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TMI-2

DIVISION

TECHNICAL EVALUATION REPORT

FOR

Waste Handling and

Packaging Facility

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Waste Handling and Packaging Facility
Technical Evaluation Report

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FIGURES

1.0 Introduction

1.1 General

The existing TMI-2 radwaste management facilities are already proving inadequate for the demands placed on them, and significant increases in the waste quantities and waste diversity are anticipated with the increase in recovery-related activities. To accommodate the increase in waste quantity and waste diversity, a new facility, capable of handling the projected waste streams efficiently, is required.

The Waste Handling and Packaging Facility (WHPF) is designed for processing and packaging solid radioactive waste generated during recovery operations of TMI Unit 2. The waste will consist of dry active waste (DAW) such as contaminated clothing, and contaminated tools and equipment. Processing, as used in this document, will consist of compaction, size reduction and decontamination of this contaminated material. Depending on the level of contamination after processing through the decontamination systems, tools and equipment will be re-used, discarded as radioactive waste or discarded as clean trash. The WHPF is not a storage facility and no radioactive waste will be stored therein.

1.2 Organization of Report

This report is organized as follows:

After this introduction, a description of the design and operation of the facility is presented. This is followed by a discussion of the safety issues associated with the facility. The report concludes with the safety evaluation required by 10CFR50, paragraph 50.59, "Changes, Tests and Experiments," and an environmental assessment.

1.3 Conclusion

The evaluation of the safety concerns detailed in this report results in the following conclusions:

- o The WHPF fulfills the need for a new facility capable of accommodating the projected waste streams associated with recovery-related activities.

- o The construction and operation of the facility is not an unreviewed safety question as defined in 10CFR50, paragraph 50.59.

2.0 Facility Description

2.1 Purpose of the Facility

The WHPF provides facilities for processing and packaging DAW and contaminated tools and equipment from the AFHB and reactor building. The following functions will be performed in the WHPF:

a. Sectioning and disassembly of large pieces of equipment to a size that will fit into a 55 gallon drum or a 4 ft x 4 ft x 6 ft low specific activity (LSA) box. This size reduction will be accomplished by use of plasma arc and oxy-acetylene torches as well as hand held tools.

b. Decontamination of tools and equipment by electro-polisher, paint digester or an abrasive blaster, as required.

c. Compaction of DAW in 55 gallon drums.

d. Packaging uncompactible trash and equipment into LSA boxes or drums.

e. Temporary staging of radioactive material prior to, during and after processing (i.e., packaging, decontaminating, compaction, sectioning and disassembly).

f. Receiving radioactive waste, tools and equipment from the reactor building and AFHB and shipping radioactive waste after processing and/or packaging to an onsite staging facility.

2.2 Summary Description

2.2.1 Location

As shown in figure 1, the WHPF will be located to the southwest of the more eastern Unit 2 cooling tower, to the east of the respirator cleaning facility.

2.2.2 Building Description

The WHPF, shown in figure 2, is a poured concrete/masonry block building with corrugated roof decking and exterior brick veneer finish. The exterior walls, with the exception of the administrative area and equipment room, will be shielded with reinforced concrete, at least 12" thick, to a minimum height of 10 feet. Concrete masonry blocks will be used above the shield wall.

2.2.3 Design Basis

The design of the facility shall conform to the recommended design practices of the American Concrete Institute (ACI), American Institute of Steel Construction (AISC), Building Officials and Code Administrators International (BOCA), and National Fire Protection Association (NFPA).

The facility is designed for the probable natural phenomena as required by the BOCA basic building code, local building ordinance, and other national codes and standards. The WHPF is designed as a non-seismic Category I structure. It is designed for seismic loads determined in accordance with the BOCA Basic Building Code. Environmental and operational live loads are determined in accordance with the General Project Design Criteria and applicable ANSI standards.

The WHPF is designed to conform with 10CFR20, paragraph 20.1(c). This ensures that personnel exposures associated with the WHPF are ALARA. In addition, access to the building will be controlled in accordance with the Radiological Control Procedures in effect at TMI Unit 2.

2.2.4 General Arrangement

The WHPF is comprised of the following areas:

- Inspection area
- Compactible trash packaging area
- Contamination control area
- Disassembly and sectioning area
- Decontamination area
- Personnel access area
- Administrative areas
- Receiving and shipping area
- Equipment room
- Separation, segregation and survey area
- Non-compactible staging and packaging area
- Swipe test area
- Fork lift battery charging area
- High radiation staging area

Figure 2 shows the layout of these areas and the location of major equipment.

2.2.4.1 Inspection Area

Equipment and tools awaiting sectioning or decontamination will be staged in this area. An inspection table, with a hood, is provided for packages that need to be opened for further evaluation, sorting and/or re-packaging. Containers leaving this area will have a maximum smearable surface activity of 500 dpm/100 cm^2 β/γ activity and 100 dpm/100cm^2 α activity.

