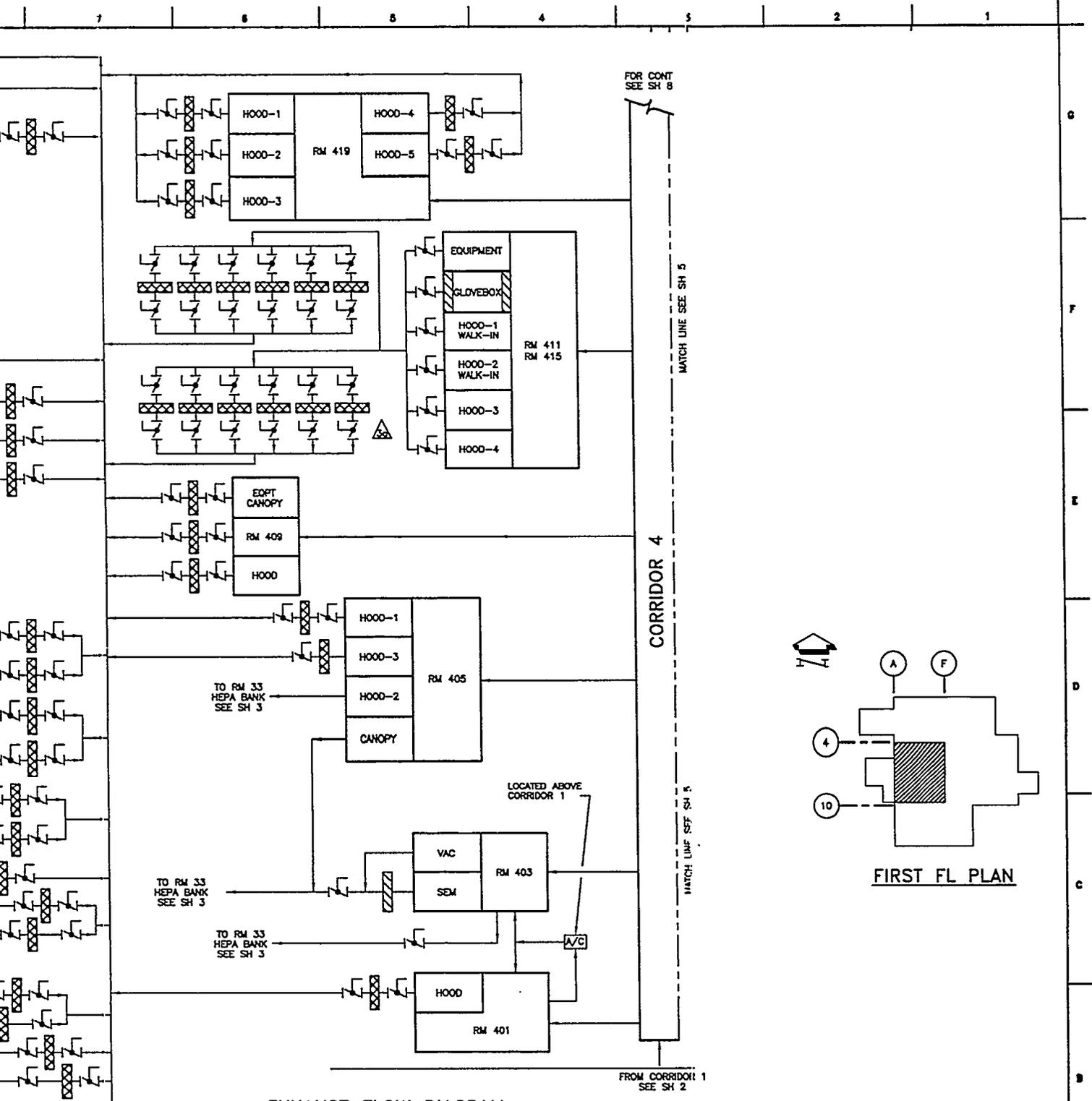
CHGCODE 30:BM:ACD2:11.0:SS CHGFILE C0702300



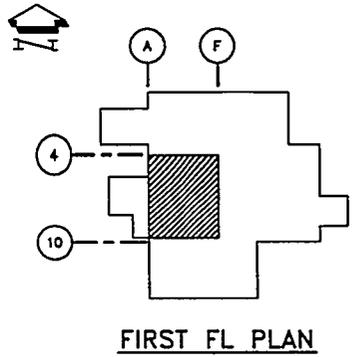


EXHAUST FLOW DIAGRAM





EXHAUST FLOW DIAGRAM



FIRST FL PLAN

REV	DATE	BY	CHK	DESCRIPTION	NO
07-11-97		DRS		ECN 89-170-127 c) REMOVED ROOM 303A PER 2 AIR INTAKE PER FMP D3399 305, 309, 313 & 317 CORRIDOR FMP01 b) REMOVED RM 303, 411-415 PER D01194-EDP01 AND 8 HEPA FILTERS FOR ROOM a) ADDED GLOVEBOX, EQUIPMENT	3
07-25-98		JES		ECN04 D00162-EDP01 R01-FMP00- & HEPA RM 409 Z6-E PER RM 300/302 Z6-B b) ADD HOOD c) ADD LAM HOOD & RELOC HEPA	2
08-25-98		JES		D3380 REV PER a) FMP D3052 b) FMP	1



FIGURE NO	ISSUING TITLE
REFERENCE DRAWINGS	
NEXT USED ON	

ORIGCODE 30:BM:ACD2:13.0:SS ORFILE C070230G

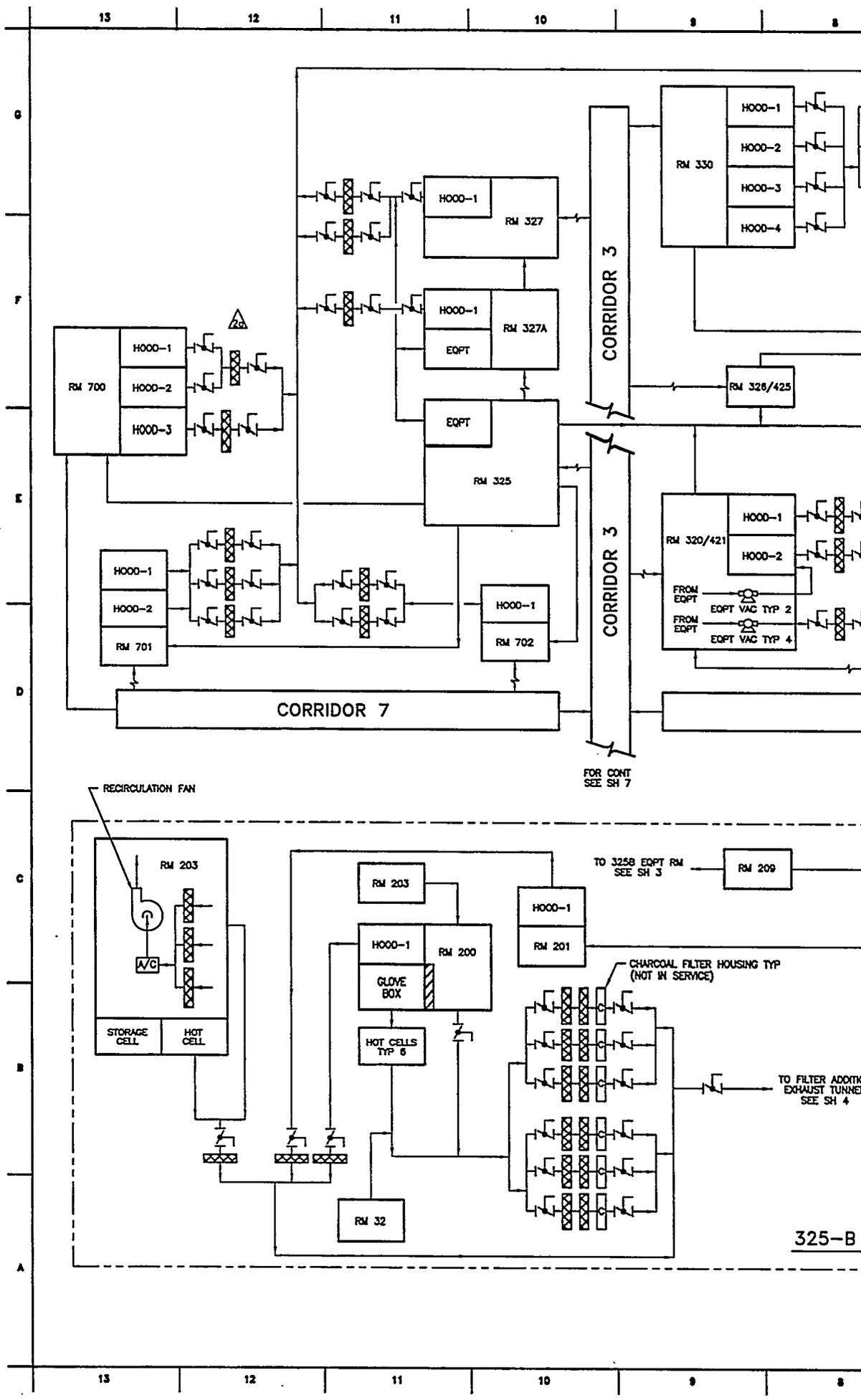
U. S. DEPARTMENT OF ENERGY
 RICHLAND OPERATIONS OFFICE
 PACIFIC NORTHWEST LABORATORY
 OPERATED BY BATTELLE MEMORIAL INSTITUTE

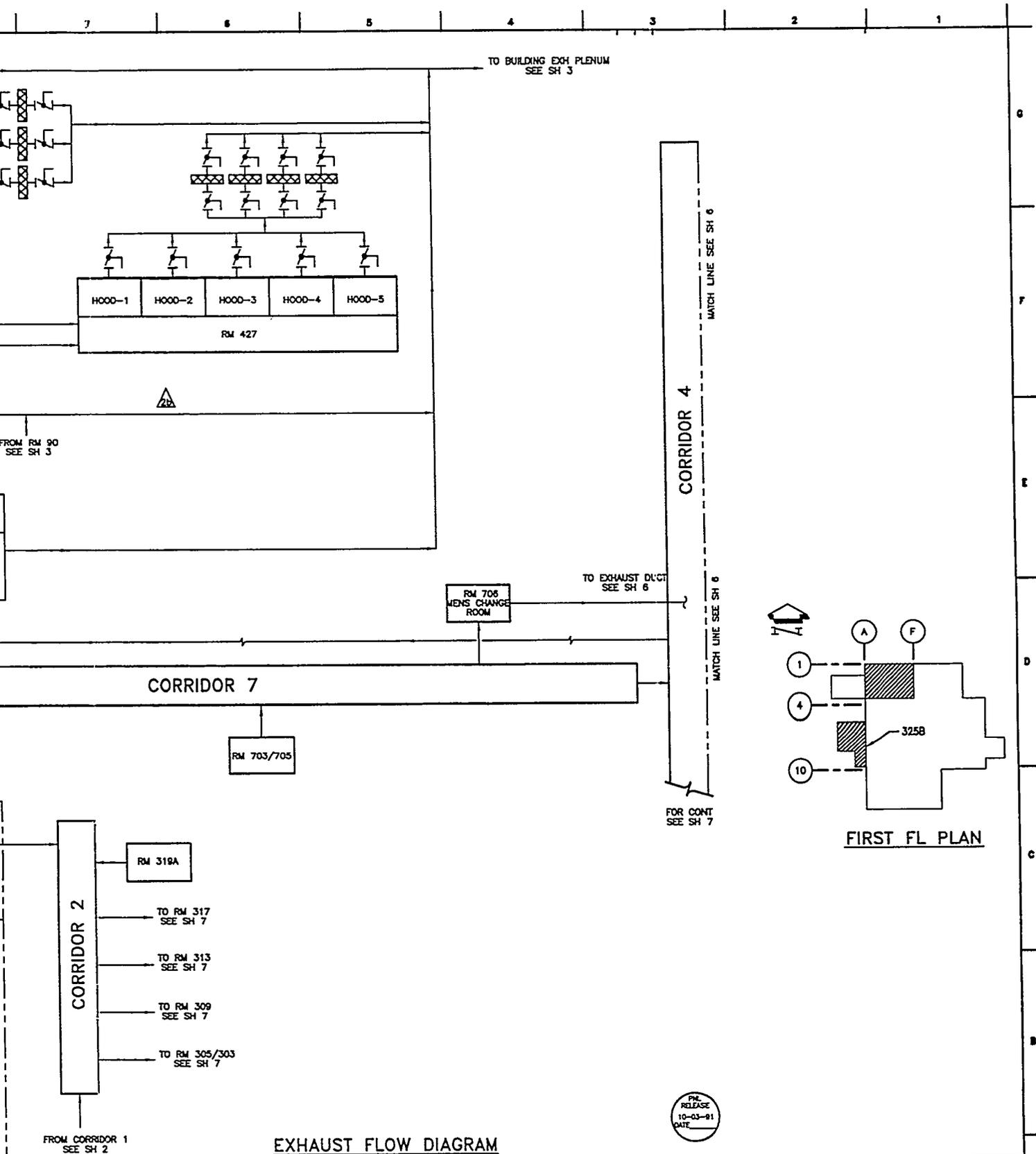
EXHAUST FLOW
 DIAGRAM FIRST FLOOR
 SOUTH WEST

EFFLUENT SYSTEM DIAGRAMS

REV	NO	DATE	BY	CHK
F	7001	325	JW	JW
	8900			

SCALE NONE SHEET 7 OF 9





EXHAUST FLOW DIAGRAM

PHL
RELEASE
10-03-81
DATE

CORRIDOR 2		TO RM 317 SEE SH 7	TO RM 313 SEE SH 7	TO RM 309 SEE SH 7	TO RM 305/303 SEE SH 7
CORRIDOR 4		MATCH LINE SEE SH 6			
CORRIDOR 7		MATCH LINE SEE SH 6			
RM 318A		TO RM 317 SEE SH 7			
RM 317		SEE SH 7			
RM 313		SEE SH 7			
RM 309		SEE SH 7			
RM 305/303		SEE SH 7			
RM 703/705		SEE SH 7			
RM 708		WENS CHANGE ROOM			
RM 427		SEE SH 3			
HOOD-1		SEE SH 3			
HOOD-2		SEE SH 3			
HOOD-3		SEE SH 3			
HOOD-4		SEE SH 3			
HOOD-5		SEE SH 3			
TO BUILDING EXH PLENUM		SEE SH 3			
FROM RM 90		SEE SH 3			
TO EXHAUST DUCT		SEE SH 6			
CORRIDOR 4		MATCH LINE SEE SH 6			
CORRIDOR 7		MATCH LINE SEE SH 6			
FOR CONT		SEE SH 7			
FIRST FL PLAN		SEE SH 7			

REV	DATE	BY	CHKD	DESCRIPTION
1	10/2/71	JW LEEPER	AG COUCH	EDP01 R01-FMPOG-ECH04 SYSTEM 25,6,7-E-F PER D00162-RMVD HEPA BANKS & B-UNIT (D)RMVD HEPA & DMFR Z12-F b)
2	10/2/71	R SCOTT SPENCER	JW LEEPER	b) FMP 3386 c) FMP 3357 REVISED PER d) FMP 3052

U. S. DEPARTMENT OF ENERGY
 PACIFIC NORTHWEST LABORATORY
 OPERATED BY BATTELLE MEMORIAL INSTITUTE

EXHAUST FLOW
 DIAGRAM FIRST FLOOR
 NORTH WEST AND 325B

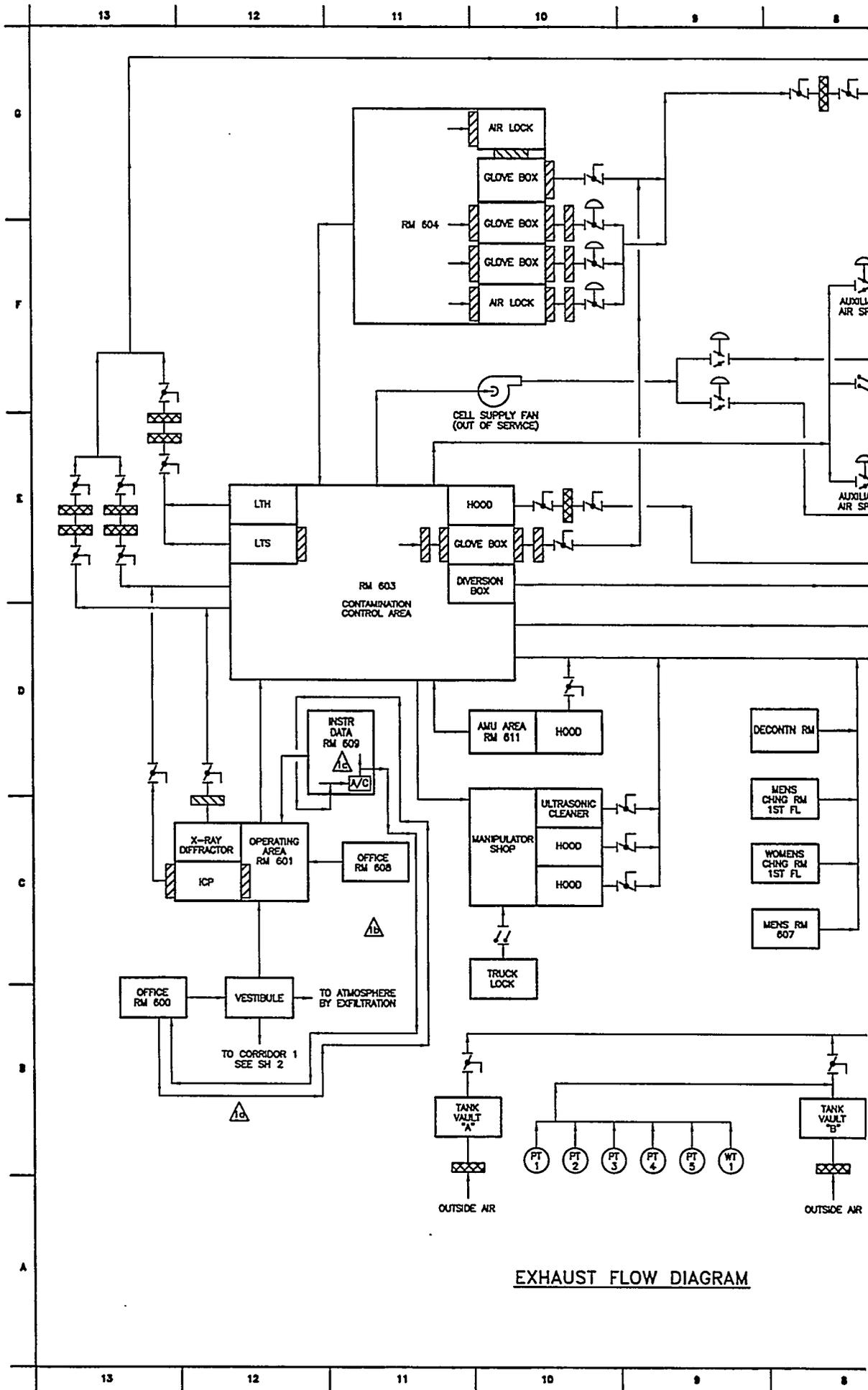
EPFLUENT SYSTEM DIAGRAMS

H-3-70230

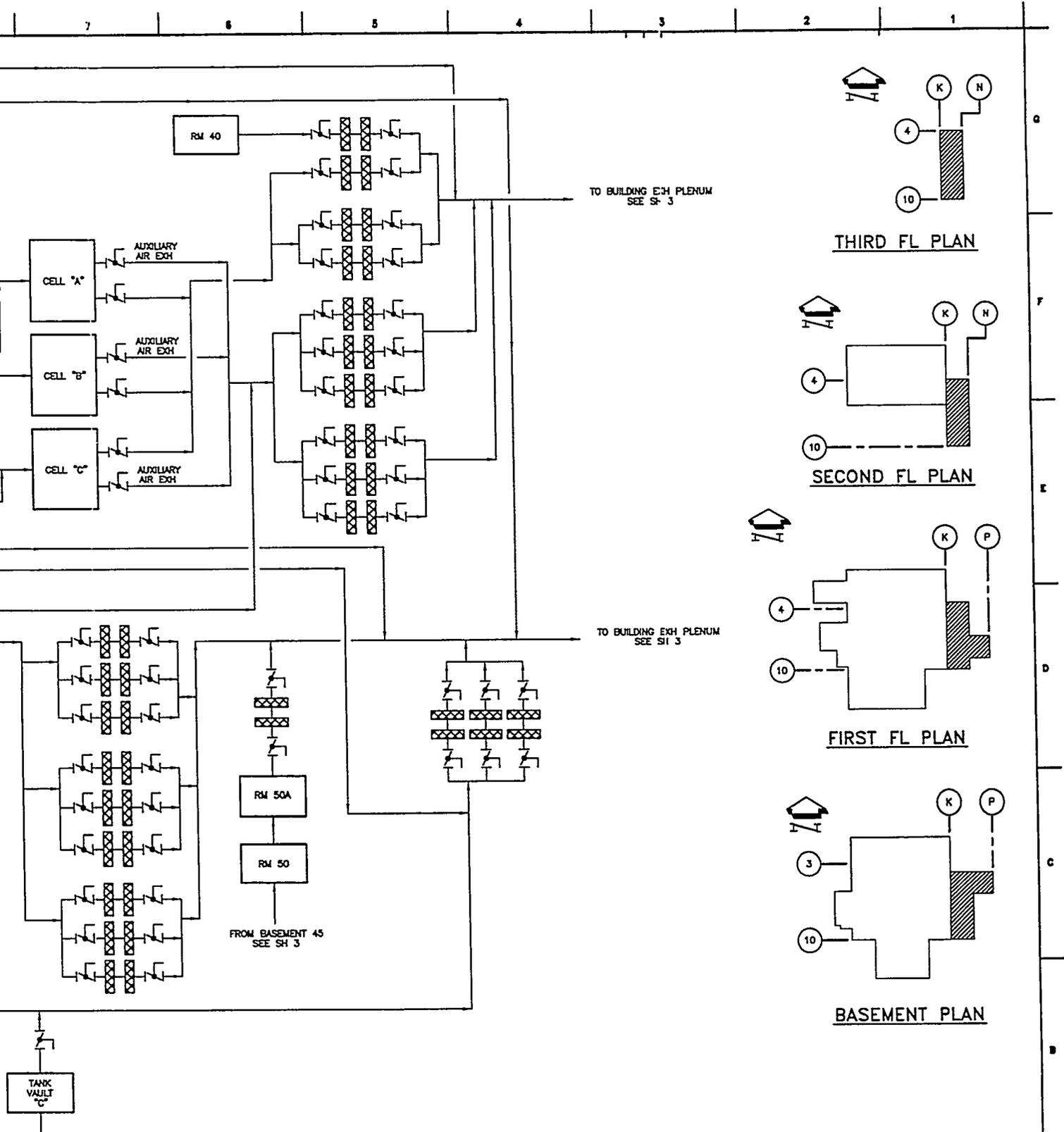
7001 325
 8900 325B

SCALE NONE

HEET 5 OF 9



EXHAUST FLOW DIAGRAM



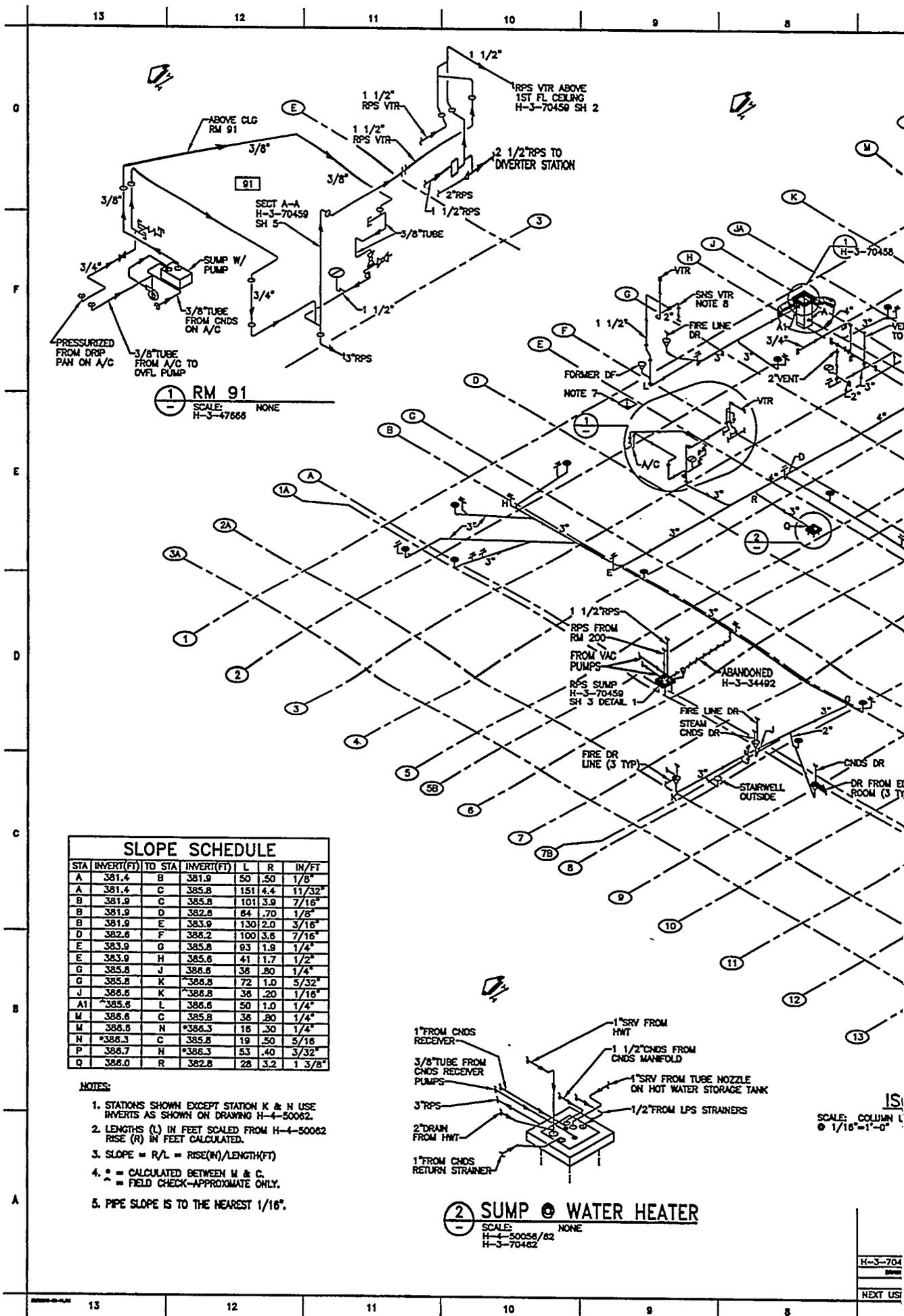
REV. RELEASE
10-03-91
DATE

IMP # 90-163

JE SANDBERG U. S. DEPARTMENT OF ENERGY INCHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEDICAL INSTITUTE		DATE 1/7/71 LRB 10/2/71 R SCOTT SPENCER 10/2/71 JW LEEPER 10/2/71 ER GORR 10/2/71 AG COUCH 10/2/71 JW LEEPER FOR PNL DATE 10/1/71	7001 325 8900 325 H-3-70230 1 SCALE NONE SHEET 9 OF 9
---	--	--	---