2.2.4.2 Compactible Trash Packaging Area

In this room, compactible DAW will be compacted in 55 gallon drums. Drums leaving this area will be wiped down to ensure their smearable surface activity does not exceed 500 dpm/100 cm^2 β/γ activity and 100 dpm/100 cm^2 α activity.

2.2.4.3 Contamination Control Area

This is an area where personnel leaving the compactible trash packaging area can remove the outer layer of their protective clothing. Changing into street clothes may be done in the personnel access control area (section 2.2.4.6).

2.2.4.4 Disassembly and Sectioning Area

This area will be used to reduce the size of contaminated equipment and tools by cutting and disassembly. Equipment used for reduction will include plasma arc cutting tools and hand held tools. Size reduction is required for:

- tools and equipment that are too large to be packaged into drums or LSA boxes;

- tools and equipment that need, and are suitable for, decontamination but are too large for the decontamination systems.

2.2.4.5 Decontamination Area

This area will contain the following decontamination systems:

- Electro-polisher
- Paint digester
- Abrasive blaster

These systems will be used to decontaminate tools and equipment from the containment building or AFHB. A rinse tank will be provided to rinse the tools and equipment after decontamination in the electro-polisher or paint digester. A self-contained emergency shower and eyewash will be provided in this area. The decontamination system equipment, including filters, will each have a contact dose rate that does not exceed 50 mrem/hr. Ion exchangers will have a maximum contact dose rate of 100 mrem/hr.

2.2.4.6 Personnel Access Control Area

This area provides space for personnel to dress prior to entering the contaminated areas of the WHPF, and lockers where they can leave their street clothes. The personnel access control area will also be used for changing back into street clothes upon leaving the contaminated area. Personnel monitoring and frisking will be performed on exiting the contaminated area. This area is designed to ensure that a general area dose rate of 1 mrem/hour is not exceeded. Temporary shielding in the work areas will be provided as necessary to ensure this limit is not exceeded.

2.2.4.7 Administrative Area

The administrative area comprises the office, lunch room, area for vending machines, toilet facilities and a storage area. The administrative area is designed to ensure that dose rates of 0.5 mrem/hour in the general area, or 0.25 mrem/hr in the office will not be exceeded. In addition to the reinforced concrete walls between the administrative area and separation, segregation and survey area, temporary shielding in the adjacent work area will be used as necessary to ensure these limits are not exceeded. The office provides space for record keeping and administrative chores such as completing radiation survey records. The storage area will be used to store supplies needed for the various rooms in the administrative area.

2.2.4.8 Receiving and Shipping Area

This area is used for receiving unprocessed DAW and contaminated tools and equipment from the AFHB and reactor building and for shipping the packaged materials, in LSA boxes or 55 gallon drums, to an onsite staging facility. Containers ready for shipping will have a maximum smearable surface activity of 500 dpm/100 cm^2 β/γ activity, and 100 dpm/100 cm^2 α activity.

2.2.4.9 Equipment Area

The HVAC equipment, compressor and air purification equipment for the compressed air system, and de-ionizing equipment for processing domestic water into demineralized water will be located in this area. The equipment area is designed to ensure a dose rate of 2.5 mrem/hr will not be exceeded. Temporary shielding in the adjacent work area will be used as necessary, in addition to the reinforced concrete wall separating these areas, to ensure this dose rate is not exceeded.

2.2.4.10 Separation, Segregation and Survey Area

This area provides space for receiving and surveying contaminated waste, tools and equipment transported to the WHPF, staging incoming waste, and determination of the appropriate processing method. All waste and contaminated tools and equipment entering this uncontaminated area will be pre-packaged to ensure a smearable surface activity that does not exceed 500 dpm/100 cm^2 β/γ activity and/or 100 dpm/100 cm^2 α activity. Packages will be labelled as to content before being moved to the WHPF. No packages will be opened in this area. Temporary shielding will be used as required to reduce the direct dose rate to personnel in the area.

2.2.4.11 Non-Compactible Staging and Packaging Area.

Dry active waste that is non-compactible will be packaged into LSA boxes in this area. This area will be used as a staging area for contaminated waste and equipment before processing and while awaiting shipping from the facility. All waste and contaminated

equipment in this area will be pre-packaged to ensure a maximum smearable surface activity of 500 dpm/100 cm^2 β/γ activity and 100 dpm/100 cm^2 α activity. No packages will be opened in this area.

2.2.4.12 Swipe Test Area

This is an area of low background radiation provided for taking radiation surveys of the containers and for counting the activity of smears.

2.2.4.13 Fork Lift Battery Charging Area

This area is provided for charging the batteries of the fork lifts. It will also be used by personnel who will view operations in the compactible trash packaging area through the window in the wall separating the two areas.

2.2.4.14 High Radiation Staging Area

This area is provided as a staging area for containers with contact dose rates in excess of 100 mrem/hr.