RR	LN	MD	SDB	TV	1	C-11 c) WAS RM 610, ZN D-11 b) REMOVED OFFICE RM 609, ZN 600 TO RM 609, ZN B-12 d) ADDED FLOW LINES FROM RM 600 TO RM 609, ZN B-12 e) ADDED FLOW LINES FROM RM 600 TO RM 609, ZN B-12 REVISED PER FMP 3269
RR	LN	MD	SDB	TV		
REVISIONS CHECKED 30:BM:ACD2:12.0:SS SAMPLE C070230J						

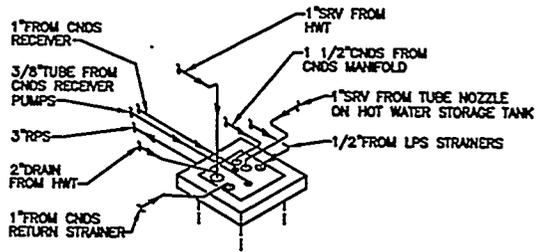
ISSUED TO	ISSUED DATE
REFERENCE DRAWINGS	
NEXT USED ON	



1 RM 91
SCALE: NONE
H-3-47666

SLOPE SCHEDULE						
STA	INVERT(FT)	TO STA	INVERT(FT)	L	R	IN/FT
A	381.4	B	381.9	50	.50	1/8"
A	381.4	C	385.8	151	4.4	11/32"
B	381.9	C	385.8	101	3.9	7/16"
B	381.9	D	382.6	64	.70	1/8"
B	381.9	E	383.9	130	2.0	3/16"
D	382.6	F	386.2	100	3.6	7/16"
E	383.9	G	385.8	83	1.9	1/4"
E	383.9	H	385.8	41	1.7	1/2"
G	385.8	J	386.6	36	.80	1/4"
G	385.8	K	386.8	72	1.0	5/32"
J	386.6	K	386.8	36	.20	1/16"
A1	385.6	L	386.6	50	1.0	1/4"
M	386.6	C	385.8	36	.80	1/4"
M	386.6	N	386.3	16	.30	1/4"
N	386.3	C	385.8	19	.50	5/16"
P	386.7	N	386.3	53	.40	3/32"
Q	386.0	R	382.8	28	3.2	1 3/8"

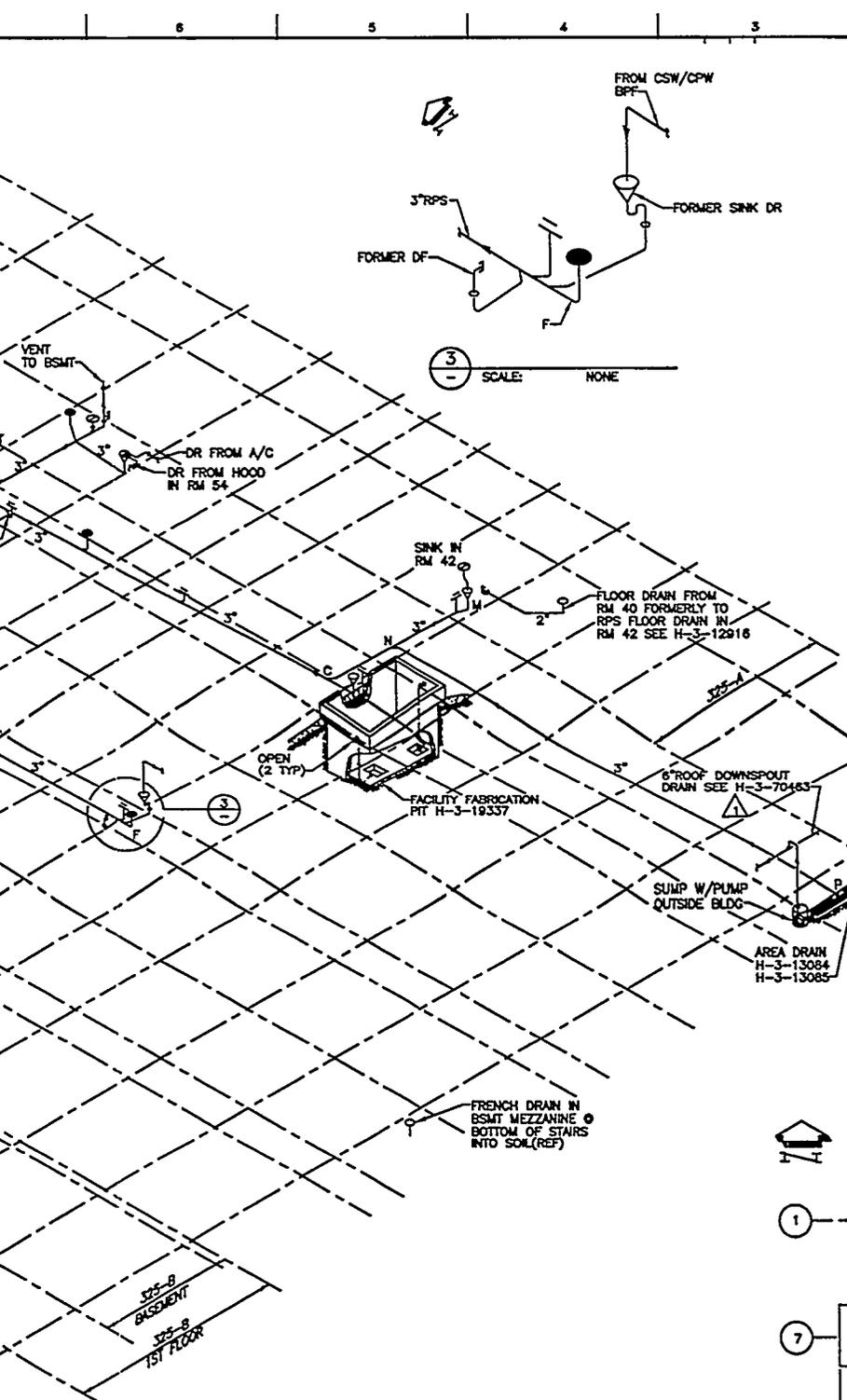
- NOTES:
- STATIONS SHOWN EXCEPT STATION K & H USE INVERTS AS SHOWN ON DRAWING H-4-50062.
 - LENGTHS (L) IN FEET SCALED FROM H-4-50062 RISE (R) IN FEET CALCULATED.
 - SLOPE = R/L = RISE(IN)/LENGTH(FT)
 - * = CALCULATED BETWEEN M & C.
^ = FIELD CHECK-APPROXIMATE ONLY.
 - PIPE SLOPE IS TO THE NEAREST 1/16".



2 SUMP WATER HEATER
SCALE: NONE
H-4-50058/62
H-3-70462

SCALE: COLUMN 1
1/16"=1'-0"

H-3-704
NEXT USE

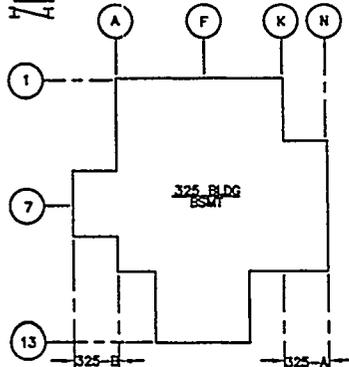


GENERAL NOTES
(UNLESS OTHERWISE NOTED)

- HORIZONTAL PIPING IS BELOW BASEMENT FLOOR EXCEPT AFTER RISER.
- ELEVATIONS ARE TO PIPE INVERT (BOTTOM OF INSIDE PIPE) AT BEND PRIOR TO RISING TO FLOOR LEVEL.
- BASEMENT FLOOR SLAB ELEVATIONS VARY BETWEEN 387'-0" & 387'-6".
- ALL LINES SLOPE TOWARDS THE RPS SUMP AT COLUMN J-1.
- ALL PROCESS SEWER (PS) HAS BEEN RECLASSIFIED AS RETENTION PROCESS SEWER (RPS).
- THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING & THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, INFORMATION FROM EXIST DRAWINGS.
- ELEVATOR PIT WITH SUMP-NO DRAIN.
- RETENTION PROCESS SEWER & SANITARY SEWER VENT TOGETHER SEE DRAWING H-3-70461 SHEET 2.

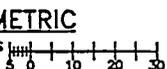
SYMBOLS/ABBREVIATIONS

- - FLOOR DRAIN CAPPED OR PLUGGED
- - FLOOR DRAIN OPEN
- ⊙ - SINK DRAIN
- ⊖ - BALL VALVE
- ⊕ - CAPPED, FLANGED OR PLUGGED LINE
- ⊘ - CHECK VALVE
- ⊙ - CLEAN OUT (C.O.)
- ⊖ - GATE VALVE
- ⊕ - FUNNEL DRAIN OR OPEN RISER DRAIN
- ⊖ - PIPE REDUCER
- ⊕ - THRU WALL OR FLOOR
- ⊖ - STEAM/VENT TRAP
- A/C - AIR CONDITIONER
- (A-Q) - SLOPE REFERENCE POINTS (SEE SCHEDULE-THIS DWG)
- BFP - BACKFLOW PREVENTER
- CLG - CEILING
- CNDS - CONDENSATE
- CPW - COLD PROCESS WATER
- CSW - COLD SANITARY WATER
- DF - DRINKING FOUNTAIN
- DR - DRAIN
- EQPT - EQUIPMENT
- EX - FORMERLY
- EXST - EXISTING
- FL - FLOOR
- HWT - HOT WATER TANK
- LPS - LOW PRESSURE STEAM
- OVL - OVERFLOW
- PP - PIPING
- PS - PROCESS SEWER
- RM - ROOM
- RPS - RETENTION PROCESS SEWER
- SNS - SANITARY SEWER
- SRV - SAFETY RELIEF VALVE
- SECT - SECTION
- SH - SHEET
- STA - STATION
- TYP - TYPICAL
- VAC - VACUUM
- VTR - VENT THRU ROOF
- XXX OR [XXX] - ROOM NUMBER



PH. RELEASE
02-24-83
DATE

KEY PLAN
SCALE: NONE



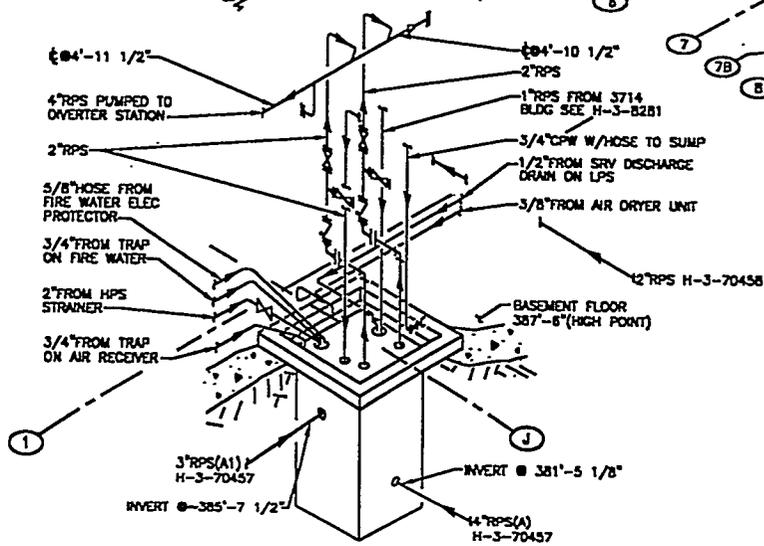
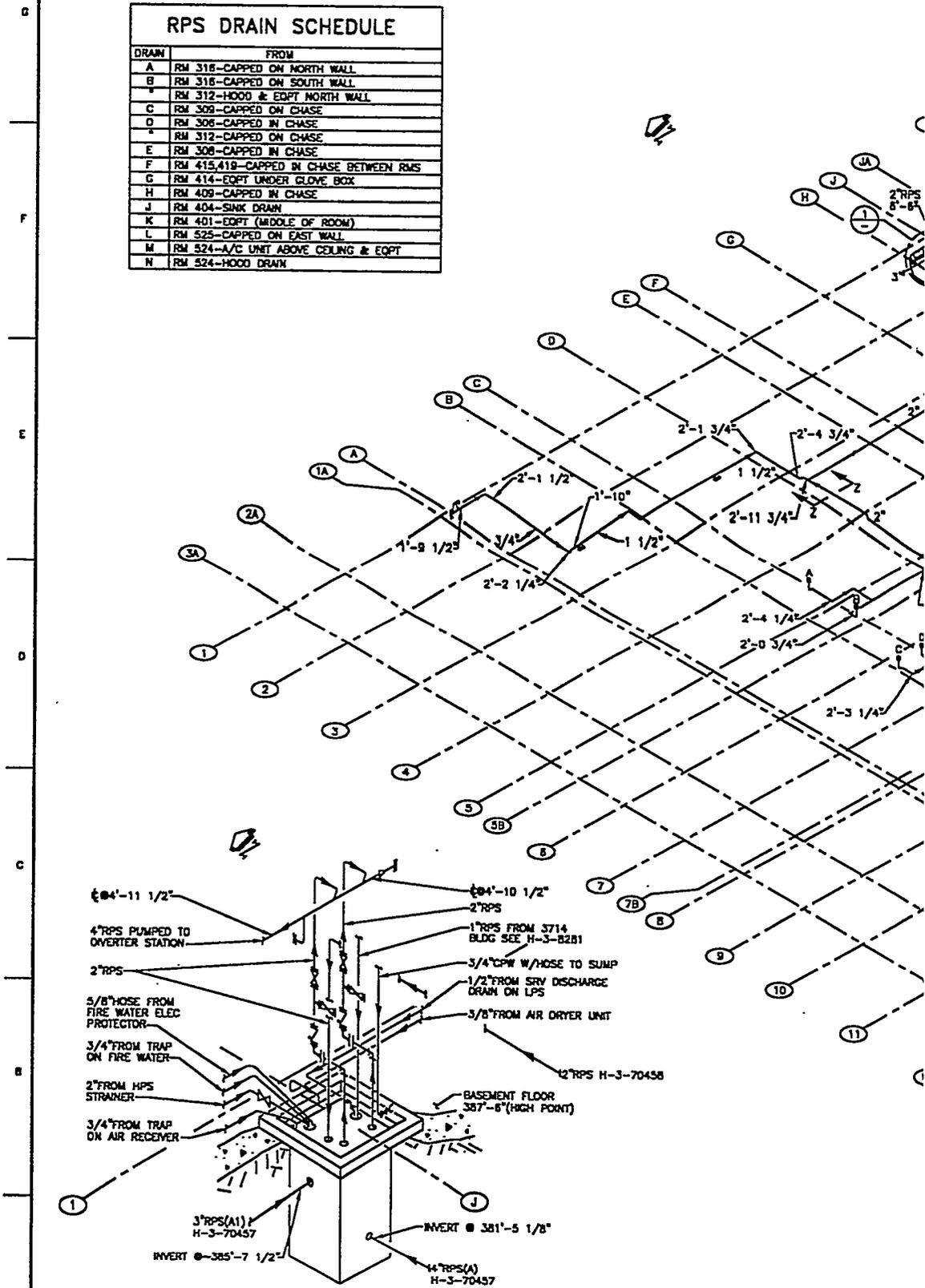
325 BLDG CR REF DWG LIST
REFERENCE DRAWINGS

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1/14/85	1/14/85	1/8/85	12/14/84			
DR	CHK	BY	DATE	REV	BY	DATE

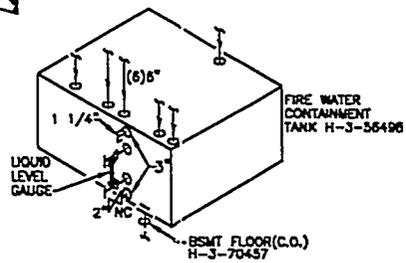
OWNER	DATE	U. S. DEPARTMENT OF ENERGY
SC NYBY	1/15/85	RESIDUAL OPERATIONS OFFICE
DESIGNED	1/14/85	PACIFIC NORTHWEST LABORATORY
WALTER B JACKSON		OPERATED BY BATTTELLE MEMORIAL INSTITUTE
DRN AND	1/23/85	RPS (EX-PS) FLOOR
RV RICHARDSON		DRAINS BELOW BASEMENT
DRN JW LEEPER	1/23/85	FLOOR SLAB ISOMETRIC
JW LEEPER		FACILITY EFFLUENT MONITORING PLAN
ER GERK	1/23/85	
DRN		
ON	1/23/85	
CW CABLE		
APPROVED FOR IMPROVEMENT		
BY JW LEEPER		
FOR PNL	DATE 1/23/85	
REV NO	8407	8409
	1-25	85-48
	H-3-70457	1
	SCALE SHOWN	SHEET 1 of 1

RPS DRAIN SCHEDULE

DRAIN	FROM
A	RM 316-CAPPED ON NORTH WALL
B	RM 316-CAPPED ON SOUTH WALL
C	RM 312-HOOD & EQPT NORTH WALL
D	RM 309-CAPPED ON CHASE
E	RM 306-CAPPED IN CHASE
F	RM 312-CAPPED ON CHASE
G	RM 308-CAPPED IN CHASE
H	RM 413,418-CAPPED IN CHASE BETWEEN RMS
I	RM 414-EQPT UNDER GLOVE BOX
J	RM 409-CAPPED IN CHASE
K	RM 404-SINK DRAIN
L	RM 401-EQPT (MIDDLE OF ROOM)
M	RM 525-CAPPED ON EAST WALL
N	RM 524-A/C UNIT ABOVE CEILING & EQPT
O	RM 524-HOOD DRAIN



(1) RPS SUMP @ COL J-1
 SCALE: NONE
 SK-3-28831
 H-3-34482.94
 H-3-45871
 H-3-57831
 H-3-70457
 H-4-50062



GENERAL NOTES
(UNLESS OTHERWISE NOTED)

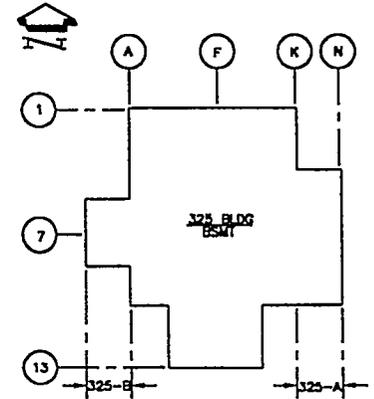
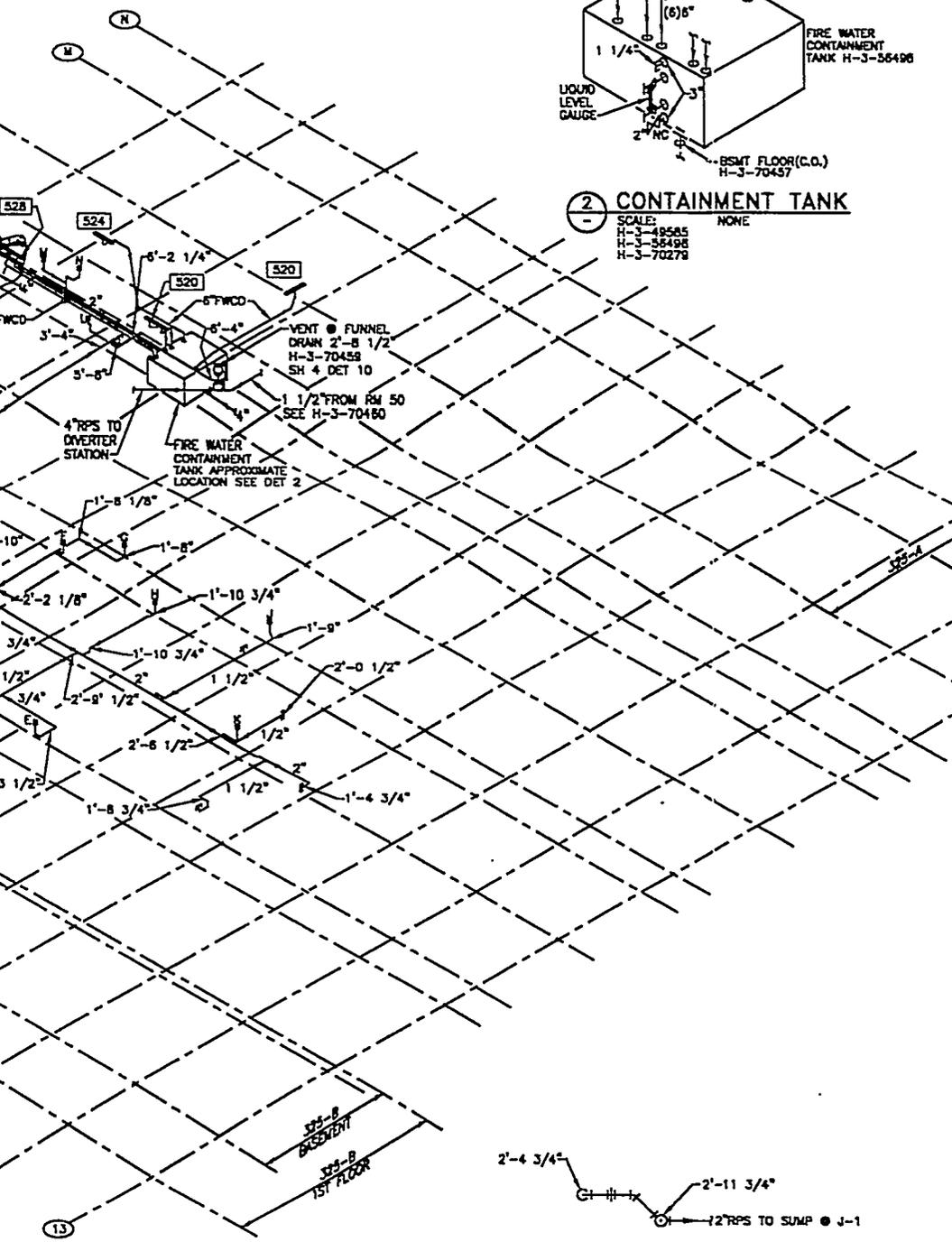
1. BASEMENT FLOOR ELEVATIONS VARY BETWEEN 387'-0" & 387'-6".
2. ALL LINES SLOPE TOWARDS RPS SUMP @ COLUMN J-1.
3. TOP OF FIRST FLOOR STEEL = 401'-6".
4. ELEVATIONS TO $\frac{1}{2}$ OF PIPE X-X ARE RELATIVE TO FIRST FLOOR STEEL(401'-6").
5. ALL PROCESS SEWER (PS) HAS BEEN RECLASSIFIED AS RETENTION PROCESS SEWER (RPS).
6. THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING & THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, INFORMATION FROM EXIST DRAWINGS.