2.3 Major Systems

2.3.1 Heating, Ventilating and Cooling (HVAC)

2.3.1.1 Design Bases

The WHPF HVAC System will:

a. Maintain a minimum area pressure of 0.20 inches w.g. negative with respect to ambient conditions within the contaminated areas of the WHPF by exhausting more air than is supplied and filtering the air being exhausted in order to limit the quantity of airborne contaminants released to the environment.

b. Direct air flow from areas of lower contamination toward areas of higher contamination.

c. Maintain a winter temperature of 70°F and a summer temperature of 75° F in the WHPF for outdoor design temperatures of

Summer	94^oF_{DB}	75^oF_{WB}
Winter	7^oF	

except in the receiving and shipping area and in the equipment room. These areas will have winter heating and forced or natural ventilation for summer cooling. The design temperatures are:

	Summer	Winter
Receiving and shipping area	104°F (max)	60°F
Equipment room	104°F (max)	60°F

d. Provide exhaust hoods or other devices for process equipment in order to limit exposure of personnel to airborne contamination.

e. Maintain the concentrations within the process areas of the WHPF below maximum permissible limits as defined in 10CFR20, Appendix B, Table I, Column 1.

f. Limit releases of airborne radioactivity to the environment below the concentrations established by 10CFR20, Appendix B, Table II, Column 1 and the TMI-2 Environmental Technical Specifications.

g. Supply filtered ventilation at a minimum rate of 5 air changes per hour.

2.3.1.2 System Description

2.3.1.2.1 General Description

The WHPF HVAC system will be divided into several areas which are described in section 2.3.1.2.2. The administrative area, shipping and receiving area and the equipment room are clean areas and are each served by separate heating and ventilation systems which are not associated with the HVAC system for the potentially contaminated work areas of the WHPF. All penetrations are sealed between clean areas, e.g. the administrative area, and the processing areas.

A radiation monitor is provided in each exhaust to the atmosphere from the potentially contaminated areas, downstream of the filter, to monitor radioactive releases to the environment. Excessive levels will automatically shut down the exhaust and supply systems. Supply units are not permitted to run unless the exhaust system is on.

Flow direction from relatively clean to more contaminated areas is maintained by appropriately arranging supply and exhaust quantities to each air space.

2.3.1.2.2 System Operation

Shipping and Receiving

In winter time the temperature of this area is maintained at or above 60°F. During the summer forced or natural ventilation will prevent the temperature from rising above a maximum temperature of 104°F. Due to the location of the equipment access doors leading into the separation, segregation and survey area from the shipping and receiving area, the negative pressure in the potentially contaminated areas will cause air to flow from the shipping and receiving area into these areas during normal operation.

Equipment Room

During the winter the temperature of this area is maintained above 60°F. In summer, forced or natural ventilation will prevent the temperature of this area from rising above 104°F.

Administrative Area

This area will have an independent HVAC system to heat, cool and ventilate the area. The air, which may be recirculated within the administrative area, will not require filtering before recirculating or exhausting to the outside. Air from the toilet areas will not be recirculated. Air conditioning is provided by a heat pump system with mechanical cooling which will also provide supplementary electric heat as required. This system is controlled by a wall mounted programmable thermostat.

Potentially Contaminated Work Areas

One or more HVAC units will be provided for these areas. Air will be supplied at a constant flow rate and temperature all year round. Duct mounted temperature controls will be provided. A temperature switch, which senses the outdoor air temperature, determines whether the refrigeration system or the heating coil is required to be in operation. Electric reheat coils controlled by room thermostats may be used to maintain temperature in each zone.

Outside air will be supplied to the WHPF for cooling and heating the air, and for ventilation, as required. Air may also be taken from clean areas for makeup for this HVAC system. Recirculated air or induction units may be used to maintain the required supply air temperature. If recirculated air is used, it will be HEPA filtered. Air from the sectioning area, electro-polisher, rinse tank and paint digester will not be recirculated.

Exhaust hoods are installed at each equipment location where fumes or other contaminants are generated, in order to reduce the exposure to operating personnel. Air flow through these hoods, except for the compactor exhaust, may be continuous. When the compactor is in operation its exhaust fan, which is an integral part of this piece of equipment, draws air from the compartment above the barrel through a HEPA filter and discharges it to the atmosphere or to the area exhaust. When the compactor is not in operation, an alternate exhaust system from the compactor room opens and the same room exhaust flow rate is maintained as when the compactor was operating. A differential pressure gauge, which is an integral part of the compactor, indicates when the filters must be changed. The inspection table hood will be provided with a HEPA filter.

Exhaust and supplied air quantities will be regulated to ensure a negative pressure of at least 0.20" w.g. is maintained in the potentially contaminated work areas relative to ambient condition. Preferably some of the exhaust hoods will be in continuous operation when the system is operated. As additional hoods are placed in use, the quantities exhausted and supplied will be adjusted to maintain a constant exhaust rate from the building. (Exhaust steps up before supply and supply steps down before exhaust).

2.3.2 Other Major Systems

2.3.2.1 Compressed Air

The compressed air system consists of compressors and an air purification package. Compressed air for the WHPF is provided by two 100 cfm, 125 psig, compressors located in the equipment room.