2 CONTAINMENT TANK

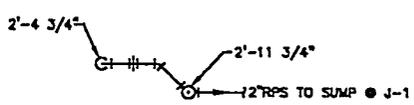
SCALE: NONE
H-3-49585
H-3-56498
H-3-70278

SYMBOLS/ABBREVIATIONS

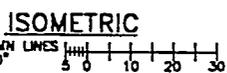
- CAPPED OR PLUGGED LINE
- |— CHECK VALVE
- |—|— FLANGED LINE
- X— (FWCD) FIRE WATER CONTAINMENT DRAIN
- X— GATE VALVE
- |— HOSE CONNECTION
- |— PIPE REDUCER
- |— THRU WALL OR FLOOR
- A THRU N - ROOM NUMBERS(SEE SCHEDULE-THIS DWG)
- A/C - AIR CONDITIONER
- BSMT - BASEMENT
- CND - CONDENSATE
- CPW - COLD PROCESS WATER
- C.O. - CLEAN OUT
- ELEC - ELECTRICAL
- EQPT - EQUIPMENT
- EX - FORMERLY
- EXIST - EXISTING
- FWCD - FIRE WATER CONTAINMENT DRAIN
- HPS - HIGH PRESSURE STEAM
- LPS - LOW PRESSURE STEAM
- NC - NORMALLY CLOSED
- PS - PROCESS SEWER
- RM - ROOM
- RPS - RETENTION PROCESS SEWER
- SH - SHEET
- SRV - SAFETY RELIEF VALVE
- XXX OR XXXX - ROOM NUMBER



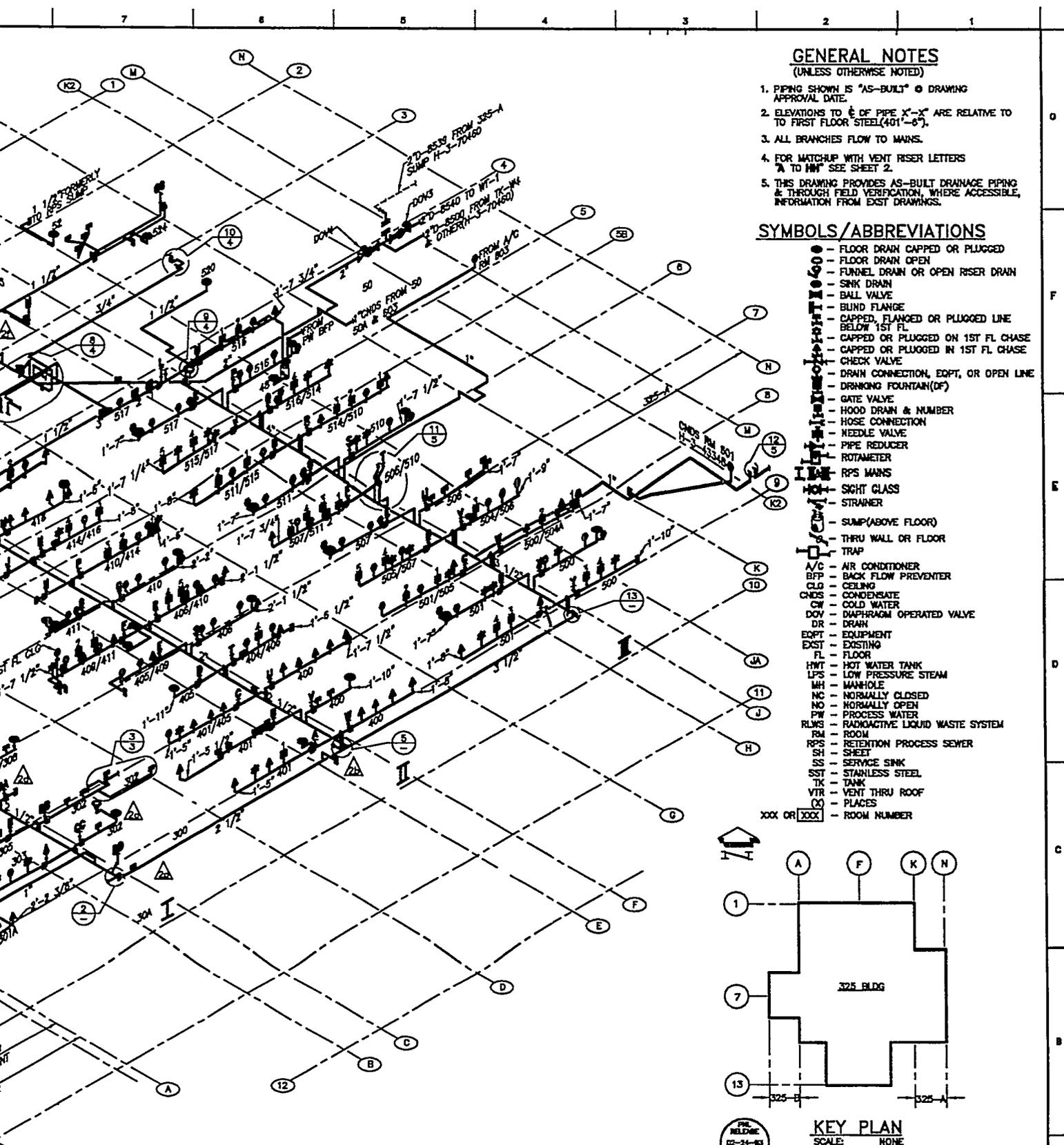
KEY PLAN
SCALE: NONE



SECTION Z-Z
SCALE: NONE



H-3-70455		325 BLDG DR REF DWG LIST		REV		DATE		DESCRIPTION		DATE		EXP 1 90-183 U. S. DEPARTMENT OF ENERGY RICHMOND OPERATORS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE RPS (EX-PS) PIPING BELOW FIRST FLOOR ISOMETRIC FACILITY EFFLUENT MONITORING PLAN	
DRAWING NO		DRAWING TITLE		BY	DATE	CHK BY	DATE	REV BY	DATE	NO	DATE	NO	DATE
NEXT USED ON		REFERENCE DRAWINGS		REVISIONS				APPROVED FOR IMPLEMENTATION BY JW LEEPER DATE 2/25/85		NO CW CABLE DATE 1/23/85		NO H-3-70458 DATE 8/47/85	
PROJECT NO		PROJECT TITLE		DRAWING NO		DRAWING TITLE		DATE		NO		DATE	
300000		30:18M:AC02:12.0:SS		DATE		C071458A		DATE		8548		SHEET 1 OF 1	

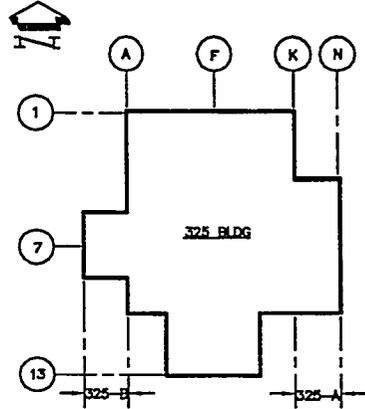


GENERAL NOTES
(UNLESS OTHERWISE NOTED)

1. PIPING SHOWN IS "AS-BUILT" • DRAWING APPROVAL DATE.
2. ELEVATIONS TO Ⓢ OF PIPE X"-Y" ARE RELATIVE TO TO FIRST FLOOR STEEL(401'-6").
3. ALL BRANCHES FLOW TO MANS.
4. FOR MATCHUP WITH VENT RISER LETTERS "A" TO "M" SEE SHEET 2.
5. THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING & THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, INFORMATION FROM EXIST DRAWINGS.

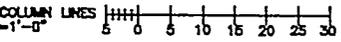
SYMBOLS/ABBREVIATIONS

- - FLOOR DRAIN CAPPED OR PLUGGED
- - FLOOR DRAIN OPEN
- - FUNNEL DRAIN OR OPEN RISER DRAIN
- - SINK DRAIN
- - BALL VALVE
- - BLIND FLANGE
- - CAPPED, FLANGED OR PLUGGED LINE BELOW 1ST FL.
- - CAPPED OR PLUGGED ON 1ST FL CHASE
- - CAPPED OR PLUGGED IN 1ST FL CHASE
- - CHECK VALVE
- - DRAIN CONNECTION, EQPT, OR OPEN LINE
- - DRINKING FOUNTAIN (DF)
- - GATE VALVE
- - HOOD DRAIN & NUMBER
- - HOSE CONNECTION
- - NEEDLE VALVE
- - PIPE REDUCER
- - ROTAMETER
- - RPS MANS
- - SIGHT GLASS
- - STRAINER
- - SUMP (ABOVE FLOOR)
- - THRU WALL OR FLOOR
- - TRAP
- A/C - AIR CONDITIONER
- BFP - BACK FLOW PREVENTER
- CLG - CEILING
- CHOS - CONDENSATE
- CW - COLD WATER
- DOV - DIAPHRAGM OPERATED VALVE
- DR - DRAIN
- EQPT - EQUIPMENT
- EXIST - EXISTING
- FL - FLOOR
- HWT - HOT WATER TANK
- LPS - LOW PRESSURE STEAM
- MH - MANHOLE
- NC - NORMALLY CLOSED
- NO - NORMALLY OPEN
- PW - PROCESS WATER
- RLWS - RADIOACTIVE LIQUID WASTE SYSTEM
- RM - ROOM
- RPS - RETENTION PROCESS SEWER
- SH - SHEET
- SS - SERVICE SINK
- SST - STAINLESS STEEL
- TK - TANK
- VTR - VENT THRU ROOF
- - PLACES
- XXX OR XXXX - ROOM NUMBER



KEY PLAN
SCALE: NONE

ISOMETRIC



REV	NO	DATE	BY	CHKD	DESCRIPTION
2					ZONE D-11, f) FMP D3388 ZONE F-5 d) FMP D3216 ZONE C-8, e) FMP D3052 D3290 ZONE C-5, c) FMP D3383 ZONE C-7, REVISED PER c) FMP D3311 ZONE C-7 b) FMP
1					9,C PER ECH #000182-EDP1-R1-FMPO-ECH3 REMOVED REFERENCE DWG H-3-70454 ZH

REF # 9D-163

U. S. DEPARTMENT OF ENERGY
NUCLEAR OPERATIONS OFFICE

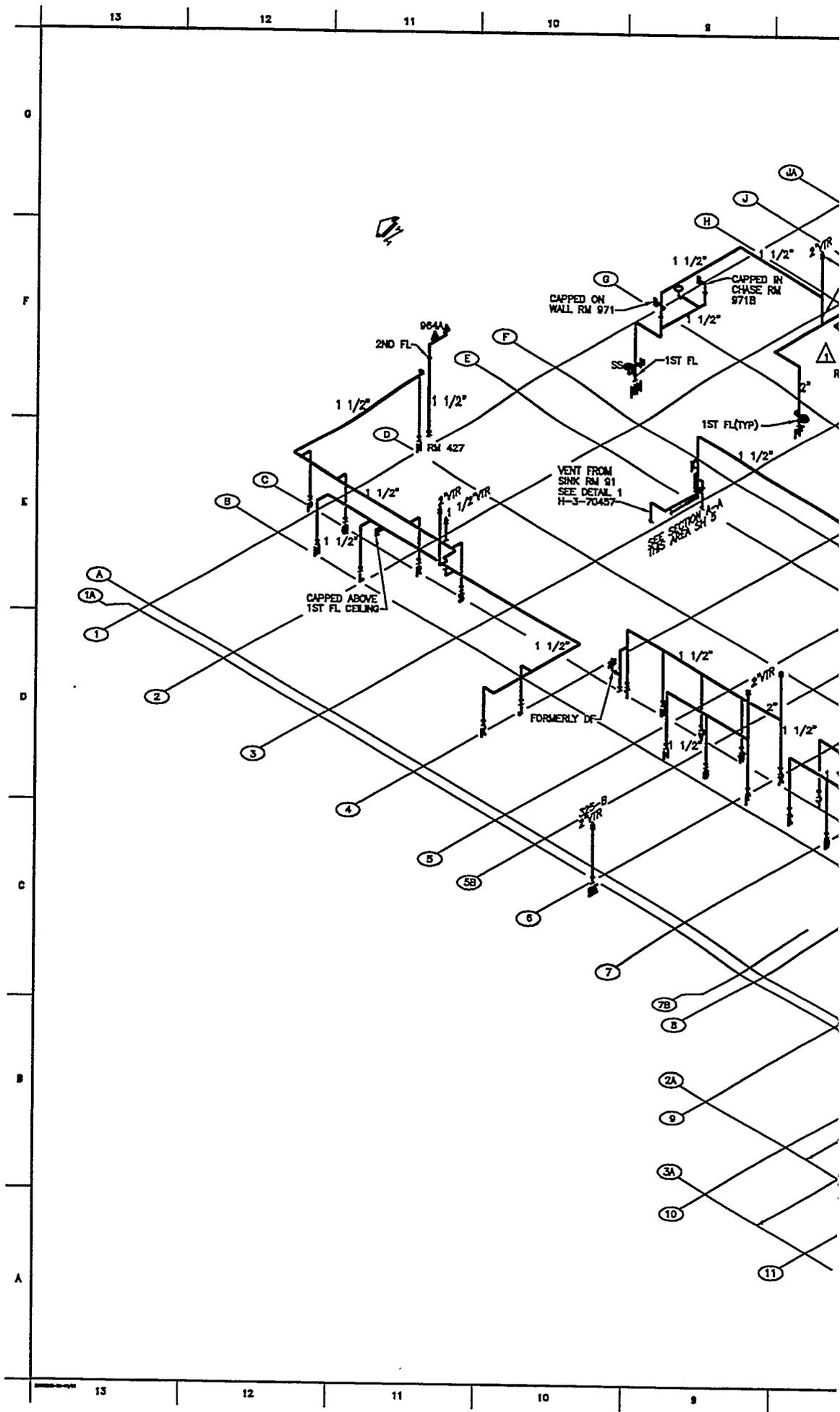
PACIFIC NORTHWEST LABORATORY
OPERATED BY BASTELLE MEMORIAL INSTITUTE

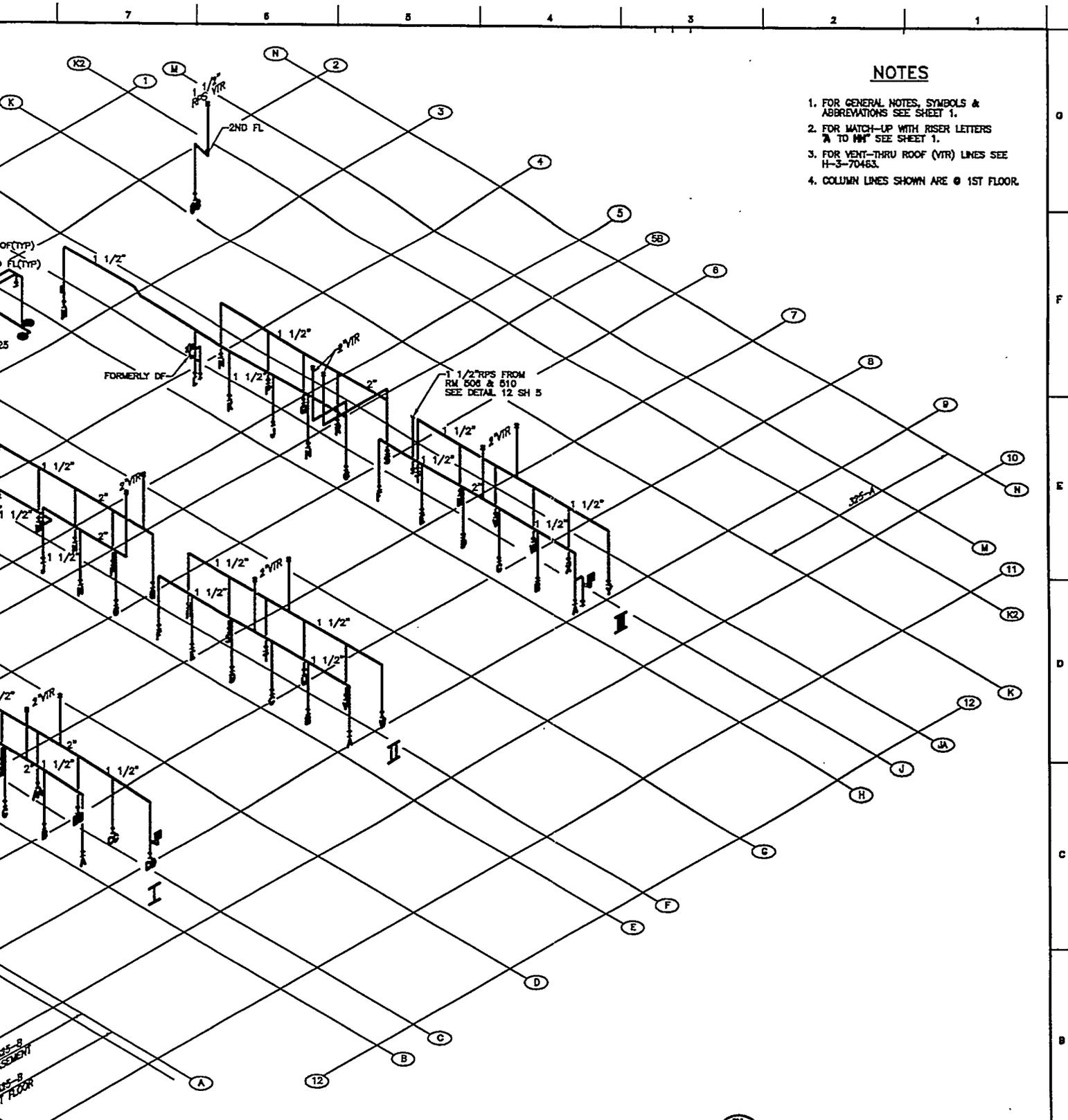
RPS PIPING BELOW
FIRST FLOOR
ISOMETRIC

FACILITY EFFLUENT MONITORING PLAN

REV NO: 2
REV: 8407, 8409, 8548
DATE: 1/2/83

DWG NO: H-3-70459
SHEET: 2 OF 5





NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.
2. FOR MATCH-UP WITH RISER LETTERS A TO HH SEE SHEET 1.
3. FOR VENT-THRU ROOF (VTR) LINES SEE H-3-70463.
4. COLUMN LINES SHOWN ARE @ 1ST FLOOR.

ISOMETRIC

SCALE: COLUMN LINES [||||] @ 3/32"=1'-0"



EXP 9 90-183

DESIGNED BY	DATE
WALTER B JACKSON	2/2/62
CHECKED BY	DATE
RY RICHARDSON	2/2/62
DR. J. W. LEEPER	2/2/62
APPROVED FOR CONSTRUCTION	DATE
BY J. W. LEEPER	2/2/62
FOR P.N.I.	DATE 7/25/60

U. S. DEPARTMENT OF ENERGY
 RICHLAND OPERATIONS OFFICE
PACIFIC NORTHWEST LABORATORY
 OPERATED BY BATTELLE MEMORIAL INSTITUTE

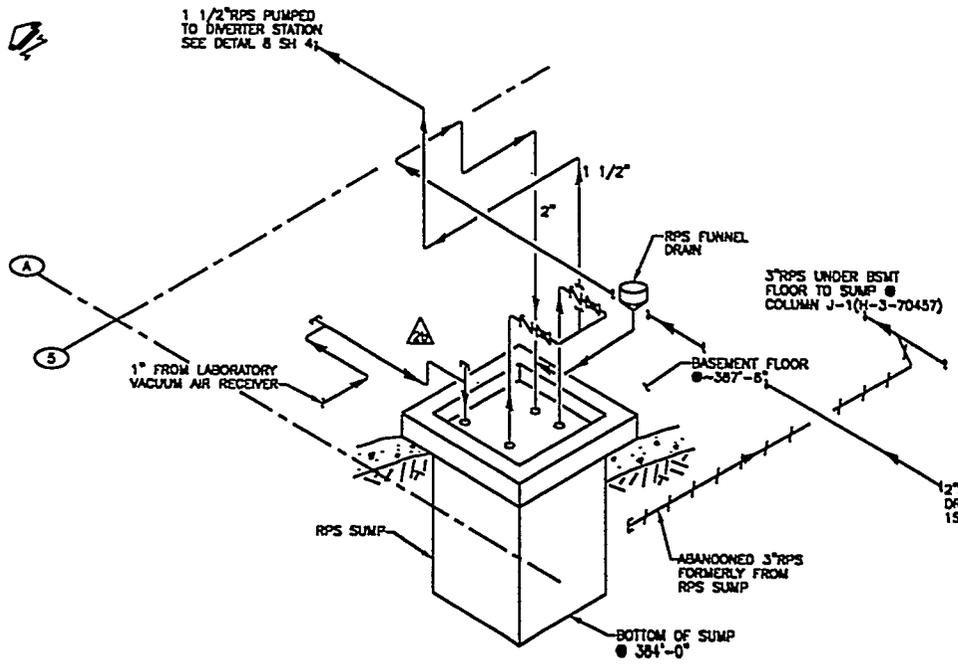
RPS PIPING/VENTS
FIRST FLOOR
ISOMETRIC

FACILITY EFFLUENT MONITORING PLAN

REV. NO. 1
 H-3-70459
 SHEET 2 OF 5

ISSUED TO	ISSUED TITLE	REVISIONS	DESCRIPTION
		1	REVISED PER FMP D3388, ZONE F-B
7	6	5	4
REFERENCE DRAWINGS		CHOCODE 3D:RMAACD2:12.0:SS	
NEXT USED ON		ENRPLX C070459B	

G
F
E
D
C
B
A



① RPS SUMP @ COL A

SCALE: NONE

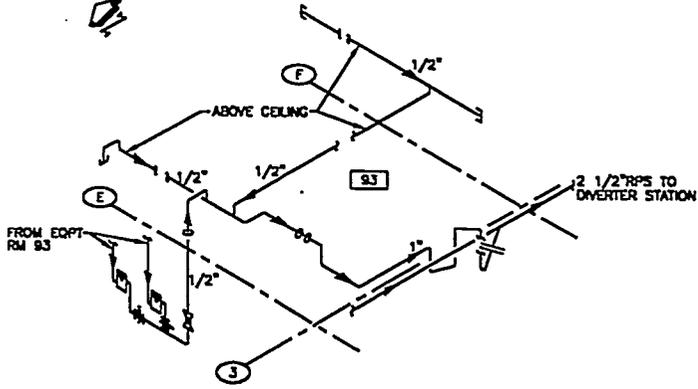
H-3-34482

H-3-34484

H-3-47242

H-3-52487

H-3-70457

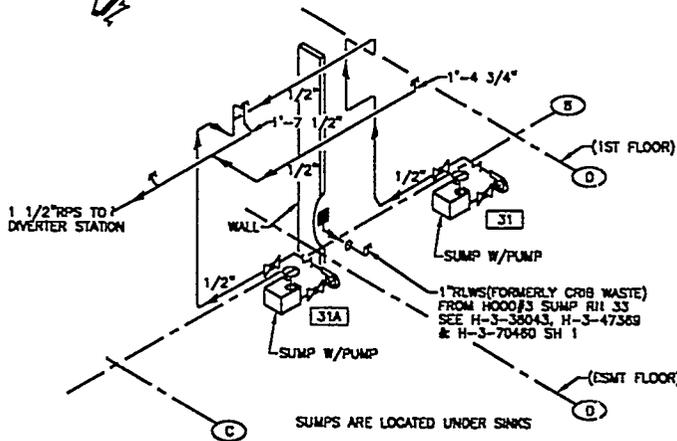


④ RPS RM 93

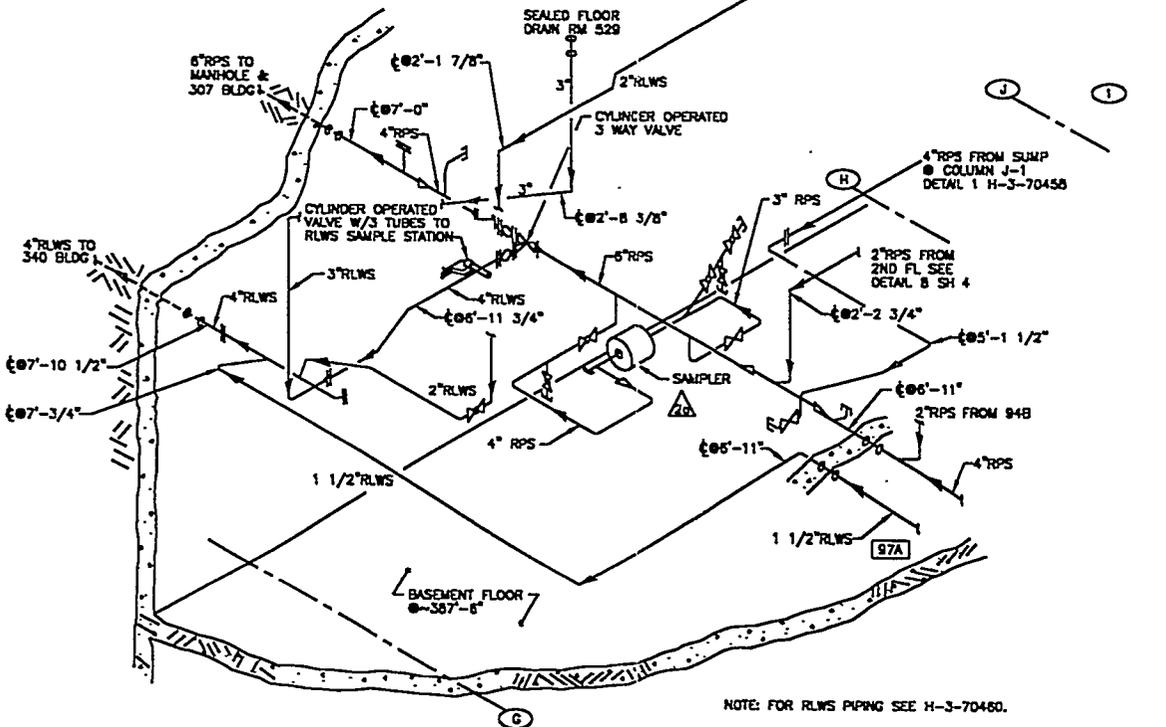
SCALE: NONE

NOTES

- FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.



3 RPS & RLWS RM 31, 31A & 33
SCALE: NONE



6 DIVERTER STATION
SCALE: NONE
M-3904
SK-3-28831
H-3-34222
H-3-34230
H-3-34494
H-3-48871

REV. RELEASE
10-24-83
DATE

DP # 90-183

REV	NO	DATE	BY	CHKD	DESCRIPTION
1	1	1/2/79	JW	JW	REVISED PER FMP U3383, ZONES G-5 & G-6
2	2	3/2/79	JW	JW	CONDICIONS b) REMOVED LAB VAC PUMP LOOP OF DIVERTER STATION PER AS FOUND
3	3	1/2/79	JW	JW	REVISED PER FMP U3383, ZONES G-5 & G-6

DESIGNED BY	DATE
WALTER B JACKSON	1/2/79
BY	DATE
RY RICHARDSON	1/2/79
BY	DATE
JW LEEPER	1/2/79
BY	DATE
ED GERK	1/2/79
BY	DATE
JW LEEPER	1/2/79

U. S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
PACIFIC NORTHWEST LABORATORY
OPERATED BY BATTILLE MEMORIAL INSTITUTE

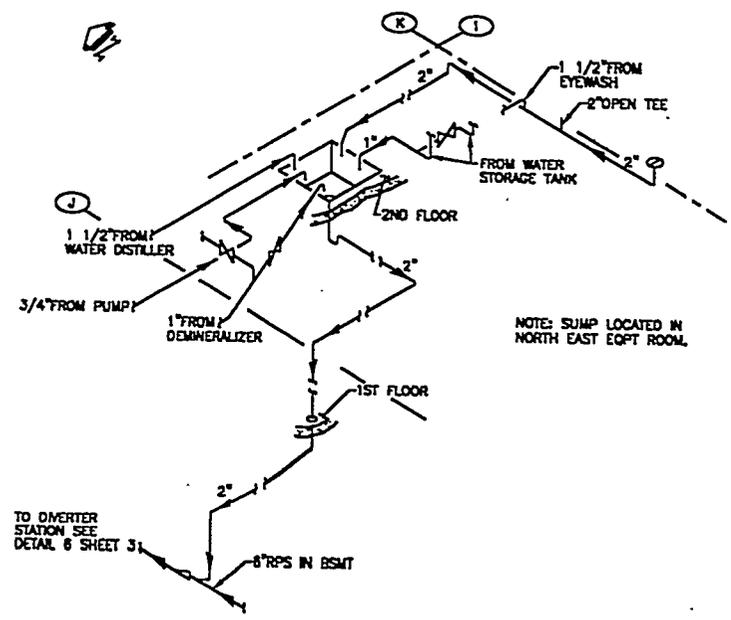
RPS PIPING BELOW FIRST FLOOR DETAILS

FACILITY EFFLUENT MONITORING PLAN

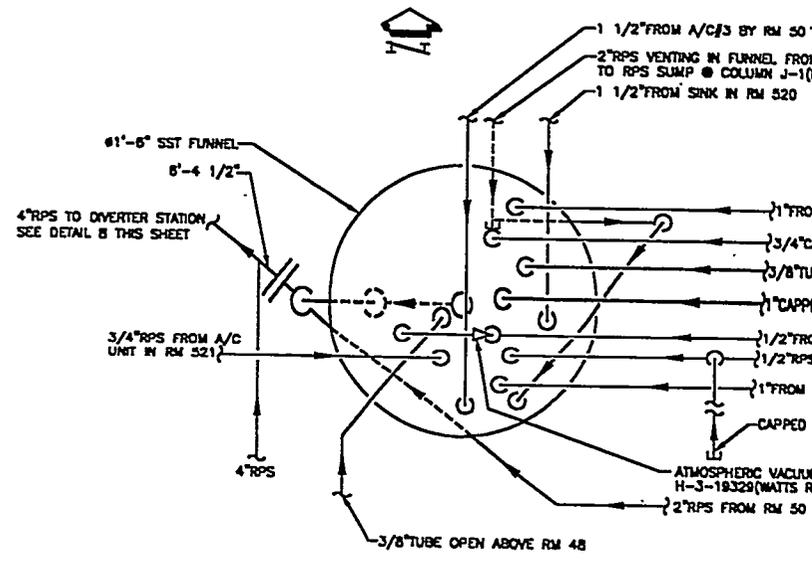
APPROVED FOR IMPROVEMENTS BY JW LEEPER DATE 1/2/79

REV NO 2
H-3-70459
SHEET 3 OF 5

ISSUING NO	ISSUING TITLE



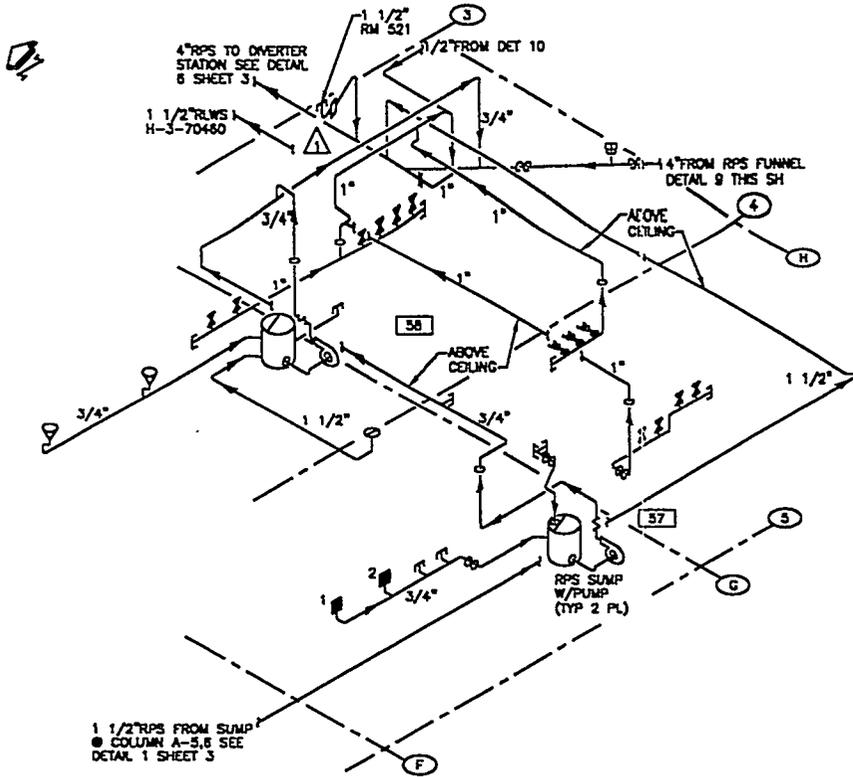
7 2ND FL SUMP
 SCALE: NONE



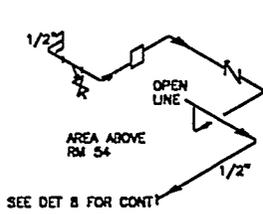
9 PLAN OF RPS FUNNEL
 SCALE: NONE
 H-3-19329
 H-3-34494

NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.



8 RPS RM 57 & 58
 1 SCALE: NONE
 H-3-28058
 H-3-47274



10 RPS DETAIL
 1 SCALE: NONE

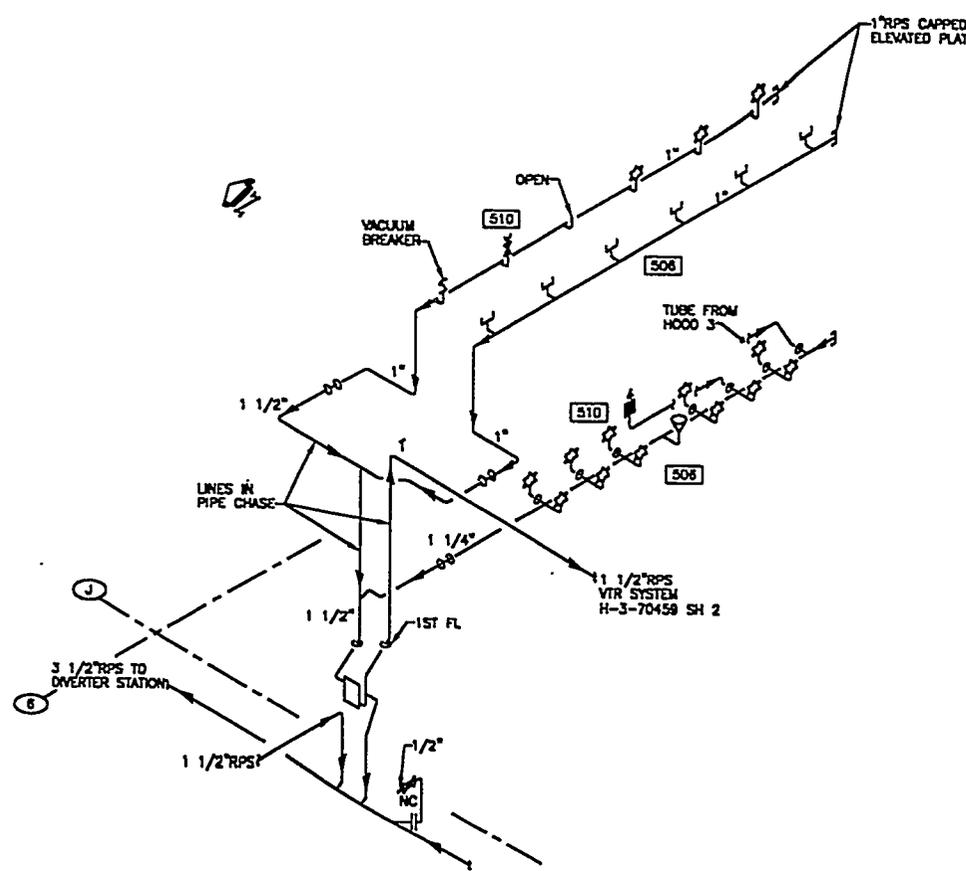


U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
CHECKED BY: WALTER B JACKSON 2/20/81 DATE: 2/20/81 DRAWN BY: JIM LEEPER 2/20/81 DATE: 2/20/81 APPROVED FOR: FR GERK 2/20/81 DATE: 2/20/81	RPS PIPING DETAILS
FACILITY EFFLUENT MONITORING PLAN H-3-70459	SHEET 4 OF 5

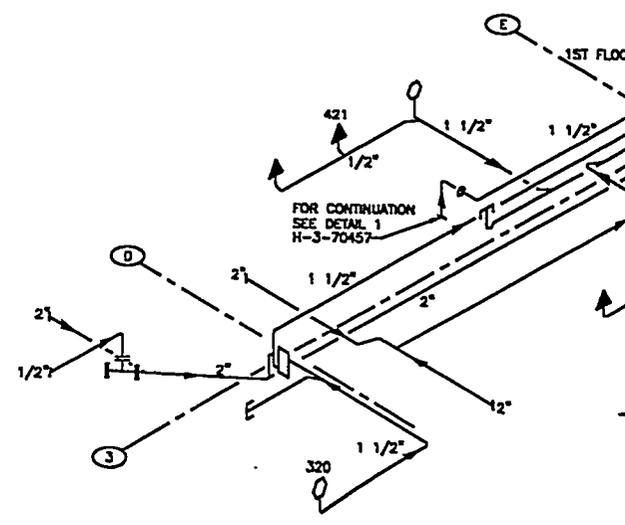
NO.	DATE	BY	REVISIONS
1			REVISED PER FMP 03386, ZONE C-6

70458)
 UNIT RM 48
 D ABOVE 48
 CAPPED ABOVE RM 48
 ABOVE RM 48
 1000 RM 54
 PPED ABOVE RM 48
 SUMP BY RM 48
 VE RM 48
 REAKER
 LATOR / 288A)

G
F
E
D
C
B
A

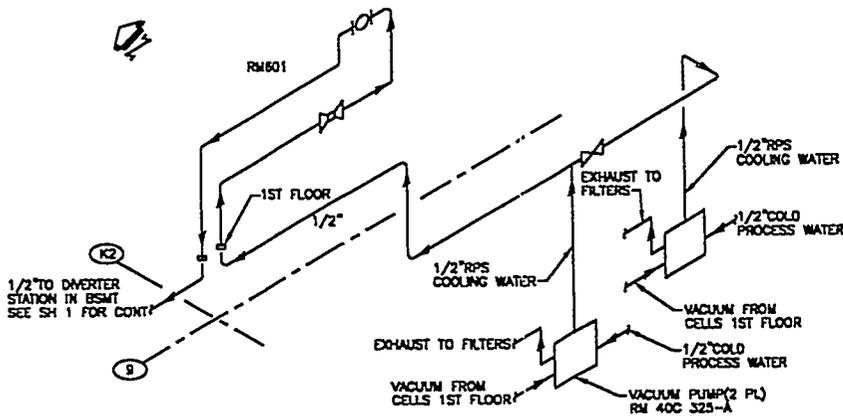


11 RPS RM 506 & 510
 1 SCALE: NONE
 H-3-47242
 H-4-50060

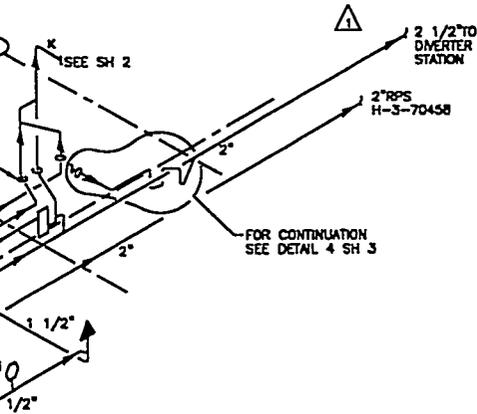


NOTES

- FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.



12 RPS 325-A
SCALE: NONE



SECTION A-A (H-3-70459 SH 1)

SCALE: NONE
H-3-47242
H-4-50060



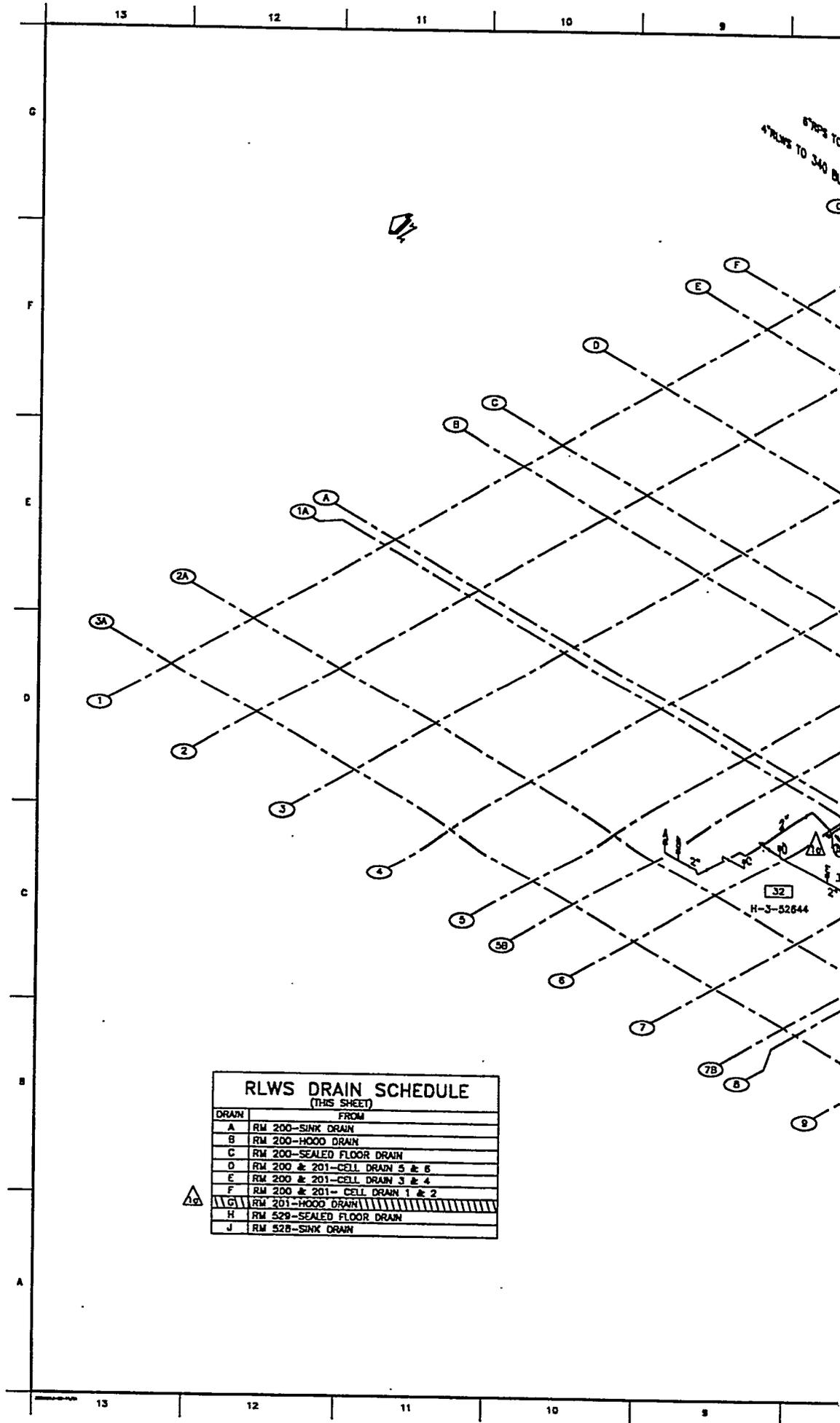
SP 1 90-183

DESIGNED SC NYBY	DATE 2/2/78
CHECKED WALTER B JACKSON	DATE 2/2/78
BY RV RICHARDSON	DATE 2/2/78
BY JW LEEPER JR	DATE 2/2/78
BY ER GERK	DATE 2/2/78
BY CJ CABLE	DATE 2/2/78
APPROVED FOR INSTALLATION BY JW LEEPER FOR PNL	DATE 2/2/78

U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE			
PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE			
RPS PIPING DETAILS			
FACILITY EFFLUENT MONITORING PLAN			
REV NO	REV DATE	REV BY	REV NO
F	8407	325	H-3-70459
	8409	325-A	
	8548	SCALE SHOWN	SHEET 5 OF 5

REV	NO	DATE	BY	DESCRIPTION	REV	NO
1				REVISED PER FMP 03386, ZONE C-6	1	
REVISIONS						
DIBCODE 30:8M:ACD2:12.0-SS						
PROFILE C070459E						

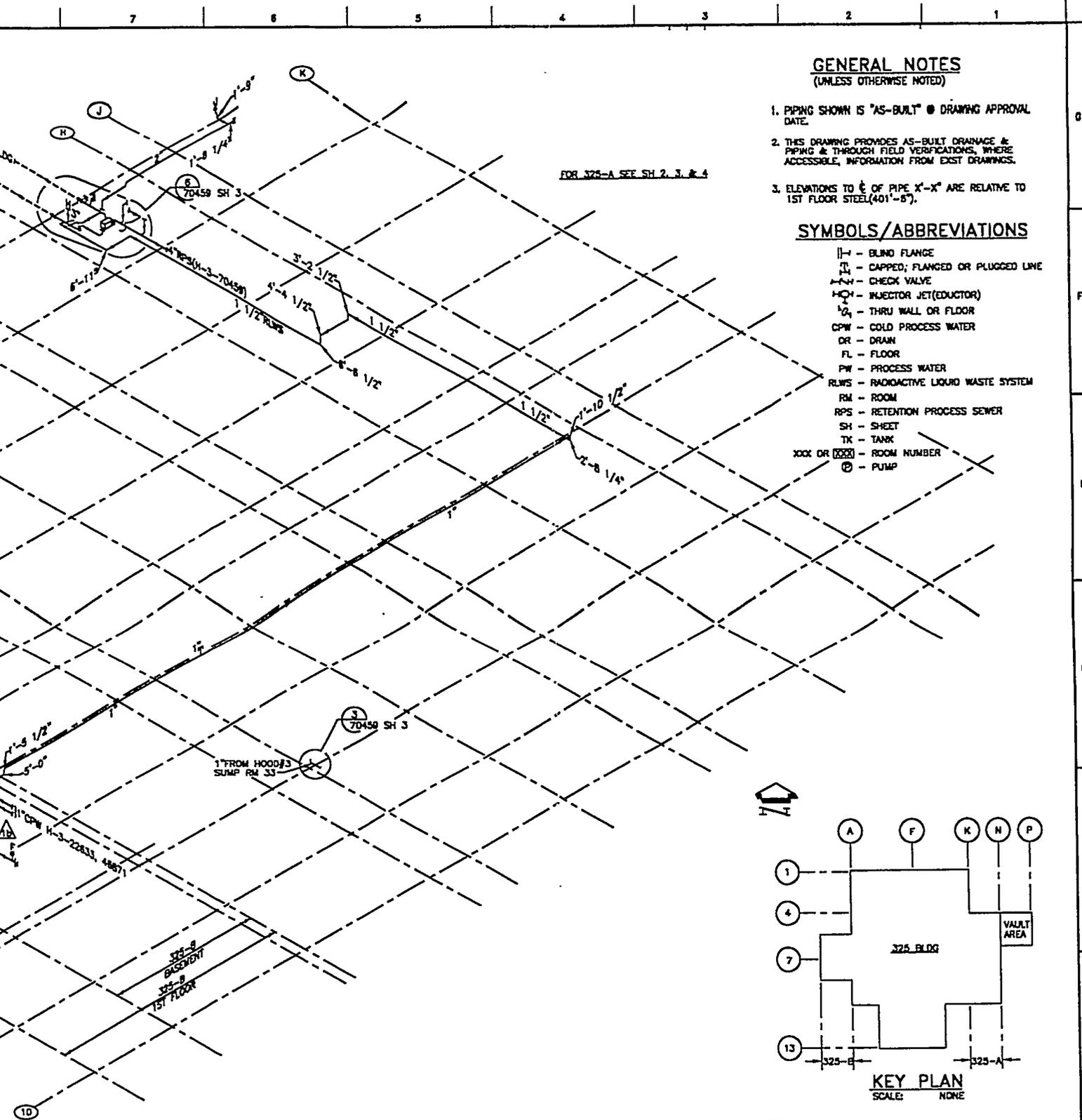
DRAWING NO	H-3-70459
DRAWING TITLE	RPS PIPING DETAILS
REFERENCE DRAWINGS	
NEXT USED ON	



RLWS DRAIN SCHEDULE
(THIS SHEET)

DRAIN	FROM
A	RM 200-SINK DRAIN
B	RM 200-HOOD DRAIN
C	RM 200-SEALED FLOOR DRAIN
D	RM 200 & 201-CELL DRAIN 5 & 6
E	RM 200 & 201-CELL DRAIN 3 & 4
F	RM 200 & 201-CELL DRAIN 1 & 2
G	RM 201-HOOD DRAIN
H	RM 528-SEALED FLOOR DRAIN
J	RM 528-SINK DRAIN





GENERAL NOTES

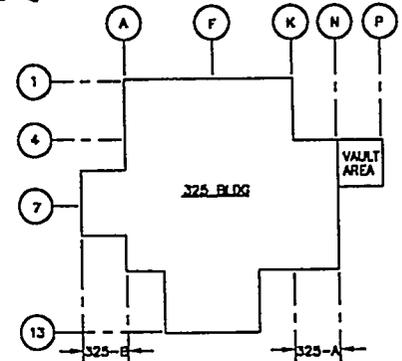
(UNLESS OTHERWISE NOTED)

1. PIPING SHOWN IS "AS-BUILT" • DRAWING APPROVAL DATE.
2. THIS DRAWING PROVIDES AS-BUILT DRAINAGE & PIPING & THROUGH FIELD VERIFICATIONS, WHERE ACCESSIBLE, INFORMATION FROM EXIST DRAWINGS.
3. ELEVATIONS TO ϕ OF PIPE X'-X" ARE RELATIVE TO 1ST FLOOR STEEL(401'-8").