An air distribution system is provided throughout the facility. The compressed air furnished is primarily for tools used in the facility. The system is also capable of providing breathing quality air when used in conjunction with the air purification package and appropriate radiological control procedures. Breathing air may be required during certain sectioning processes. Condensate drained from the compressed air system will be routed to the sanitary drainage system.

2.3.2.2 Demineralized Water

Demineralized water is provided for system make-up by processing domestic water within the WHPF. This processing equipment consists of replaceable/rechargeable de-ionizing resin tanks and associated piping and accessories. Water is routed through a distribution system to the decontamination area and battery charging area of the WHPF. Controls limit to 50 gallons the amount of water that can be supplied to the process area without resetting the controls. Resin regeneration will not be done in this facility.

2.3.2.3 Fire Protection

A sprinkler system will cover the entire facility. The system shall conform to the applicable portions of National Fire Protection Association (NFPA) chapter 13. The system will consist of 165°F fusible sprinkler heads, piping and fittings, isolation valve with tamper-proof switch, and an adjustable time-delay action deluge valve with abort switch. The deluge valve will be actuated by a signal from a heat or ionization detector, or manually. The sprinkler system shall be for ordinary hazard (group 1).

The building shall be zoned as required. Heat detectors set for 165° F shall cover the disassembly and sectioning area. The rest of the facility shall be covered by appropriate ionization detectors. Audible fire alarms, which are activated by the detectors, shall annunciate simultaneously at the local panel, and in the plant main control room. Signals for trouble, alarm, and system discharge shall be annunciated. All wiring shall be supervised. A signal from any detector shall initiate the alarms and the time-delay action to open the deluge valve. Auxiliary contacts shall be provided in the panel to shutdown the HVAC system.

Fire hose standpipes will be provided in conformance with the applicable portions of NFPA Codes and Standards. Fire hose racks with hose and fog nozzles will be provided as required by the NFPA Code. In addition, portable fire extinguishers are provided throughout the facility in accordance with NFPA Codes and Standards.

2.3.2.4 Waste and Drain Systems

A sanitary drain system from the toilet area of the WHPF will be routed to the plant sanitary system. Clean, uncontaminated condensate from the HVAC system may also be discharged to this system.

Spills or leakage within the process area from processing equipment, the demineralized water system and from the sprinkler system will be contained in the individual areas and will not be discharged into this waste and drain system.

2.3.2.5 Domestic Water System

Domestic hot and cold water will be provided to the toilet area. Demineralized water will be processed from domestic water.

2.3.2.6 Electrical

Electrical service is provided to supply power for lighting, receptacles and electrically operated equipment. All electrical equipment, structures and metal components are grounded.

2.3.2.7 Communications

The WHPF communication system interfaces with the existing plant PA communication system.

2.3.2.8 Radiation Monitoring

A portable airborne radioactivity monitor with local readout and alarm is provided for personnel protection. Each exhaust to the atmosphere is isokinetically sampled for particulate activity. Each exhaust monitor is provided with local alarm, readout and recorder, and remote alarm in the main control room. Portable monitors will be used as required. Area radiation monitors will be provided as required by radiological control procedures.

Air samples from the building exhaust, which are used to assess radiological releases to the environment, will be analyzed for alpha activity. In the event any of these samples shows a significant increase in the frequency of alpha detection, the level of analytical scouting for the alpha emitters will be increased appropriately to address the situation.