FOR 325-A SEE SH 2, 3, & 4

SYMBOLS/ABBREVIATIONS

- ||- - BLIND FLANGE
- ⊥ - CAPPED, FLANGED OR PLUGGED LINE
- ∧ - CHECK VALVE
- ⊥ - INJECTOR JET(EDUCTOR)
- ⊥ - THRU WALL OR FLOOR
- CPW - COLD PROCESS WATER
- DR - DRAIN
- FL - FLOOR
- PW - PROCESS WATER
- RLWS - RADIOACTIVE LIQUID WASTE SYSTEM
- RM - ROOM
- RPS - RETENTION PROCESS SEWER
- SH - SHEET
- TK - TANK
- XXX OR XXXX - ROOM NUMBER
- ⊕ - PUMP



KEY PLAN
SCALE: NONE

ISOMETRIC

SCALE: COLUMN LINES
• 3/32" = 1'-0"

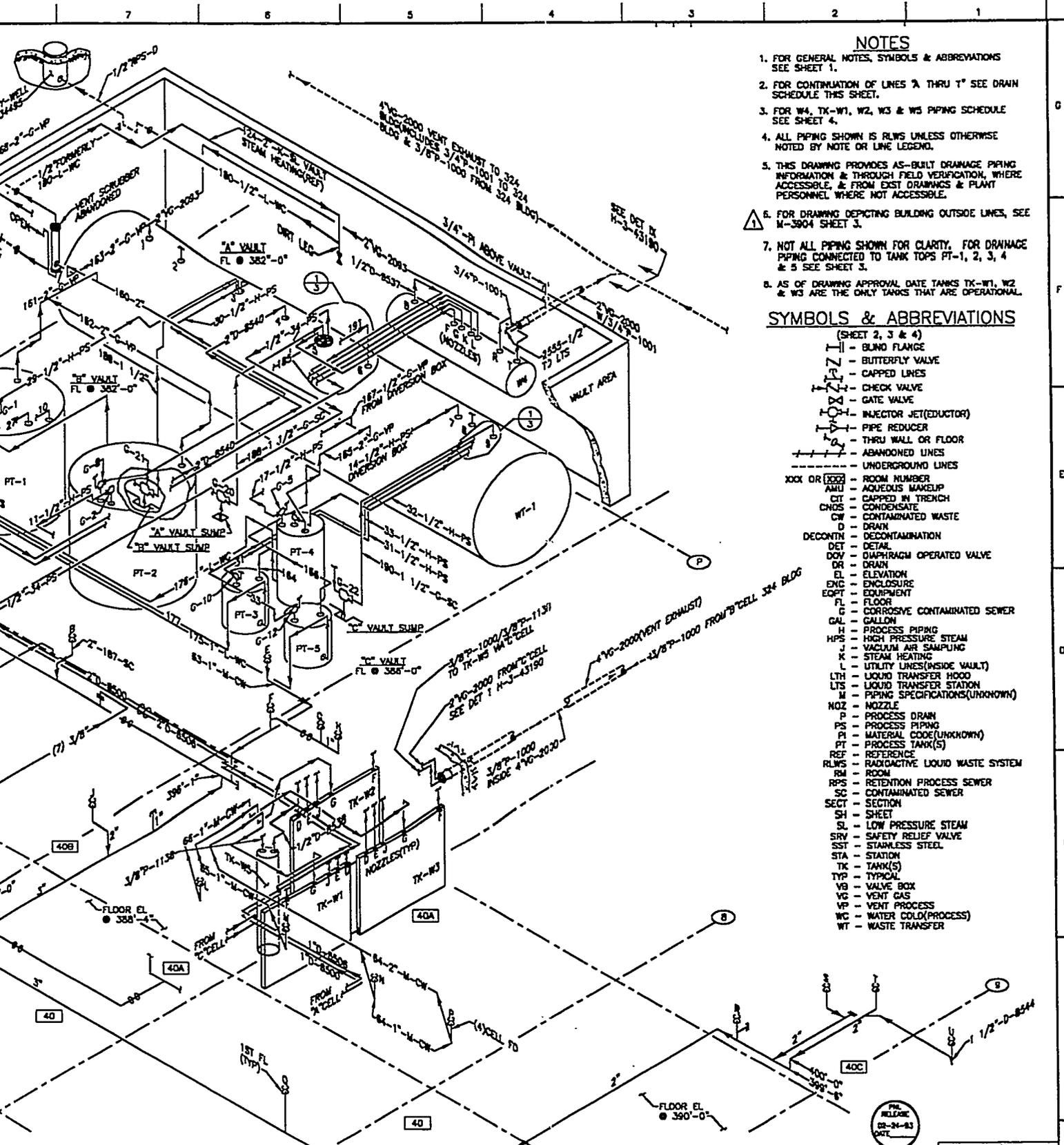


EP 1 90-183

DRAWN BY: SC NYBY CHECKED BY: WALTER B JACKSON DATE: 7/2/78		U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTILLE MEMORIAL INSTITUTE
DATE: 7/2/78 BY: RW RICHARDSON DATE: 7/2/78 BY: JW LEEPER DATE: 7/2/78 BY: ER GERK DATE: 7/2/78		RLWS PIPING BELOW FIRST FLOOR ISOMETRIC
DATE: 7/2/78 BY: CW CABLE DATE: 7/2/78 APPROVED FOR BUILDING: JW LEEPER DATE: 7/2/78		FACILITY EFFLUENT MONITORING PLAN SHEET NO: 8409 SHEET NO: 325 SHEET NO: 8548 SCALE: SHOWN
PROJECT NO: 3039WJAC02:1.0:SS DRAWING NO: C079460A		H-3-70460 REV NO: 1

NO	DATE	BY	DESCRIPTION
1			ECH06 1b) D00780-EDP01-RO-FMP01-ECN05 REVISED PER 1a) D00780-EDP01-RO-FMP01-

H-3-70456	325 BLDG DR REF DWG LIST
REFERENCE DRAWINGS	
NEXT USED ON	



NOTES

- FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.
- FOR CONTINUATION OF LINES "A" THRU "I" SEE DRAIN SCHEDULE THIS SHEET.
- FOR W4, TX-W1, W2, W3 & W5 PIPING SCHEDULE SEE SHEET 4.
- ALL PIPING SHOWN IS RLWS UNLESS OTHERWISE NOTED BY NOTE OR LINE LEGEND.
- THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING INFORMATION & THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, & FROM EXIST DRAWINGS & PLANT PERSONNEL WHERE NOT ACCESSIBLE.
- FOR DRAWING DEPICTING BUILDING OUTSIDE LINES, SEE M-3904 SHEET 3.
- NOT ALL PIPING SHOWN FOR CLARITY. FOR DRAINAGE PIPING CONNECTED TO TANK TOPS PT-1, 2, 3, 4 & 5 SEE SHEET 3.
- AS OF DRAWING APPROVAL DATE TANKS TX-W1, W2 & W3 ARE THE ONLY TANKS THAT ARE OPERATIONAL.

SYMBOLS & ABBREVIATIONS

- (SHEET 2, 3 & 4)
- BLIND FLANGE
 - BUTTERFLY VALVE
 - CAPPED LINES
 - CHECK VALVE
 - GATE VALVE
 - INJECTOR JET(EDUCTOR)
 - PIPE REDUCER
 - THRU WALL OR FLOOR
 - ABANDONED LINES
 - UNDERGROUND LINES
 - XXX OR XXXX - ROOM NUMBER
 - AHU - AQUEOUS MAKEUP
 - CT - CAPPED IN TRENCH
 - CNOS - CONDENSATE
 - CW - CONTAMINATED WASTE
 - D - DRAIN
 - DECONTH - DECONTAMINATION
 - DET - DETAIL
 - DOV - DIAPHRAGM OPERATED VALVE
 - DR - DRAIN
 - EL - ELEVATION
 - ENC - ENCLOSURE
 - EQUIP - EQUIPMENT
 - FL - FLOOR
 - G - CORROSIVE CONTAMINATED SEWER
 - GAL - GALLON
 - H - PROCESS PIPING
 - HPS - HIGH PRESSURE STEAM
 - J - VACUUM AIR SAMPLING
 - K - STEAM HEATING
 - L - UTILITY LINES(INSIDE VAULT)
 - LTH - LIQUID TRANSFER HOOD
 - LTS - LIQUID TRANSFER STATION
 - M - PIPING SPECIFICATIONS(UNKNOWN)
 - NOZ - NOZZLE
 - P - PROCESS DRAIN
 - PS - PROCESS PIPING
 - PI - MATERIAL CODE(UNKNOWN)
 - PT - PROCESS TANK(S)
 - REF - REFERENCE
 - RLWS - RADIOACTIVE LIQUID WASTE SYSTEM
 - RM - ROOM
 - RPS - RETENTION PROCESS SEWER
 - SC - CONTAMINATED SEWER
 - SECT - SECTION
 - SH - SHEET
 - SL - LOW PRESSURE STEAM
 - SRV - SAFETY RELIEF VALVE
 - SST - STAINLESS STEEL
 - STA - STATION
 - TK - TANK(S)
 - TYP - TYPICAL
 - VB - VALVE BOX
 - VG - VENT GAS
 - VP - VENT PROCESS
 - WC - WATER COLD(PROCESS)
 - WT - WASTE TRANSFER

325-A ISOMETRIC
SCALE: NONE

PH. RELEASE
02-24-83
DATE

EP 1 90-183

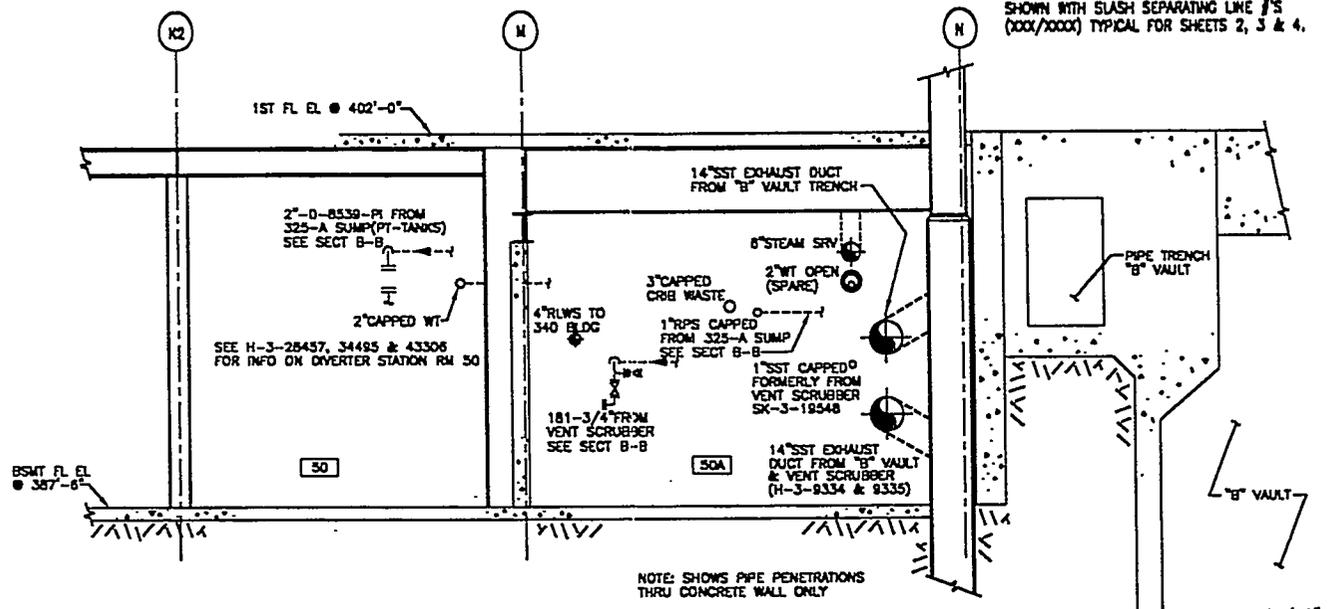
NAME: SC NYBY CHECKED: WALTER B JACKSON DATE: 1/14/83 BY: RICHARDSON DATE: 2/25/83 DRAWN: JIM LEEPER DATE: 2/25/83 CHECKED: ER GERK DATE: 2/25/83		U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
PER ECN #000182-EDP1-R1-FMPO-ECN3 ADDED REFERENCE DWG M-3904 SH-3 ZN 3.F REMOVED REFERENCE DWG H-3-70484 &		MISCELLANEOUS DRAINAGE PIPING BELOW FIRST FLOOR ISOMETRIC	
PROJECT: 30-JEM-AC02:12.0-SS SHEET: C07U4608		FACILITY EFFLUENT MONITORING PLAN	
APPROVED FOR MODIFICATIONS BY: JIM LEEPER DATE: 1/21/83		DRAWN BY: JIM LEEPER DATE: 2/25/83	
CHECKED BY: ER GERK DATE: 2/25/83		SCALE: AS SHOWN	

REV	DATE	DESCRIPTION
1	1/14/83	PER ECN #000182-EDP1-R1-FMPO-ECN3 ADDED REFERENCE DWG M-3904 SH-3 ZN 3.F REMOVED REFERENCE DWG H-3-70484 &

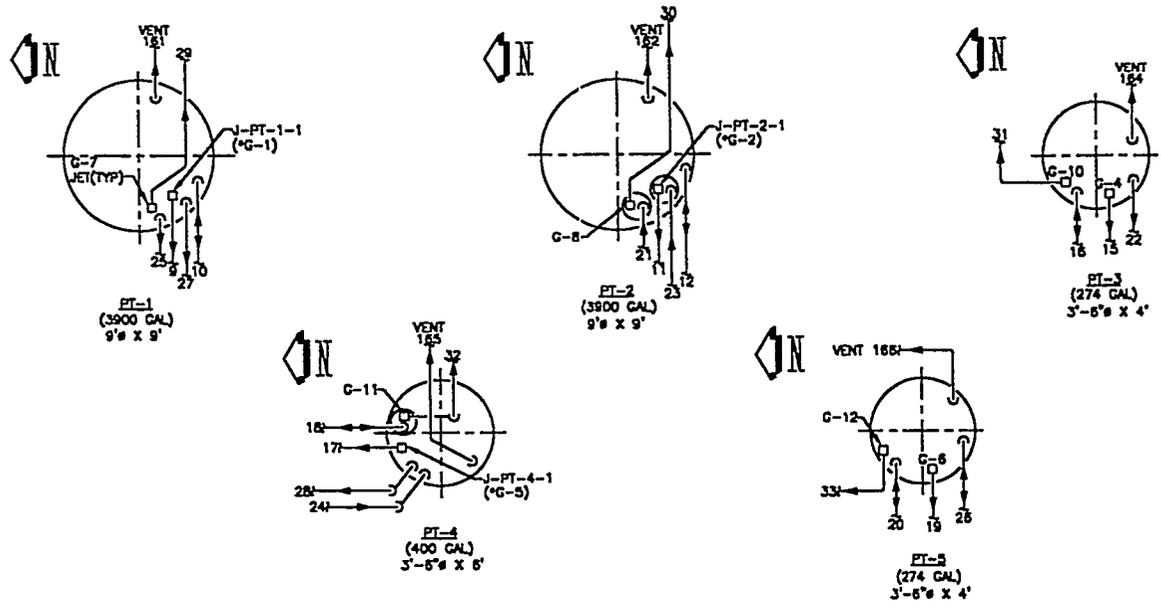
REV	DATE	DESCRIPTION
1	1/14/83	PER ECN #000182-EDP1-R1-FMPO-ECN3 ADDED REFERENCE DWG M-3904 SH-3 ZN 3.F REMOVED REFERENCE DWG H-3-70484 &

NOTES

- FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1 & 2.
- SOME DRAINAGE LINES ON EXIST DRAWINGS SHOW MORE THAN ONE LINE NUMBER. THESE LINES SHOWN WITH SLASH SEPARATING LINE #'S (XXX/XXXX) TYPICAL FOR SHEETS 2, 3 & 4.



SECTION A-A SH 2
SCALE: 3/8"=1'-0"



TANK TOPS PT-1, 2, 3, 4 & 5
SCALE: NONE

H-3-9315, 16 & 111
(*G-X) = FORMER JET (REF H-3-43168)
FOR TANK PIPING SCHEDULE SEE SH 4



OP 1 90-163

U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
TANK DRAINAGE PIPING SECTIONS & DETAILS	
PROJECT: SC NYBY DESIGNED: WALTER B JACKSON DATED: 2/2/82 BY: RICHARDSON DATE: 2/2/82 CHECKED: JW LEEPER DATE: 2/2/82 APPROVED: JW LEEPER DATE: 2/2/82	FACILITY EFFLUENT MONITORING PLAN SHEET NO: 8409 325A DRAWING NO: H-3-70460 SCALE: AS SHOWN SHEET 3 OF 4

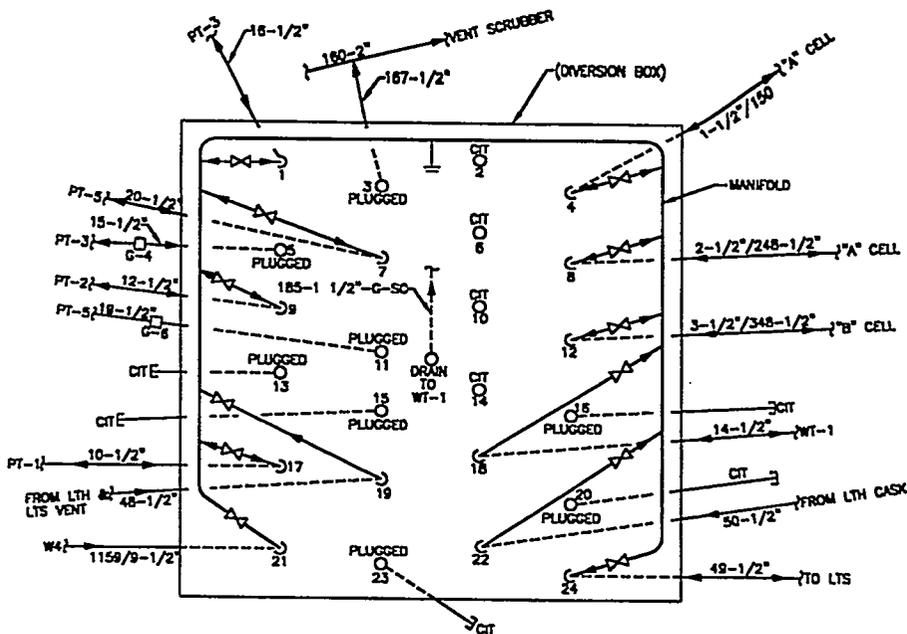
NO.	DATE	DESCRIPTION

FOR TANK DWG DETAILS PT-1, 2, 3, 4 & 5 SEE H-3-9321

PT TANKS PIPING SCHEDULE

DB = DIVERSION BOX(1ST FL)
= JET
= FORMER JET NUMBER

TANK	LINE(S)	FROM	VIA	TO	NOZZES
PT-1 (3900 GAL)	9-1/2"/1138	PT-1	*J-PT-1-1(*G-1)	W4	K
	10-1/2"	PT-1 OR DB		DB OR PT-1	
	25-1/2"/350-1/2"	PT-1		"B" CELL	
	(27-1/2"/258-1/2") (1/2"-P-1192/ 1/2"-P-1151	PT-1	*J-A8-1	"A" CELL	
	29-1/2" 181-2" 178-1 1/2"	PT-1 PT-1 PT-1	G-7 160-2"	WT-1 VENT SCRUBBER 325-A SUMP	3
PT-2 (3900 GAL)	11-1/2"/-P-1135	PT-2	J-PT-2-1(*G-2)	W4	C
	12-1/2"	PT-2 OR DB		DB OR PT-2	
	21-1/2"/148-1/2"	"A" CELL		PT-2	
	23-1/2"/250-1/2"	"A" CELL		PT-2	
	30-1/2" 182-2" 178-1 1/2"	PT-2 PT-2 PT-2	G-8 161/160	WT-1 VENT SCRUBBER 325-A SUMP	3
PT-3 (274 GAL)	15-1/2"	PT-3	*G-4	LTS	9
	16-1/2"	PT-3 OR LTS		LTS OR PT-3	
	31-1/2"	PT-3	*G-10	WT-1	
	164-2"	PT-3	168/165/160	VENT SCRUBBER	
	22/148-1/2" 177-1"	"A" CELL PT-3		PT-3 325-A SUMP	
PT-4 (400 GAL)	17-1/2"/1134	PT-4	J-PT-4-1(*G-5)	W4	L
	(18-1/2"/-P-1193) (4-1/2"/448-1/2") (1/2"-P-1128	"C" CELL	J-C3-3	PT-4	
	(24-1/2"/27-1/2") (1/2"-P-1194/ 1/2"-449/1/2"-1092)	"C" CELL	J-C2-1	PT-4	
	28-1/2"/-450/-1091	PT-4 OR "C" CELL		"C" CELL OR PT-4	
	32-1/2" 165-2" 178-1"	PT-4 PT-4 PT-4	*G-11 160-2"	WT-1 VENT SCRUBBER 325-A SUMP	9
PT-5 (274 GAL)	19-1/2"	PT-5	*G-6	DB	9
	20-1/2"	PT-5 OR DB		DB OR PT-5	
	28-1/2"/348-1/2"	PT-5 OR "B" CELL		"B" CELL OR PT-5	
	33-1/2" 166-2" 175-1"	PT-5 PT-5 PT-5	*G-12 160/165	WT-1 VENT SCRUBBER 325-A SUMP	



325-A DIVERSION BOX PLAN DIAGRAM

H-3-9318
H-3-9325
H-3-9328
H-3-43178
H-3-43186
H-3-47144

SHOWN FOR INFORMATION ONLY
LOCATION: APPROXIMATELY COLUMN LINE 8-N RM 603 1ST FLOOR

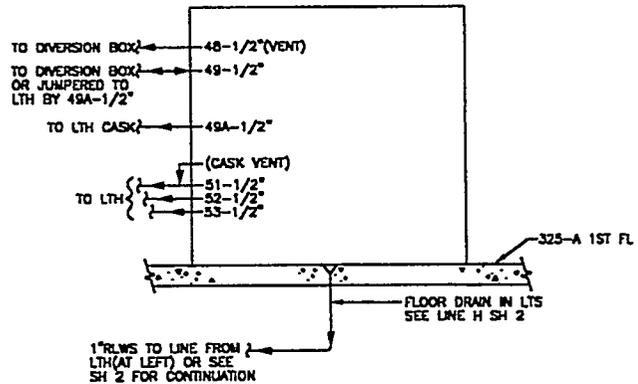
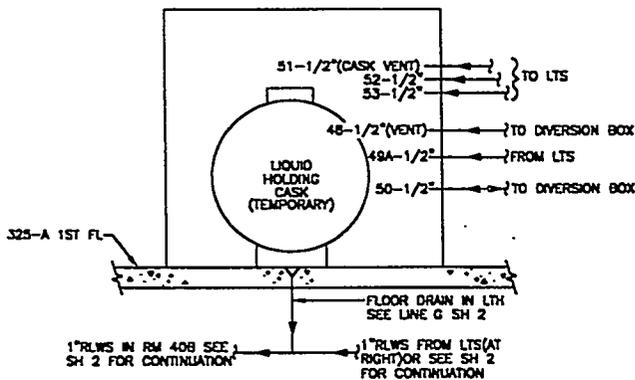
325-A TANK PIPING SCHEDULE

FOR TANK DWG DETAILS
 TK-W1, W2 & W3 SEE H-3-43311
 TK-W5 SEE H-3-73312
 W-4 SEE H-3-43187, 43196
 W1-1 SEE H-3-8321

NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS
 SEE SHEET 1 & 2.

TANK	NOZZLE	LINE(S)#	FROM	TO
W4 (398 GAL)	B	8537	COL(W4)	DIVERTER STATION RM 50
	F	1137/13	WT-1	W4
	G	1135/11	PT-2	W4
	K	1138/9	PT-1	W4
	L	1134/17	PT-4	W4
	R	P-1001	W4	324 BLDG
	S	1159/9	W4	DB
T	VG-2093	W4	VENT SCRUBBER VA 183-2-G-VF	
TK-W1	G	{ 2"-D-8533 64-1"-M-CW 64-2"-M-CW }	"A" CELL FD	TK-W1
	E	1142/139	TK-W1	"A" CELL
	F	1143	TK-W1	LTS
	D	1/2"-1160	TK-W1	LTS
	J	2546/239	TK-W1(VENT)	"A" CELL
TK-W2	G	{ 1"-D-8534 65-1"-M-CW }	"B" CELL FD	TK-W2
	E	1145/339	TK-W2	"B" CELL
	F	1146	TK-W2	LTS
	D	1161	TK-W2	LTS
	J	2545/340	TK-W2(VENT)	"B" CELL
TK-W3	G	{ 1"-D-8535 66-1"-M-CW }	"C" CELL FD	TK-W3
	E	1139/456	TK-W3	"C" CELL
	F	1141	TK-W3	LTS
	D	1140/440	TK-W3	"C" CELL
	J	2547/439	TK-W3(VENT)	"C" CELL
TK-W5	A	3/8"-P-1127 (SPARE)	TK-W5	"C" CELL
	B	3/8"-P-1128	TK-W5	"C" CELL
	C	{ 3/8"-P-1138/ 1/2"-P-1000 }	324 BLDG	TK-W5 VIA 4"VG-2000
	F	1/2"-D-8538	TK-W5	RPS DIVERTER STATION RM 50 VA 2"-D-8500



325-A LIQUID TRANSFER HOOD(LTH)

LOCATION: APPROXIMATELY COLUMN LINE 6, 7-N 1ST FLOOR.
 NOTE: ONLY THE DRAIN LINES BETWEEN THE LTS, LTH & DIVERSION BOX SHOWN FOR CLARITY, SHOWN FOR INFORMATION ONLY.

H-3-8315
 H-3-8318
 H-3-8139
 H-3-12901
 H-3-12917
 H-3-12919
 H-3-12939
 H-3-12940
 H-3-43168
 H-3-43179
 H-3-43478

325-A LIQUID TRANSFER STATION(LTS)

LOCATION: APPROXIMATELY COLUMN LINE 7-N 1ST FLOOR.
 NOTE: ONLY THE DRAIN LINES BETWEEN THE LTS, LTH & DIVERSION BOX SHOWN FOR CLARITY, SHOWN FOR INFORMATION ONLY.

H-3-8316
 H-3-8318
 H-3-12917
 H-3-12919
 H-3-43168
 H-3-43188
 H-3-9315
 H-3-9139
 H-3-12940
 H-3-43179
 H-3-43478



REF 1 90-183

U. S. DEPARTMENT OF ENERGY PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
TANK DRAINAGE PIPING SCHEDULE	
APPROVED FOR SUBMITTANCE BY JW LEEPER FOR PNL DATE 2/2/83	INDEX NO. 8409 SHEET NO. 8548 SCALE NONE SHEET 4 OF 4

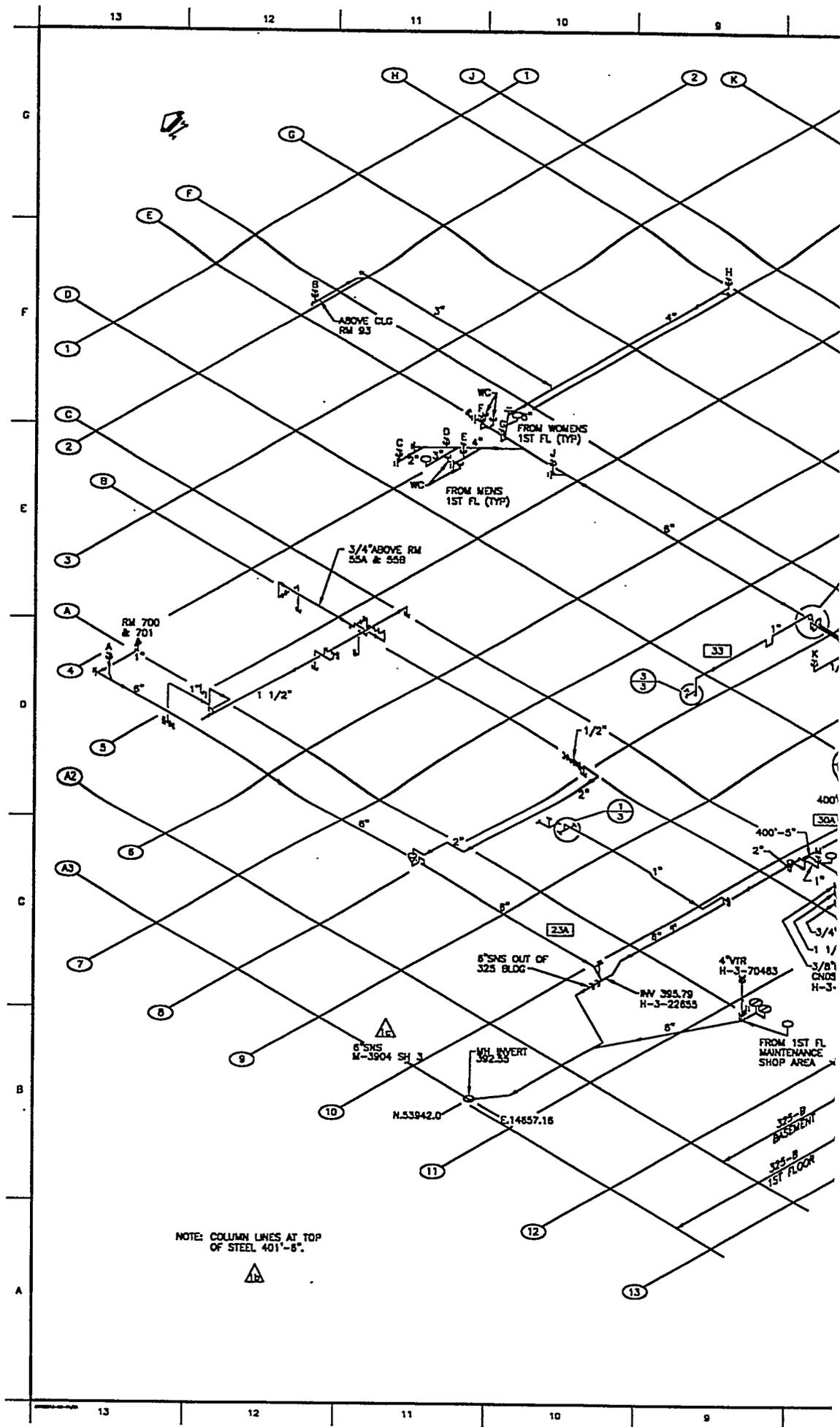
NO.	DATE	BY	DESCRIPTION

REVISIONS

CHOCODE 302EM/ACD2:12.0:SS CHOPLE C0714800

REFERENCE DRAWINGS

NEXT USED ON



NOTE: COLUMN LINES AT TOP OF STEEL 401'-8".



13 12 11 10 9

13 12 11 10 9

G
F
E
D
C
B
A

H J I 2 K

13

12

11

10

9

8

7

6

5

4

3

2

1

33

3

1

23A

10

11

12

13

400'

30A

400'-5"

2"

1"

3/4"

1 1/2"

3/8"

1-3-

H-3-

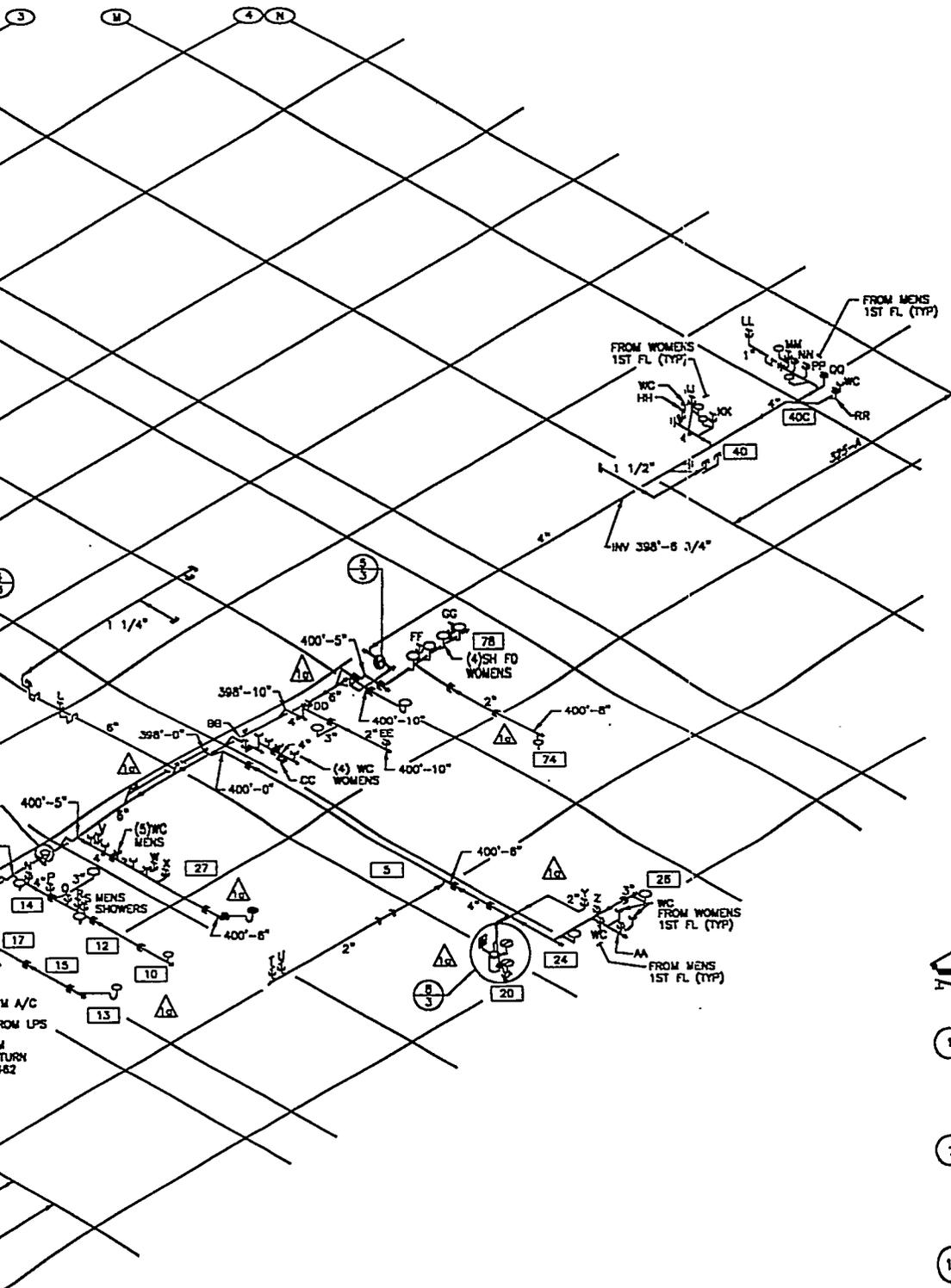
GENERAL NOTES

(UNLESS OTHERWISE NOTED)

- FLOOR DRAINS, SINK DRAINS, DRINKING FOUNTAINS, MENS & WOMENS WATER CLOSETS & SHOWERS ARE ON 1ST FLOOR.
- THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING THROUGH FIELD VERIFICATION WHERE ACCESSIBLE, AND INFORMATION FROM EXIST DRAWINGS.
- FOR MATCH UP WITH VENT & DRAIN RISERS "A" TO "RR" SEE SHEET 2.

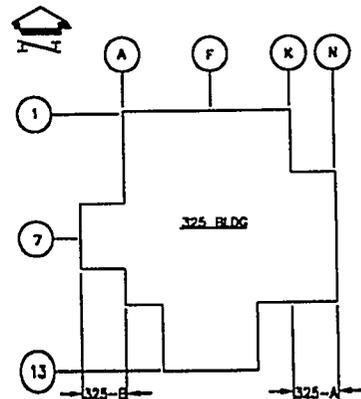
SYMBOLS/ABBREVIATIONS

- - BALL VALVE
- - CAPPED OR PLUGGED LINE
- - CAPPED OR PLUGGED IN 1ST FL CHASE
- - CHECK VALVE
- - CLEAN OUT (C.O.)
- - DRAIN CONNECTION, EDPT, OR OPEN LINE
- - DRINKING FOUNTAIN (DF)
- - FLOOR DRAIN CAPPED OR PLUGGED
- - FLOOR DRAIN/SHOWER OPEN
- - FUNNEL DRAIN OR OPEN RISER DRAIN
- - GATE VALVE
- - HOSE CONNECTION
- - SIGHT GLASS
- - SINK DRAIN
- - THRU WALL OR FLOOR
- A/C - AIR CONDITIONER
- AHU - AIR HANDLING UNIT
- AMU - AQUEDUS MAKEUP
- CLG - CEILING
- CHDS - CONDENSATE
- DET - DETAIL
- DMNRZ/R - DEMINERALIZER
- DR - DRAIN
- DW - DISTILLED WATER
- EDPT - EQUIPMENT
- FD - FLOOR DRAIN
- FL - FLOOR
- HX - HEAT EXCHANGER
- INV - INVERT
- JC - JANITORS CLOSET
- KS - KITCHEN SINK
- L - LAVATORY
- LPS - LOW PRESSURE STEAM
- MEZZ - MEZZANINE
- MH - MANHOLE
- PL - PLACE
- RM - ROOM
- XXX OR XXXX - ROOM NUMBER
- RPS - RETENTION PROCESS SEWER
- SH - SHOWER
- SNS - SANITARY SEWER
- SRV - SAFETY RELIEF VALVE
- SS - SERVICE SINK
- TYF - TYPICAL
- UR - URINAL
- VTR - VENT THRU ROOF
- WC - WATER CLOSET
- (X) - PLACES



ISOMETRIC

SCALE: COLUMN LINES 1/32" = 1'-0"



KEY PLAN

SCALE: NONE

H-3-70458		325 BLDG DR REF DWG LIST		DRAWING NO		DRAWING TITLE	
REFERENCE DRAWINGS		CHOCODE 30486AC02:12.0:SS		CHFILE C073481A		REVISIONS	
RR	M	VN	MCH	RPZ	DLB	D00182-EDP01R1-FMP00-ECN03	
1/24/82		1/24/82	1/24/82	1/24/82	1/24/82	b) ADDED NOTE ZONE A-11. c) REV PER 92-092-002 AND EGN 92-092-005.	
						e) UPDATED SNS ZONES C/D4-B PER FMP	
DR	MF	DA	DR	DR	REV	DESCRIPTION	
						BY: J.W. LEEPER	
NEXT USED ON		DATE		BY		DATE	

EDP # 90-183

U. S. DEPARTMENT OF ENERGY
 RICHLAND OPERATIONS OFFICE
 PACIFIC NORTHWEST LABORATORY
 OPERATED BY BATTELLE MEMORIAL INSTITUTE

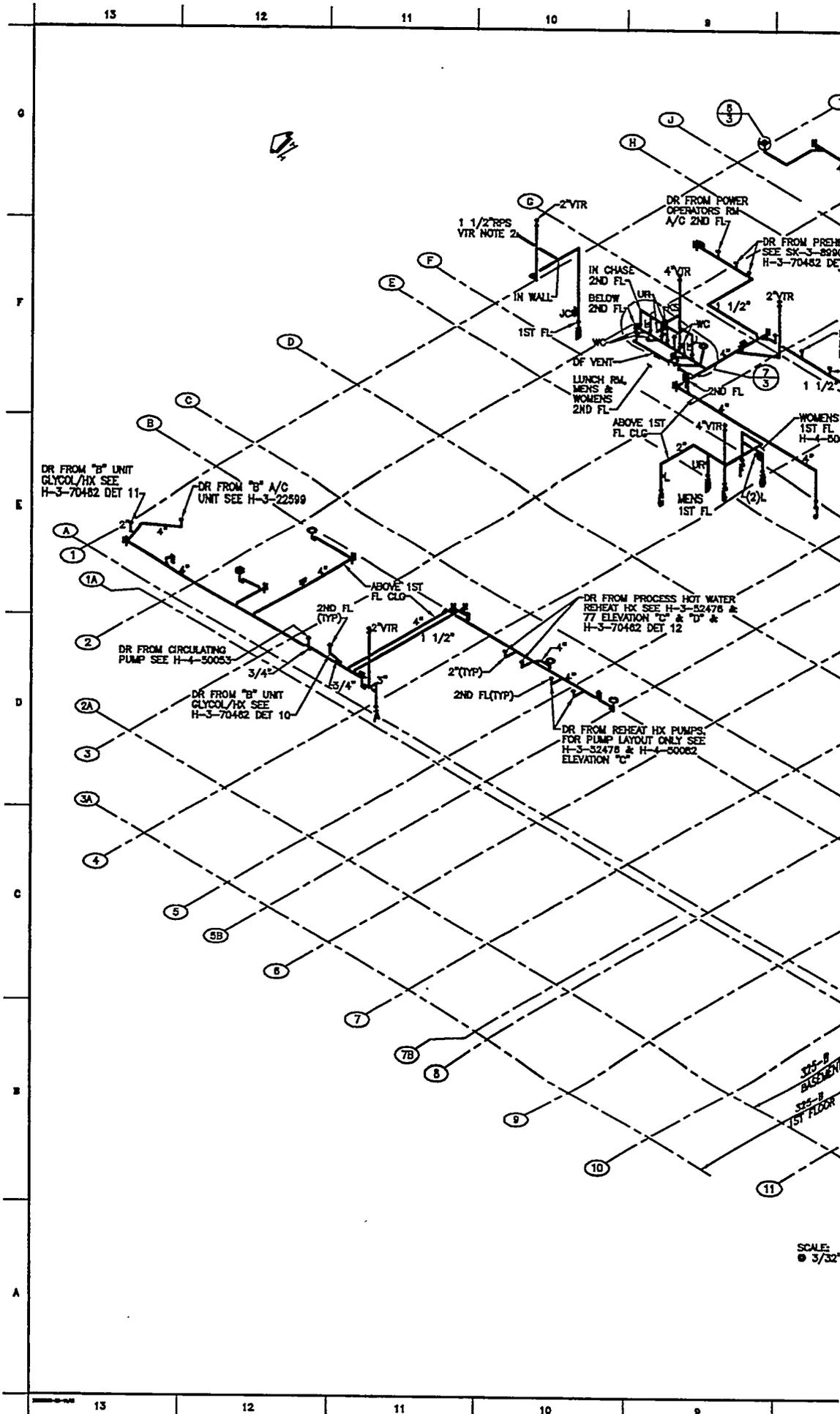
**SANITARY SEWER PIPING
 BELOW FIRST FLOOR
 ISOMETRIC**

FACILITY EFFLUENT MONITORING PLAN

DATE: 1/24/82
 DRAWN BY: J.W. LEEPER
 CHECKED BY: J.W. LEEPER
 SCALE: AS SHOWN

H-3-70461 1

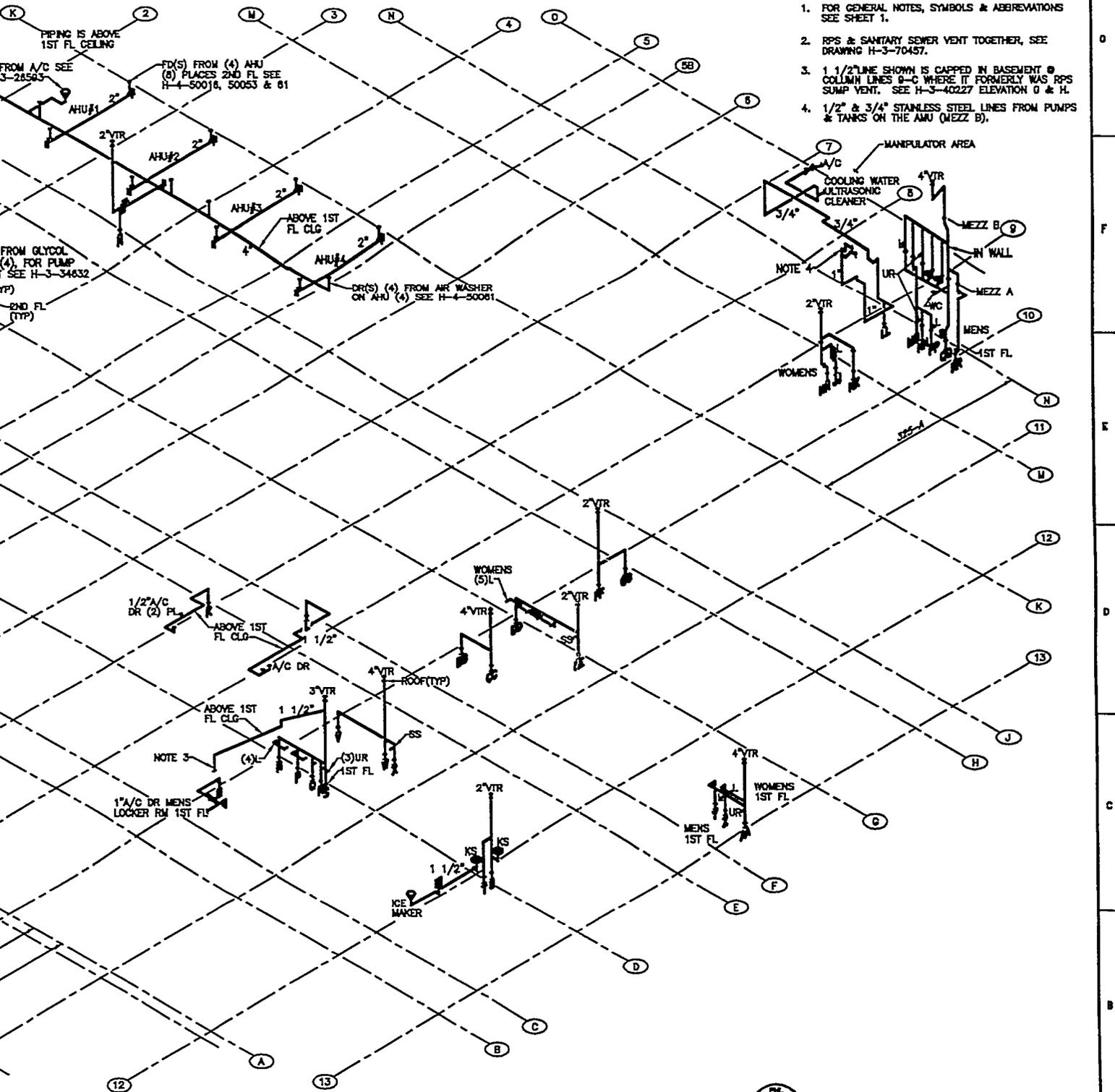
SHEET 1 OF 3



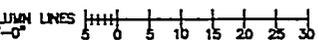
SCALE:
 3/32"

NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.
2. RPS & SANITARY SEWER VENT TOGETHER, SEE DRAWING H-3-70457.
3. 1 1/2" LINE SHOWN IS CAPPED IN BASEMENT @ COLUMN LINES B-C WHERE IT FORMERLY WAS RPS SUMP VENT. SEE H-3-40227 ELEVATION 0 & H.
4. 1/2" & 3/4" STAINLESS STEEL LINES FROM PUMPS & TANKS ON THE AMU (MEZZ B).



ISOMETRIC



REF # 90-163

OWNER SC NYBY		DATE 5/1/82	U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE	
CHECKED WALTER B JACKSON		DATE 1/2/83	PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE	
DESIGNED BY RV RICHARDSON		DATE 1/2/83	SANITARY SEWER ABOVE FIRST FLOOR & BELOW SECOND FLOOR ISOMETRIC	
DRAWN BY JW LEEPER		DATE 1/2/83	FACILITY EFFLUENT MONITORING PLAN	
CHECKED BY CR GERK		DATE 1/2/83	SIZE F	PROJECT NO. H-3-70461
APPROVED FOR IMPLEMENTATION BY JW LEEPER		DATE 1/2/83	SCALE AS SHOWN	SHEET NO. 2 OF 3

NO.	DATE	BY	DESCRIPTION

DRAWING NO: 30:EM:ACD2:12.0:SS
 PROJECT: C0704818
 NEXT USED ON:
 7 6 5 4 3 2 1

G

F

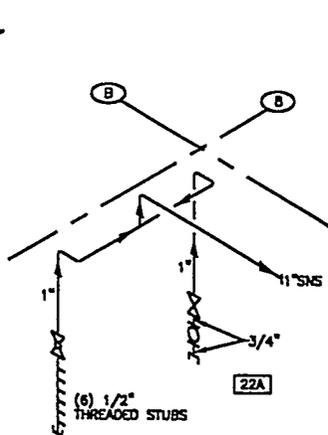
E

D

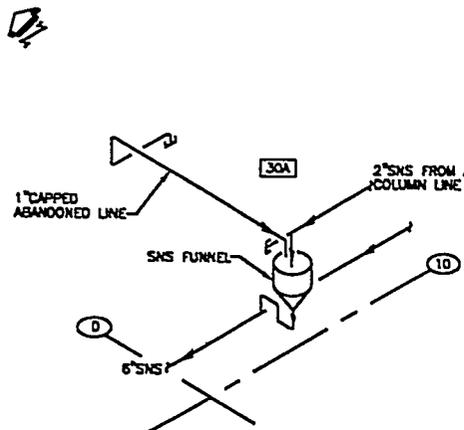
C

B

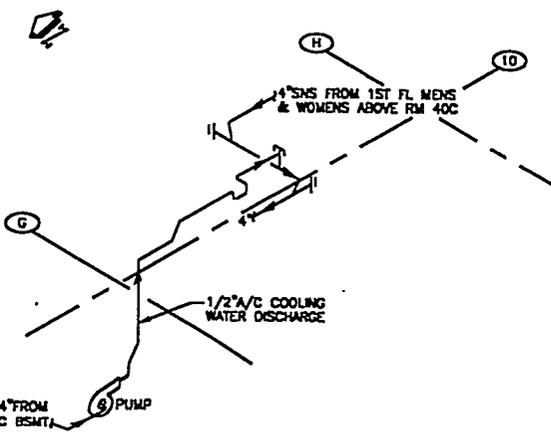
A



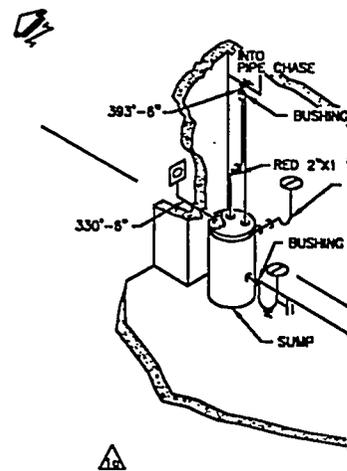
① RM 22A
① SCALE: NONE



② RM 30A
① SCALE: NONE



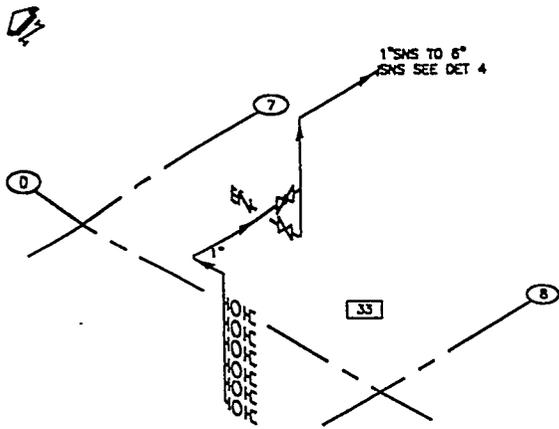
⑤ A/C DRAIN
① SCALE: NONE



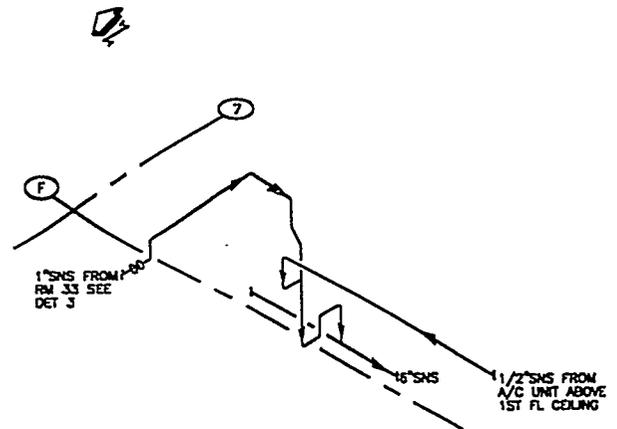
⑧ RM 8
① SCALE: NONE

NOTES

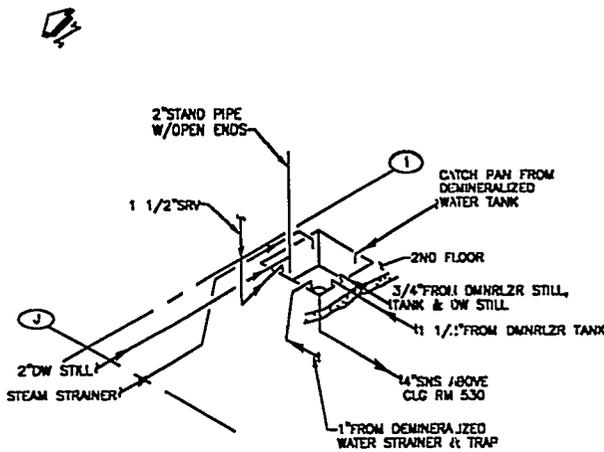
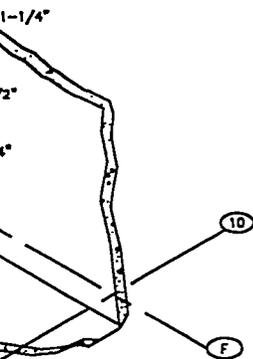
- FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.