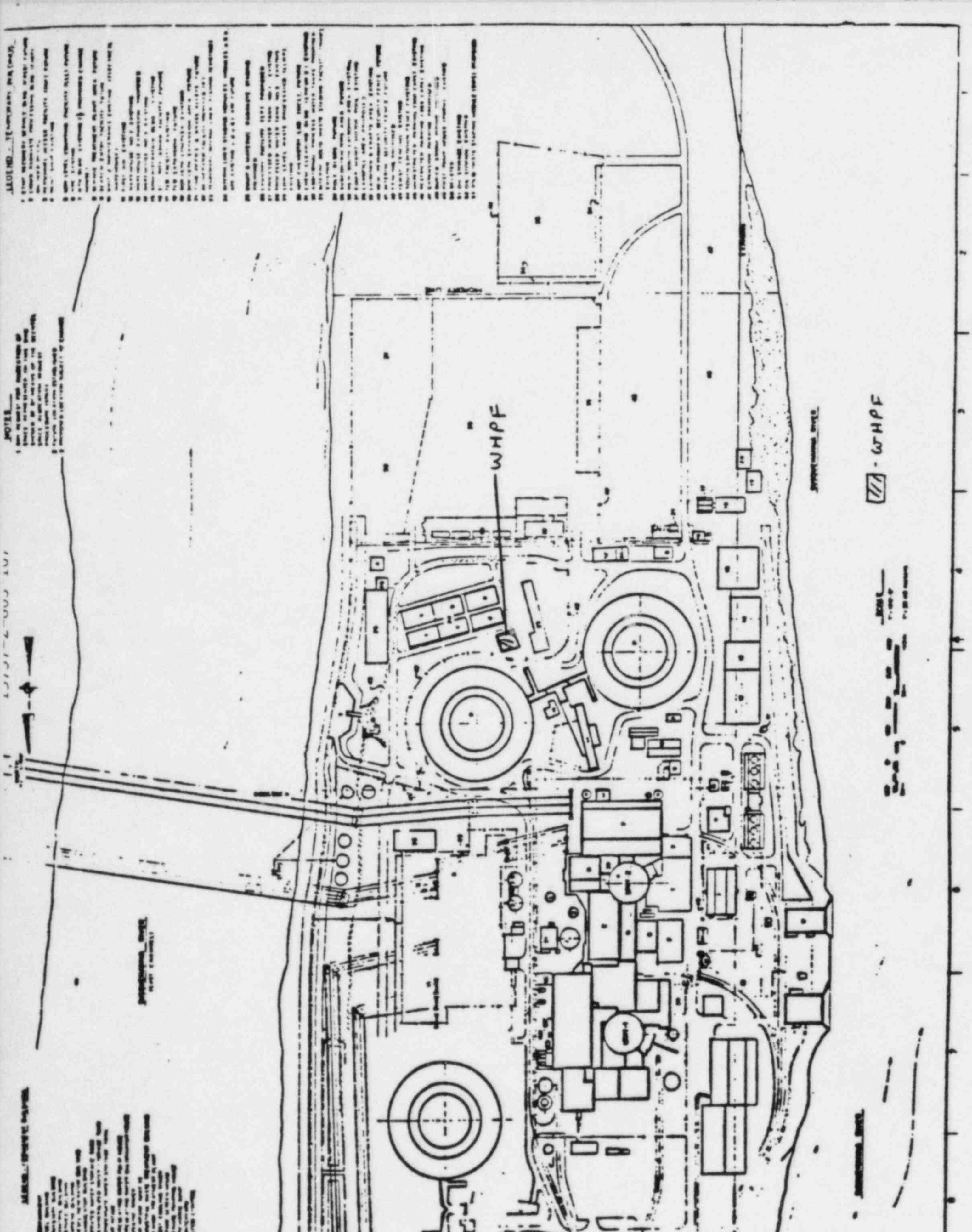
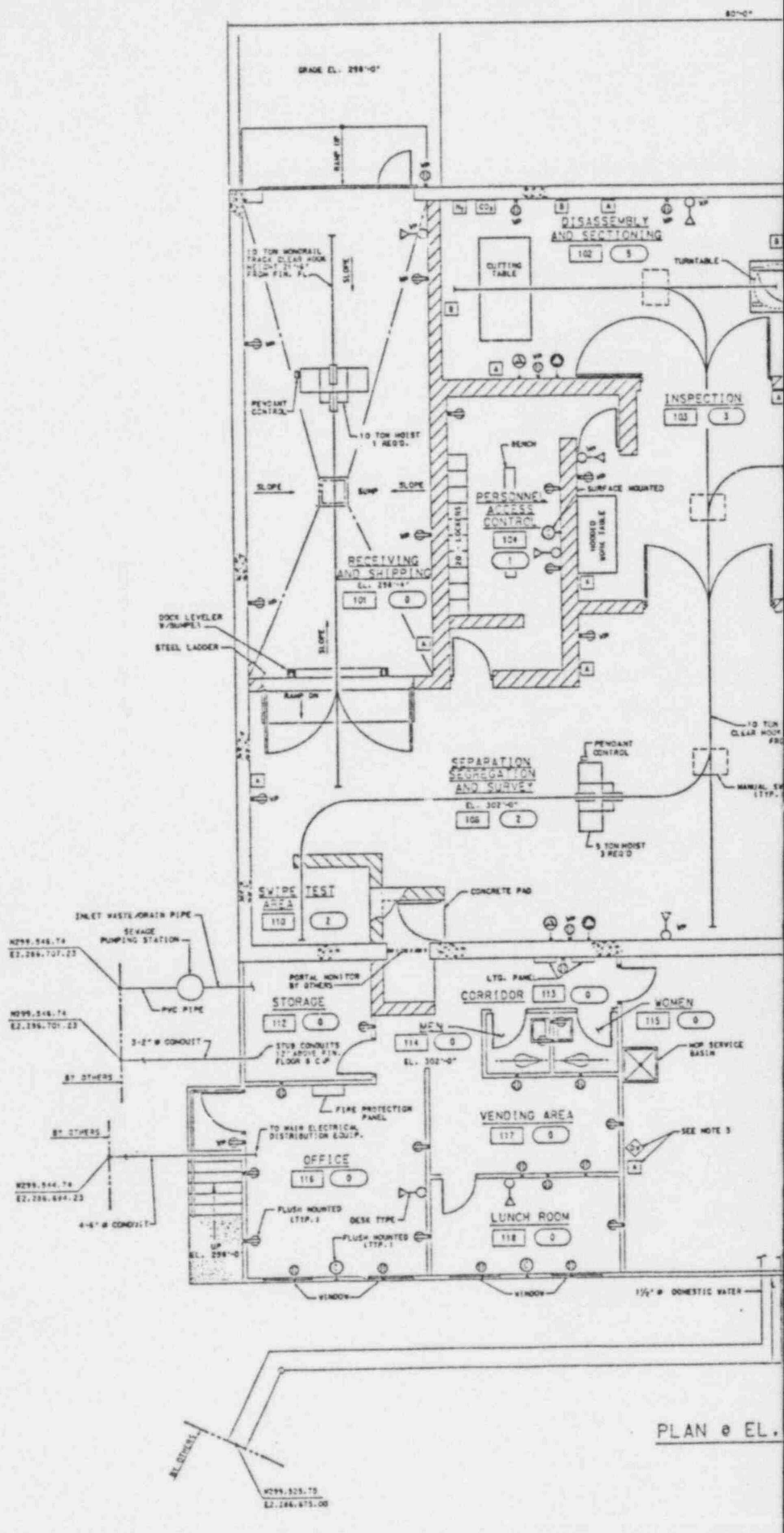