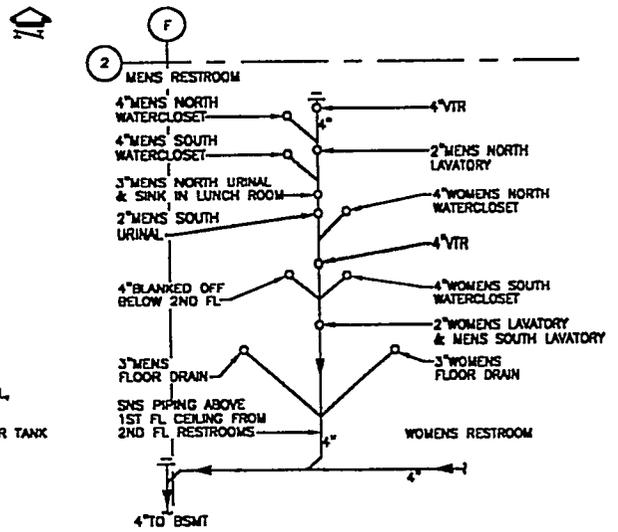
3 RM 33
SCALE: NONE



4 SNS-BSMT
SCALE: NONE



6 2ND FL SUMP
SCALE: NONE



7 PLAN OF 2ND FL RESTROOMS
SCALE: NONE

REL/ARC
02-24-83
DATE

90-183

SC NYBY CHECKED WALTER B JACKSON BY RICHARDSON J.W. LEEPER ER GERK		U. S. DEPARTMENT OF ENERGY RICHARD OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY METELLE MEDICAL INSTITUTE SANITARY SEWER DETAILS	
RR M VN MDH RFPZ 1/2/85 1/23/85 1/23/85 1/23/85		92-092-005. d) REVISION PER FMP 92-092-002 AND ECM	
RR M VN MDH RFPZ 1/2/85 1/23/85 1/23/85 1/23/85		REVISIONS	
CHOCODE 30-JBM:ACA02:12.0-SS		DIGFILE CO*0481C	
NEXT USED ON		FACILITY EFFLUENT MONITORING PLAN DATE: 8508 325 8510 SCALE SHOWN: H-3-70461 SHEET 3 OF 3	

DRIVING NO	DRIVING TITLE
REFERENCE DRAWINGS	
NEXT USED ON	

7

6

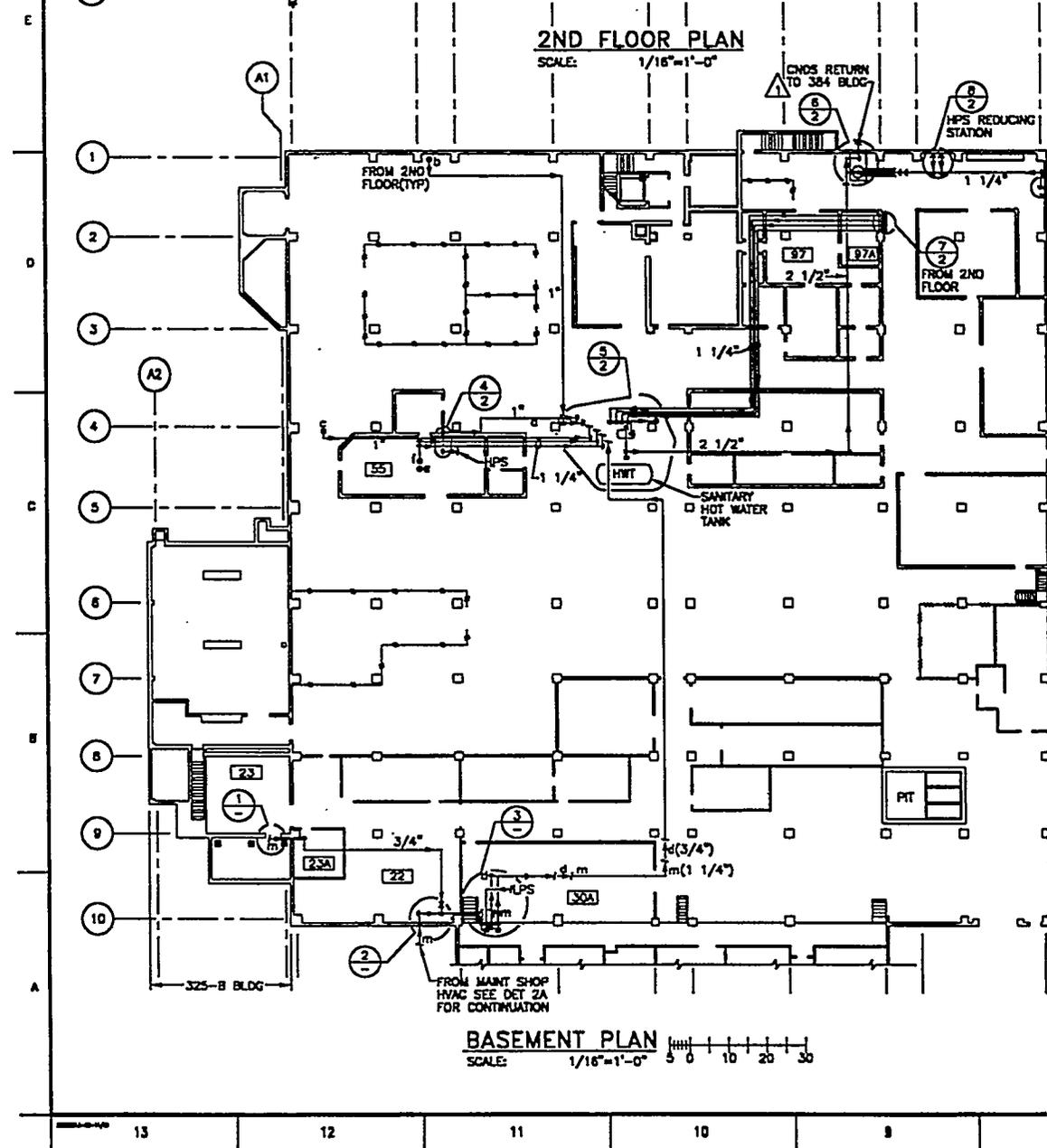
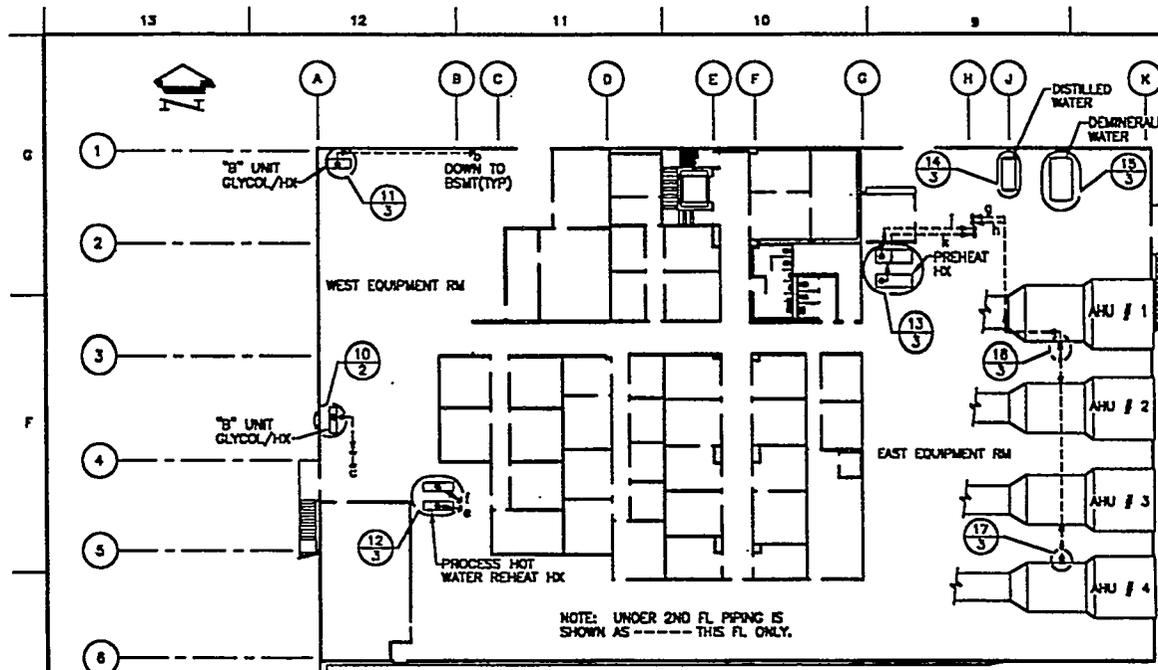
5

4

3

2

1

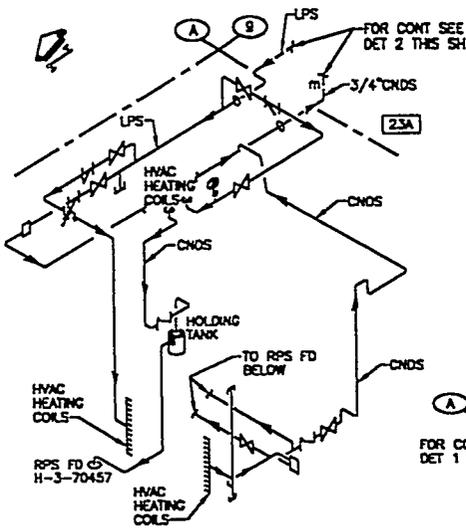


GENERAL NOTES
(UNLESS OTHERWISE NOTED)

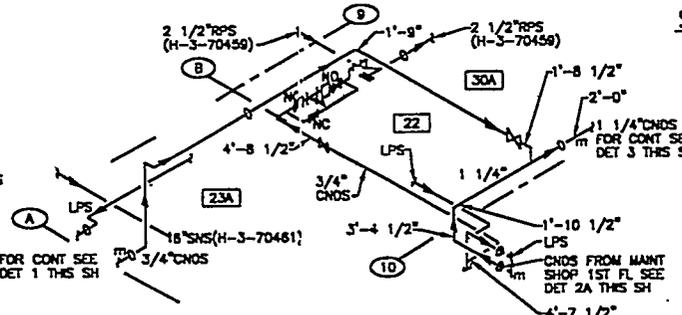
1. THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, & INFORMATION FROM EXIST DRAWINGS.
2. ELEVATIONS TO $\frac{1}{2}$ OF PIPE X"-X" ARE RELATIVE TO 1ST FLOOR STEEL(401'-8").
3. ALL 2ND FLOOR CNOS FLOWS TO BSMT.

SYMBOLS/ABBREVIATIONS

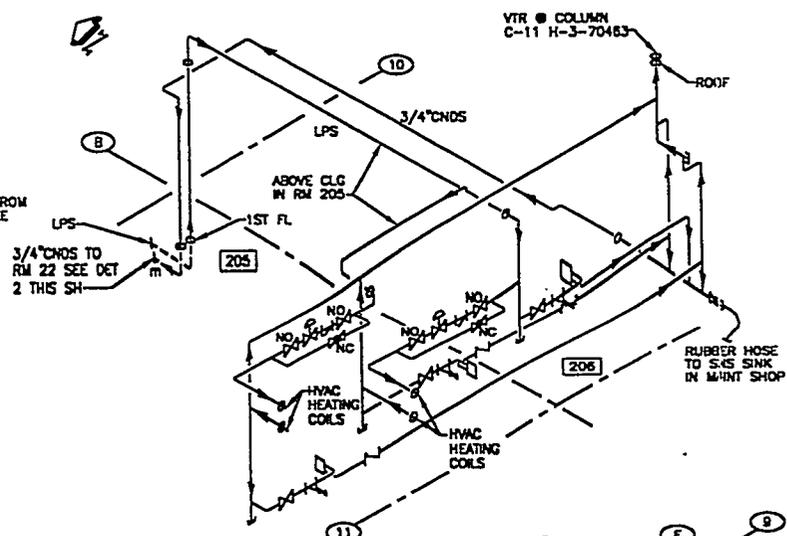
- ⊘ - BALL VALVE
- - BLIND FLANGE
- - CAPPED OR PLUGGED LINE
- - CHECK VALVE
- - CONTROL VALVE
- - GATE VALVE
- - GLOBE VALVE
- - HOSE CONNECTION
- - PIPE DOWN
- - PIPE UP
- - PRESSURE GAUGE
- - PUMP
- XXX OR XXXX - ROOM NUMBER
- - STRAINER
- - SAFETY RELIEF VALVE(SRV)
- - THREE WAY CONTROL VALVE
- - THRU WALL OR FLOOR
- - TRAP
- A/C - AIR CONDITIONER
- AHU - AIR HANDLING UNIT
- BSMT - BASEMENT
- CONT - CONTINUATION
- CLG - CEILING
- CNOS - CONDENSATE
- CSW - COLD SANITARY WATER
- DET - DETAIL
- DR - DRAIN
- EQPT - EQUIPMENT
- FD - FLOOR DRAIN
- FL - FLOOR
- HPS - HIGH PRESSURE STEAM
- HPW - HOT PROCESS WATER
- HSW - HOT SANITARY WATER
- HSWR - HOT SANITARY WATER RETURN
- HVAC - HEATING VENTILATION & AIR CONDITIONING
- HWT - HOT WATER TANK
- HX - HEAT EXCHANGER
- LPS - LOW PRESSURE STEAM
- MAINT - MAINTENANCE
- MECH - MECHANICAL
- NC - NORMALLY CLOSED
- NO - NORMALLY OPEN
- PRV - PRESSURE REGULATING VALVE
- RM - ROOM
- RPS - RETENTION PROCESS SEWER
- SH - SHEET
- SNS - SANITARY SEWER
- SPLY - SUPPLY
- VTR - VENT THRU ROOF



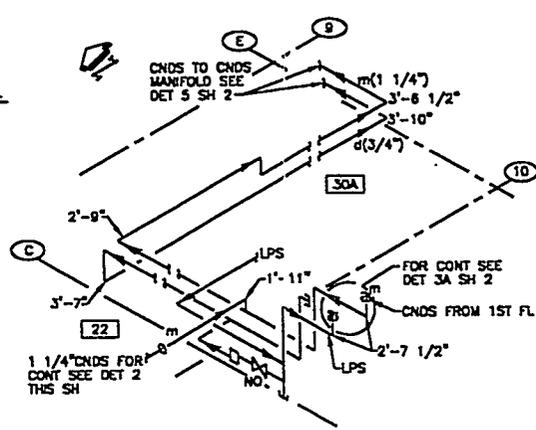
1 MECH EQPT RM
SCALE: NONE



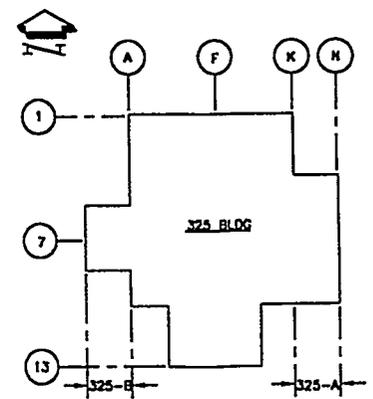
2 RM 22
SCALE: NONE
H-3-22510



2A MAINT SHOPS-1ST FL
SCALE: NONE



3 RM 30A
SCALE: NONE



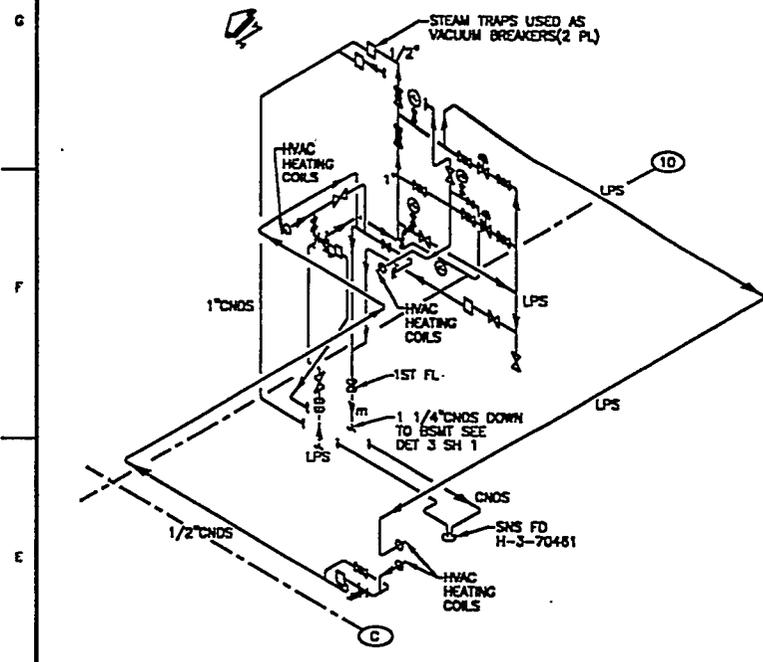
KEY PLAN
SCALE: NONE

H-3-70458	325 BLDG DR REF DWG LIST
REFERENCE DRAWINGS	
NEXT USED ON	

RR	M	CWC	JWL	WSJ	SCN	10.E PER ECN #D0162-EDP1-R1-FMPO-ECN3 REMOVED REFERENCE DRAWING H-3-70464 ZN	1
1/2/88		1/16/85	1/11/85	1/16/85	1/14/88		
REVISIONS							
CHOCODE	30784AC02:12.0:SS	CHOFLE	C070462A				

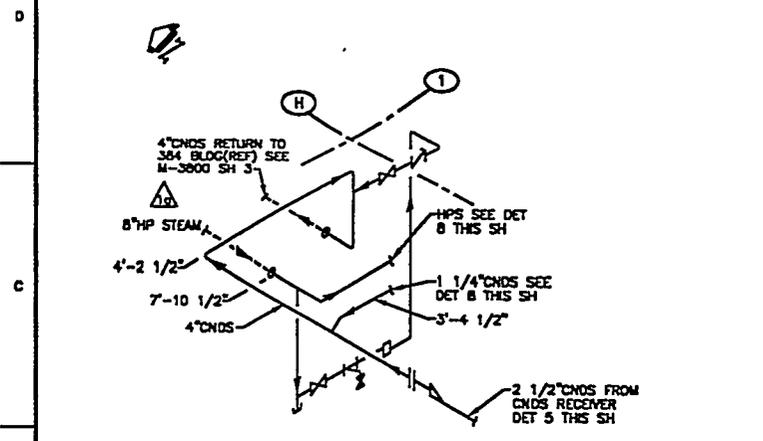
DESIGNED BY	SC NYBY	DATE	6/1/82
CHECKED BY	WALTER B JACKSON	DATE	7/2/82
DESIGNED BY	EV RICHARDSON	DATE	1/22/82
CHECKED BY	JW LEEPER	DATE	3/23/82
DESIGNED BY	ER GERM	DATE	2/2/82
CHECKED BY	DR	DATE	
DESIGNED BY	CW CABLE	DATE	1/24/82
APPROVED FOR REPLICATION	JW LEEPER	DATE	8/30/82
FOR PLOT		DATE	2/2/83

U. S. DEPARTMENT OF ENERGY			
RICHARD OPERATIONS OFFICE			
PACIFIC NORTHWEST LABORATORY			
OPERATED BY BATTELLE MEMORIAL INSTITUTE			
CONDENSATE RETURN PIPING PLAN & DETAILS			
FACILITY EFFLUENT MONITORING PLAN			
DATE	8/30/82	DATE	8/30/82
DATE	8/30/82	DATE	8/30/82
SCALE	AS SHOWN	SHEET	1 OF 3

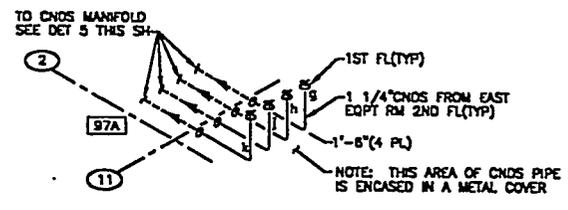


4 ABOVE CLG RM 5
 1 NOTE: LINES C, E & F ARE NOT SHOWN FOR CLARITY

3A CNDS MENS RM 1ST FL
 1 H-3-19846
 H-3-19847

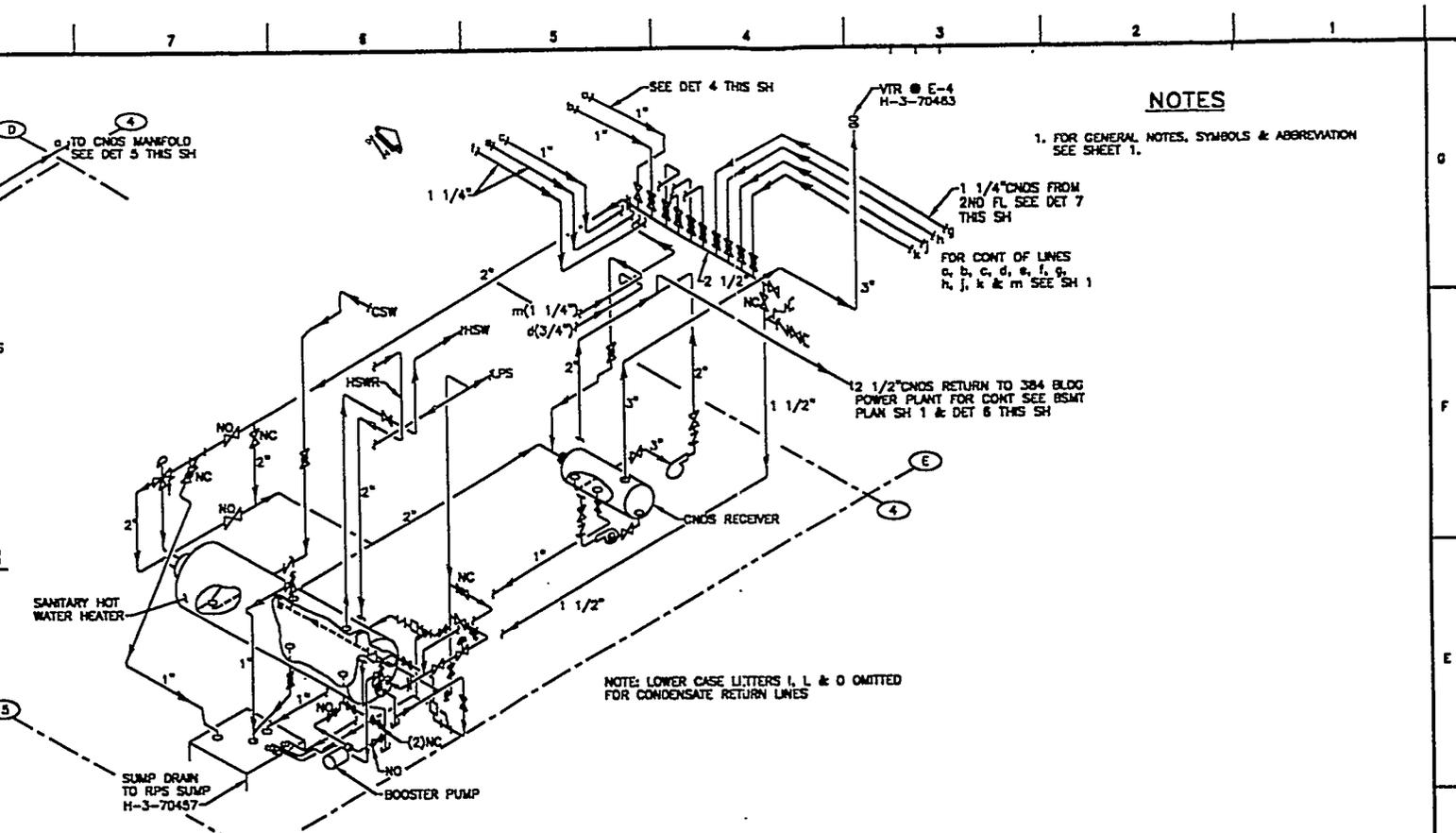


6 CNDS COL H-1 BSMT
 1



7 CNDS COL H-2 BSMT
 1

8 HI/L
 1 H-3-50



NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATION SEE SHEET 1.

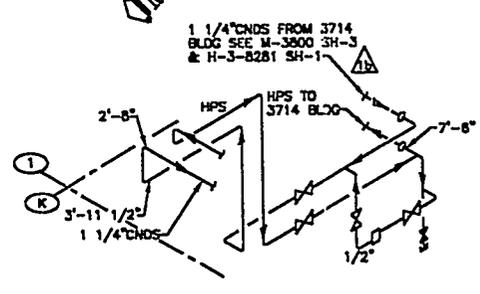
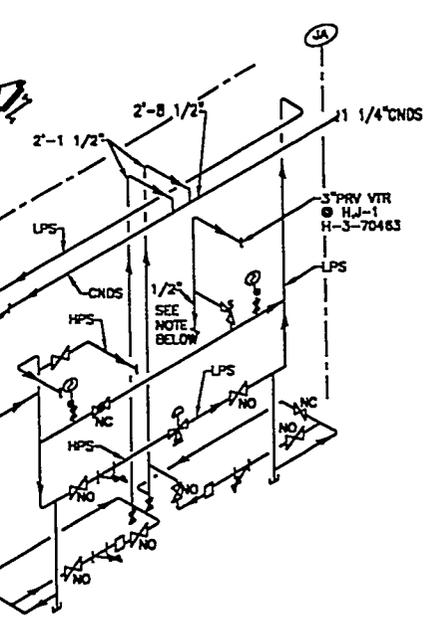
1 1/4" CNDS FROM 2ND FL. SEE DET 7 THIS SH
FOR CONT. OF LINES a, b, c, d, e, f, g, h, j, k & m SEE SH 1

2 1/2" CNDS RETURN TO 384 BLDG POWER PLANT FOR CONT SEE BSMT PLAN SH 1 & DET 6 THIS SH

NOTE: LOWER CASE LETTERS I, L & O OMITTED FOR CONDENSATE RETURN LINES

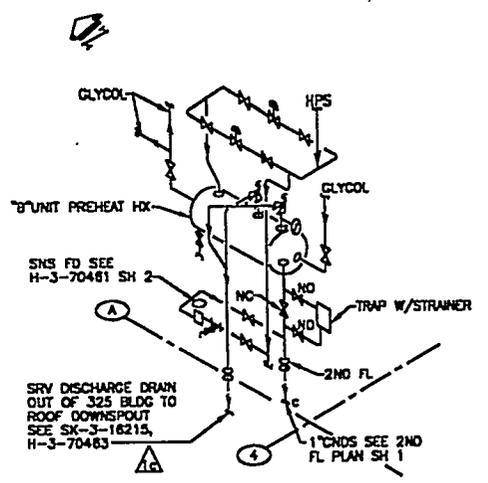
5 HOT WATER TANK & CNDS MANIFOLD

H-3-36303
H-4-50067



9 CNDS COL K-1 BSMT

H-3-36297
H-4-50061



10 "B" UNIT GLYCOL/HX 2ND FL

H-3-36297
H-4-50061

PRESSURE REDUCING STEAM STATION

NOTE: 1/2" FROM SRV TO RPS SUMP SEE DET 1 (H-3-70458)

REV	DATE	BY	CHKD	DESCRIPTION
1				000182-EDP1-R1-1MPO-ECN3 H-3-70484 ZN 2.8 PER ECN # ZN 4, c) REMOVED REFERENCE DWG H-3-70484 & ADDED N-3800 & H-3-8281 (PLACES) ZN 13, c) REMOVED REFERENCE DWG d) REMOVED REFERENCE DWG H-3-70484 (2)

DESIGNED: SC NYBY CHECKED: WALTER B JACKSON DATE: 1/2/78 DRAWN: RY RICHARDSON DATE: 1/2/78 IN CHARGE: JW LEEPER DATE: 1/2/78 APPROVED: ER GERK DATE: 1/2/78	U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE CONDENSATE RETURN PIPING DETAILS FACILITY EFFLUENT MONITORING PLAN SHEET NO. 8502 325 DRAWING NO. H-3-70462 SCALE: NONE SHEET 2 OF 3
---	---

G

F

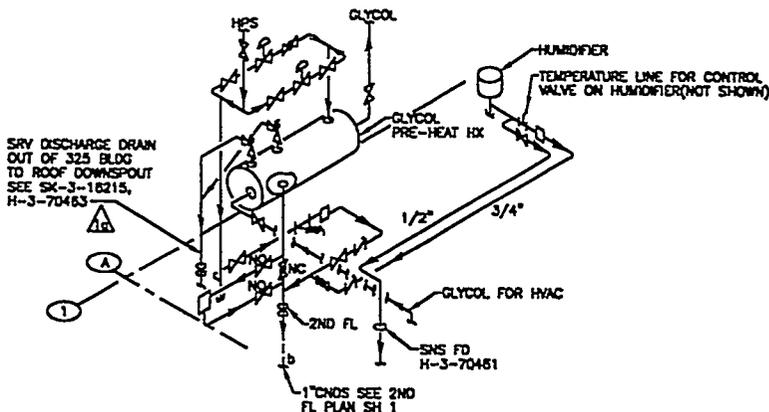
E

D

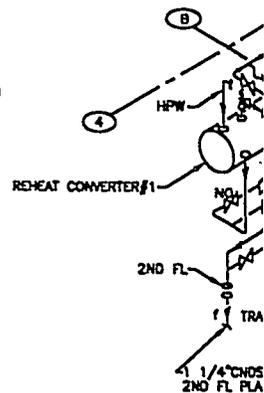
C

B

A

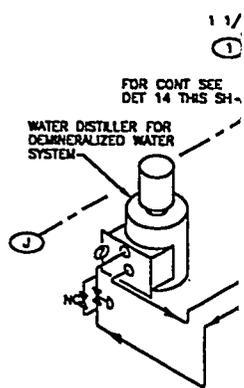
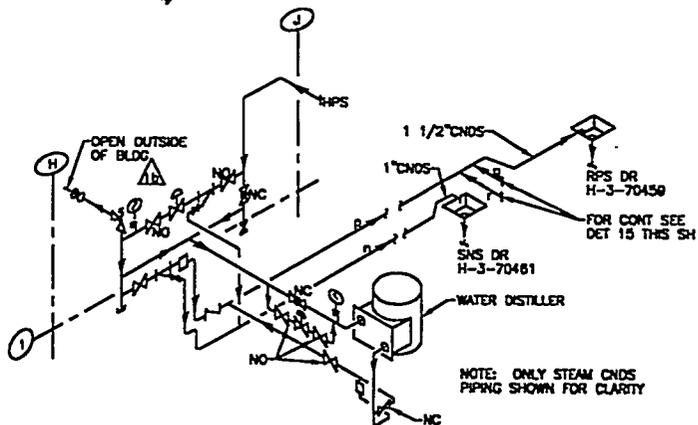


SRV DISCHARGE DRAIN
OUT OF 325 BLDG
TO ROOF DOWNSPOUT
SEE SK-3-18215,
H-3-70483



11 "B" UNIT GLYCOL/HX-2ND FL
 H-3-36297
 H-3-43273
 H-4-50018
 H-4-50082

12 PROCESS
 H-3-52478
 H-3-52477

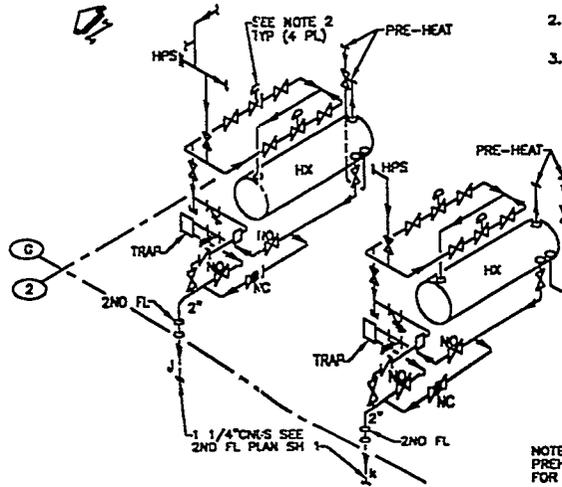
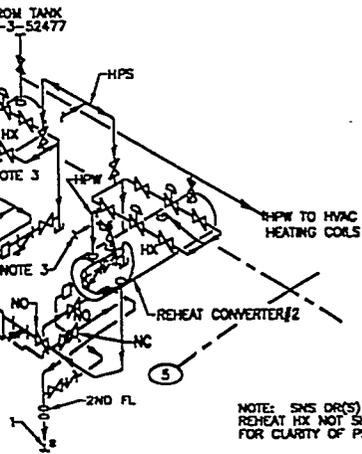


14 DISTILLED WATER STILL-2ND FL

15 DEMINERALI
 H-3-50068

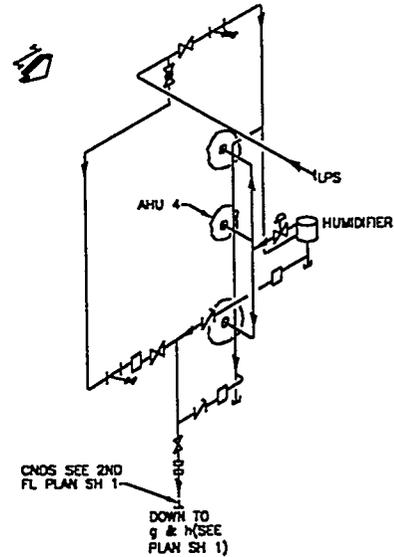
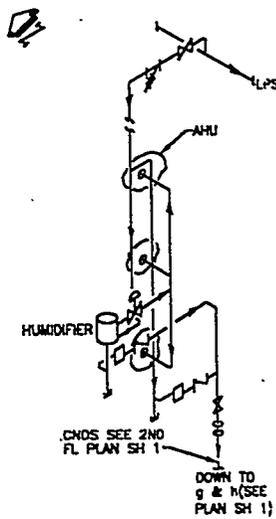
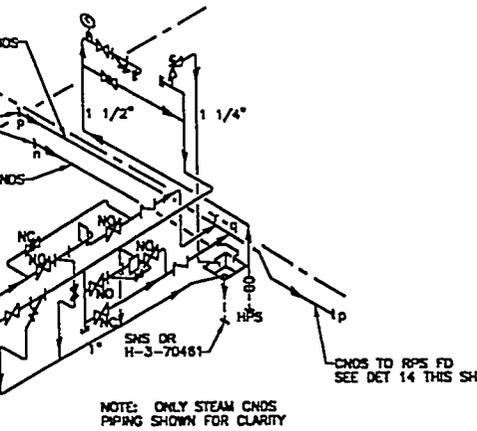
NOTES

1. FOR GENERAL NOTES, SYMBOLS & ABBREVIATIONS SEE SHEET 1.
2. VALVES INSTALLED BACKWARDS FOR BETTER HEATING CONTROL DUE TO FLOW CHARACTERISTICS OF VALVES.
3. SRV DRAINS INTO ROOF DOWNSPOUT SEE SK-3-16215, H-3-70463.



WATER REHEAT HX-2ND FL

13 PREHEAT EXCHANGER-2ND FL
H-4-50053, 82, 83
SK-3-8990



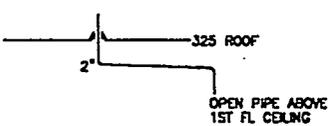
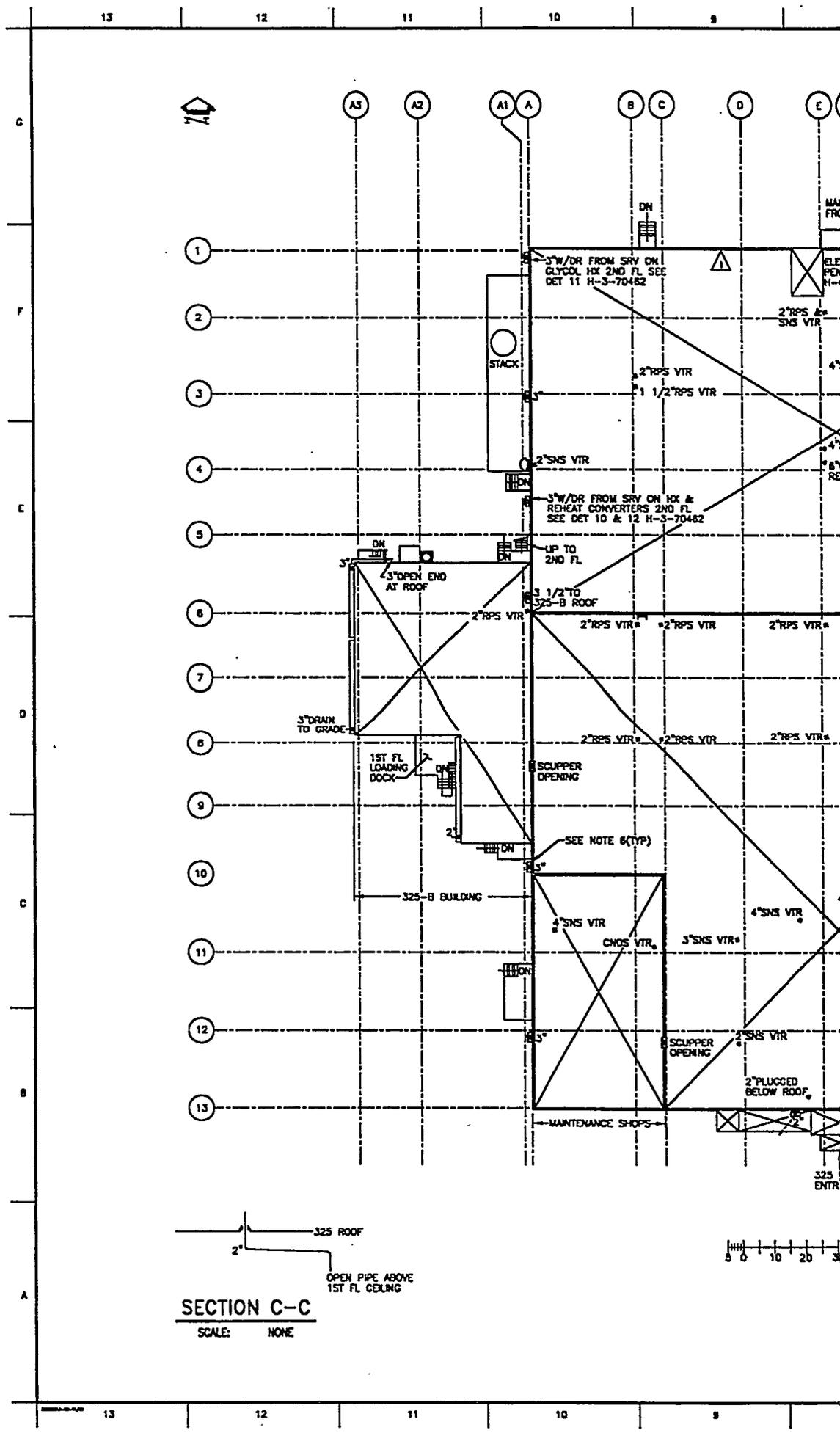
CONDENSATE WATER STILL-2ND FL

16 HUMIDIFIER CNDS-(AHU) 1,2,&3
(#1 SHOWN)
(#2 & 3 SIMILAR)

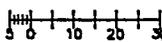
17 HUMIDIFIER CNDS-(AHU) 4
H-3-34632

REV	NO	DATE	BY	CHKD	DESCRIPTION	APP	DATE	REV NO	
1	1	1/11/83	JWL	WSJ	SCN	ECN #D00162-EDP-R1-FMPO-ECN3 DRAWING H-3-70464 ZN 13.C PER H-3-70464 ZN 13.C e) REMOVED REFERENCE DRAWING H-3-70464 ZN 13.F b) REMOVED REFERENCE DRAWING c) REMOVED REFERENCE DRAWING H-3-70464	1	1	
REVISIONS						DESCRIPTION			
DRAWING NO						DRAWING TITLE			
NEXT USED ON						REVISIONS			
DRAWING NO						DRAWING TITLE			
DRAWING NO						DRAWING TITLE			

DESIGNED SC NYBY CHECKED WALTER B JACKSON DATE 1/23/83 DRAWN JW LEEPER DATE 1/23/83 IN CHARGE ER GERK DATE 1/23/83	U. S. DEPARTMENT OF ENERGY FACILITY OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE
FACILITY EFFLUENT MONITORING PLAN SHEET 3 OF 3	H-3-70462 1



SECTION C-C
SCALE: NONE

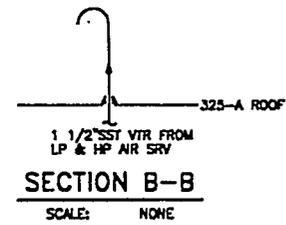
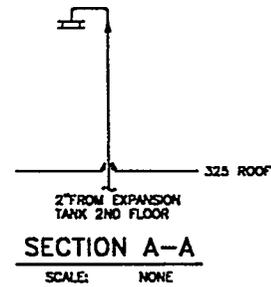
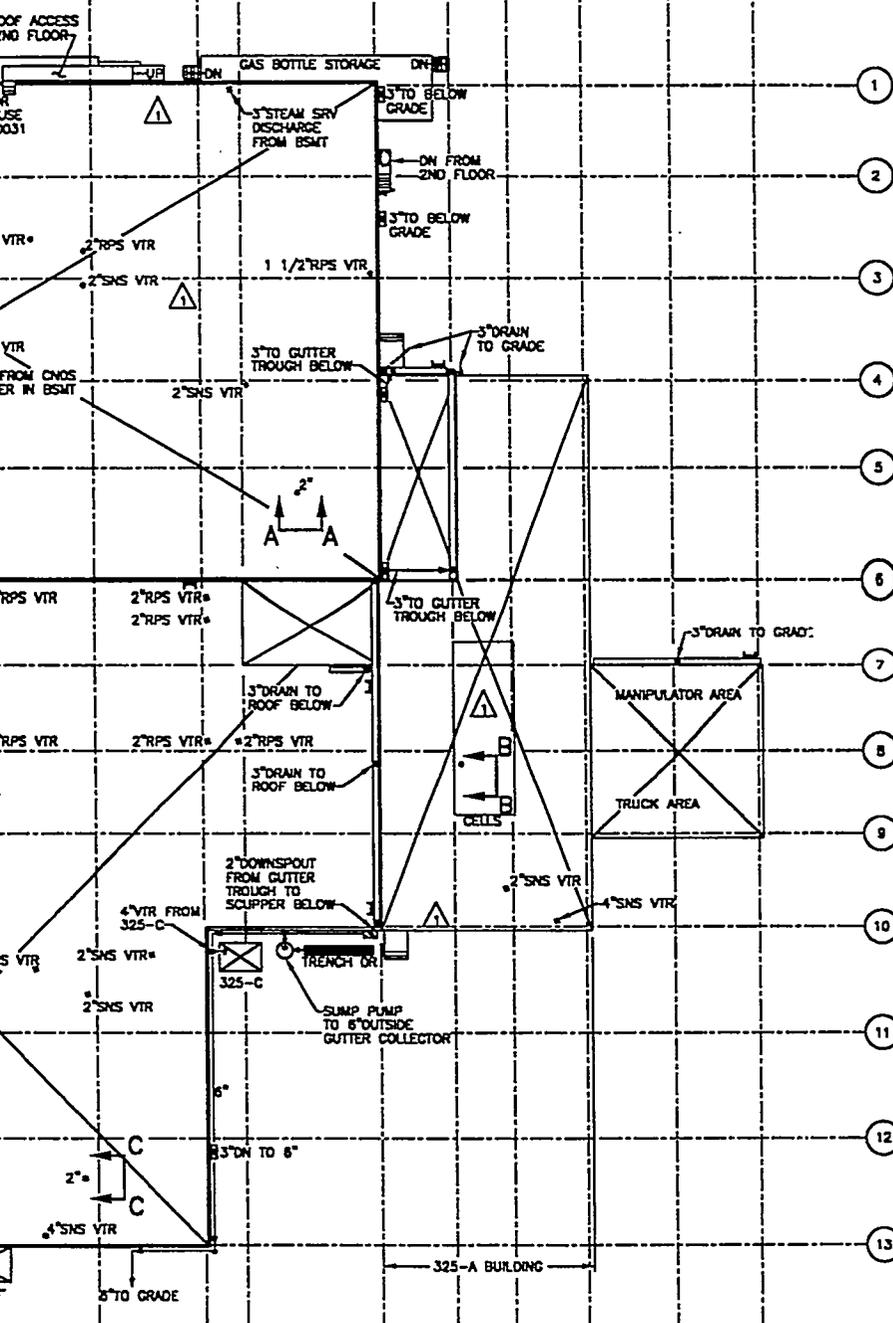


GENERAL NOTES
(UNLESS OTHERWISE NOTED)

1. THIS DRAWING PROVIDES AS-BUILT DRAINAGE PIPING THROUGH FIELD VERIFICATION, WHERE ACCESSIBLE, & INFORMATION FROM EXIST DRAWINGS.
2. FOR RPS VTR SEE H-3-70450 SH-2.
3. FOR SNS VTR SEE H-3-70461 SH-1 & 2.
4. FOR CHOS VTR AND STEAM SRV DISCHARGE SEE H-3-70482 SH 1, 2 & 3.
5. ALL STAIRS ARE 1ST FLOOR STAIRS.
6. [SC] DRAIN TO GRADE ELEVATION.

SYMBOLS/ABBREVIATIONS

- A/C - AIR CONDITIONER
- BSMT - BASEMENT
- CHOS - CONDENSATE
- DN - DOWN
- EXST - EXISTING
- EXH - EXHAUST
- FL - FLOOR
- HP - HIGH PRESSURE
- HX - HEAT EXCHANGER
- LP - LOW PRESSURE
- RPS - RETENTION PROCESS SEWER
- SIM - SIMILAR
- SNS - SANITARY SEWER
- SRV - SAFETY RELIEF VALVE
- VTR - VENT THRU ROOF
- - PIPE DOWN
- [SC] - SCUPPER & LEADER(DOWNSPOUT)
- ⊙ - VENT LINE
- [Gutter] - GUTTER TROUGH & DOWNSPOUT
- [Vertical Ladder] - VERTICAL LADDERS TO ROOF



ROOF PLAN
SCALE: 1/16"=1'-0"



EP / 90-183

DESIGNED BY: SC NYBY CHECKED BY: WALTER B JACKSON DRAWN BY: RY RICHARDSON IN CHARGE: JIM LEEPER APPROVED: JIM LEEPER DATE: 1/23/83	DATE: 1/23/83 U. S. DEPARTMENT OF ENERGY RICHLAND OPERATIONS OFFICE PACIFIC NORTHWEST LABORATORY OPERATED BY BATTELLE MEMORIAL INSTITUTE VTR & DOWNSPOUT ROOF PIPING PLAN FACILITY EFFLUENT MONITORING PLAN H-3-70463 SCALE SHOWN SHEET 1 OF 1
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NO.	DATE	DESCRIPTION
1	3/85	REVISED PER FMP 000651-EDP01-FMP02

NO.	DATE	DESCRIPTION
H-3-70456		325 BLDG DR REF DWG LIST

REVISIONS
 3048M:ACD2:13.0:SS
 0070463A

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