Figure 1
Location of WHPF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RAMP UP
DISASSEMBLY AND SECTIONING
102
CUTTING TABLE
TURNTABLE
INSPECTION
103
10 TON HOIST 1 REQ'D.
PENDANT CONTROL
SLOPE
SUMP
BENCH
SURFACE MOUNTED
PERSONNEL ACCESS CONTROL
104
RECEIVING AND SHIPPING
101
DOCK LEVELER W/BUMPER
STEEL LADDER
RAMP DN
SEPARATION SEGREGATION AND SURVEY
EL. 302'-0"
106
5 TON HOIST
SWIPE TEST AREA
110
CONCRETE PAD
INLET WASTE/DRAIN PIPE
SEWAGE PUMPING STATION
PVC PIPE
PORTAL MONITOR BY OTHERS
STORAGE
112
LTG. PANEL
CORRIDOR
113
MEN
114
WOMEN
115
MOP SERVICE BASIN
STUB CONDUITS
BY OTHERS
FIRE PROTECTION PANEL
VENDING AREA
117
SEE NOTE 3
OFFICE
116
FLUSH MOUNTED
DESK TYPE
LUNCH ROOM
118
UP
WINDOW
DOMESTIC WATER
PLAN @ EL.

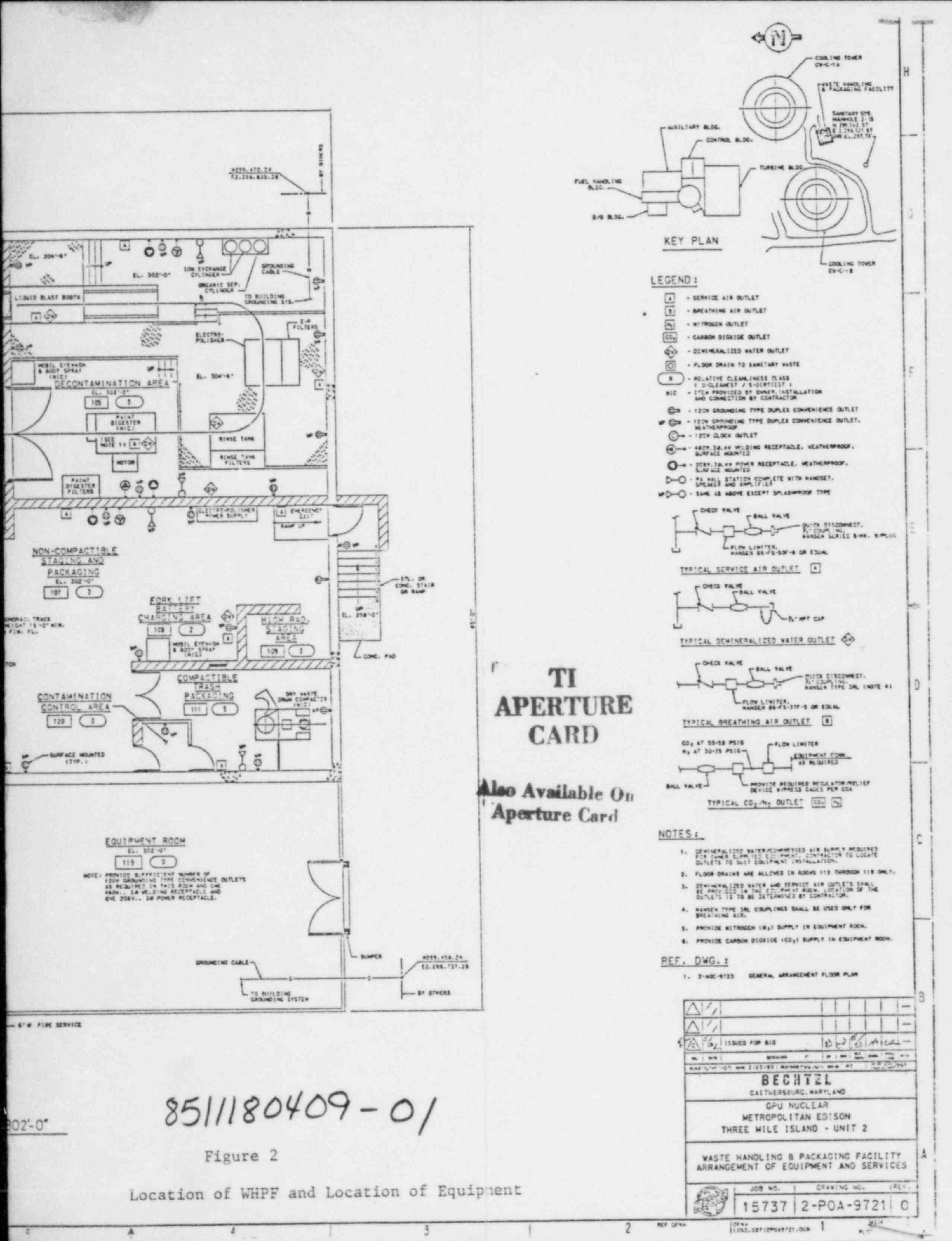

Figure 2

Location of WHPF and Location of Equipment

3.0 Technical Evaluation

3.1 General

This section summarizes the safety issues which were considered in the design of the WHPF. These issues deal with the expected performance of the facility during normal operations and various design basis events.

The safety issues associated with the operation of the WHPF are:

- Demonstrating compliance with 10CFR20 with respect to on-site dose limits.
- Demonstrating compliance with 10CFR50, Appendix I, with respect to offsite radiation doses due to releases of radioactivity to the environment from normal operations within the WHPF.
- Assessing the consequences of potential accidents in the WHPF that could lead to radioactive releases to the environment.
- Demonstrating compliance with the principles of ALARA.

Each of these issues is addressed in the following sections.

3.2 Dose Assessment and Accident Analysis

3.2.1 On-Site Dose Assessment

The WHPF exterior walls will be reinforced concrete or grout filled CMU blocks and will be 10 feet high. These walls will be thick enough to ensure that the direct dose rates from material in the building will not exceed the following dose rates:

	Dose Limit	Minimum Wall Thickness
-outside building	2.5 mrem/hr	12 inches
-site boundary fence	0.6 mrem/hr	12 inches

These wall thicknesses are based on the dose rates from 20 drums, each with a contact dose rate of 100 mrem/hr in 2 rows, stacked 2 high, staged adjacent to the wall. The calculation of the dose rates was performed using an interactive computer program designed to solve gamma ray transport problems using the point kernel method. Any response function can be calculated by specifying appropriate conversion factors and Berger buildup factor parameters. The program library contains attenuation coefficients and buildup factor parameters for common shielding materials, and

dose equivalent and absorbed dose conversion factors. The problem geometry must be described by a set of up to 15 orthogonal slabs, right cylinders, and/or right parallelepipeds.

These assumptions are also used in calculating the wall thicknesses required to ensure that the following dose rates within the facility are not exceeded:

	Dose Limit	Minimum Wall Thickness
-Personnel access area	1.0 mrem/hr	15 inches
-Administrative area	0.5 mrem/hr	15 inches
-Office	0.25 mrem/hr	15 inches
-Equipment area	2.5 mrem/hr	12 inches

The wall for the personnel access area will be filled CMU block. The other walls will be formed or poured concrete.

Since radiation field strengths are not precisely known for components that may be staged or processed in the WHPF, temporary shielding and/or administrative controls may be required to limit the radiation field directly outside the WHPF. This may include limiting personnel access to particular areas outside of the WHPF to prevent unnecessary personnel exposure. Administrative controls will be in accordance with radiological control procedures.

3.2.2 Off-Site Dose Assessment

3.2.2.1 Normal Operations

3.2.2.1.1 Airborne Dose

The handling of contaminated material in the WHPF was evaluated to determine the resultant offsite doses from airborne activity released from the facility. The only source for airborne radioactivity in the WHPF will be the result of activities related to processing contaminated material from the reactor building and AFHB. To assess this dose, the following assumptions were made:

a. The material staged in the separation, segregation and survey area and in the non-compactible staging and packaging area of the WHPF is radiologically clean, that is, it will have a smearable surface activity of less than 500 dpm/100 cm^2 β/γ activity and less than 100 dpm/100 cm^2 α activity.

b. The total annual activity available for release from dry active waste and contaminated tools and equipment being processed in the contaminated areas of the WHPF is equivalent to the activity of:

120,000 ft^3 dry active waste (DAW)	141 Ci
12,000 ft^3 contaminated tools and equipment	52 Ci (ref. 1)

This includes transuranic activity on the contaminated material.

c. Of this activity 10^{-6} is released due to material handling. This release fraction is based on the airborne release fraction due to a drum containing compacted waste breaking open through impact (ref. 2) for all material handling except sectioning. The 10^{-6} release fraction from sectioning is based on the release fraction from shattered contaminated concrete (ref. 2) and further considers the fact that only a fraction of the equipment and tools will be sectioned.

d. The assumed isotopic distribution of radioactive waste is listed in Table 3-1. The fission product distribution is based on historical data, and the distribution for transuranics is based on calculated predictions of core inventory.

Table 3-2 lists the estimated annual airborne releases based on the above assumptions.

The dose to the public was calculated for these releases based on the following parameters.

a. The nearest milk cow is located 1.1 miles east of the release point. The corresponding meteorological dispersion and deposition parameters at this location are 6.91×10^{-6} sec/m^3 and 2.05×10^{-8}/m^2 for X/Q and D/Q, respectively, at this location.

b. The nearest residence and garden are 0.4 mile south-south-east of the release point. The corresponding meteorological parameters are 5.57×10^{-5} sec/m^3 and 2.10×10^{-7}/m^2 for X/Q and D/Q, respectively, at this location.

c. The nearest meat and milk goats are 1.2 miles north of the release point. The corresponding meteorological parameters are 7.83×10^{-6} sec/m^3 and 1.71×10^{-8}/m^2 for X/Q and D/Q, respectively, at this location.

d. The vegetable intake for the individual of interest is assumed to be from the location of the nearest garden.

e. The dose rate from the ground plane source was calculated based on the location of the nearest residence as described in b. above.

The locations were obtained from a table of receptor locations and the meteorological parameters were obtained from the TMI-Unit 1 Offsite Dose Calculation Manual (ODCM), and are applicable to Unit 2. The resulting annual dose to the maximally exposed individual is summarized in Table 3-3.

The most restrictive dose is to a child's bone. It is estimated that this dose will be 1.4×10^{-2} mrem/yr when the milk consumed

is from a cow and 1.9 x 10^{-2} mrem/yr when goat's milk is consumed. These doses are less than 0.5% of the 10CFR50 Appendix I limits for the site. If credit is taken for the HEPA filters in the WHPF ventilation exhaust these annual doses will be further reduced by a factor of 1000.

The average particulate release from the WHPF is 6.1 x 10^{-6} µCi/sec. This is a very small percentage of the Technical Specification limit of 2.4 x 10^{-2} µCi/sec for particulates.

3.2.2.1.2 Skyshine and Direct Dose Rate

The whole body dose to a member of the public from all sources in the fuel cycle is limited to 25 mrem/year by 40CFR190. An analysis was made to determine the contribution to this dose from operation of the WHPF. Both direct and air-scattered (skyshine) radiation were considered in this analysis. The following parameters were used:

a. The WHPF is in the S and SSE sectors. The nearest residence for these sectors is in the SSE sector and is 0.4 miles from the facility;

b. Credit was taken for 12 inch concrete outer walls of the WHPF, but no credit was taken for inner walls or roof;

c. A total source of 2.51 x 10^{11} gamma/sec is used for the skyshine analysis. This source term includes the contribution from all sources within the WHPF that contribute to the skyshine dose (e.g. waste containers, equipment, etc.);

d. The direct offsite dose is from drums staged in the WHPF with a contact dose rate of 100 mrem/hr;

e. These activities are conservatively considered to be 100% Cs-137.

f. An occupancy factor of 0.7 at the residence was assumed.

The skyshine dose calculation was performed utilizing a previous skyshine calculation done for the Interim Solid Waste Staging Facility (see Ref. 6). This calculation used a point-kernel theory computer code which accounts for the scattering in air. The degradation of the scattered photon's energy is determined from the incident energy and angle of scatter of the uncollided photons. The Klein-Nishina differential scattering cross section formulation is used to assess the probability of scattering from the differential scattering volume (air). Multiple scattering in air is also accounted for by applying a buildup factor.

The total annual dose to a member of the public was calculated to be 0.6 mrem. This annual dose is at a distance of 0.4 miles from the WHPF. However, the distance to the nearest residence from the site is measured from the mid-point between the TMI-1 and TMI-2 reactor buildings. The WHPF is approximately 0.5 miles from this residence. Therefore the dose contribution to the nearest residence to the site resulting from the operation of the WHPF will be a small fraction of the 40CFR190 limit of 25 mrem/year.

3.2.2.2 Contaminated Material Fire

For the purpose of evaluating the consequences of a potential fire in the WHPF the following assumptions were made:

a. The total activity assumed available for release in a fire is the total activity of the staged material (from ref. 1), both awaiting processing and awaiting shipment, plus the expected activity (1/7 of staged waste awaiting processing) from waste and equipment being processed. The total activity available for release is 7.6 Ci, of which 2.8 Ci are from waste in sealed containers awaiting shipping, 4.4 Ci are from waste awaiting processing or being processed and 0.4 Ci are from the decontamination equipment. Of this activity 3.9×10^{-3} Ci are from the transuranic contamination assumed in the DAW and on the tools and equipment. The isotopic distribution of this waste is listed in Table 3-1.

b. Release fractions of 10^{-3} for waste in sealed containers and 10^{-2} for decontamination equipment and contaminated tools, equipment and waste awaiting processing or being processed were used to estimate the airborne release (ref. 2).

c. No credit was taken for HEPA filtration or the WHPF building.

d. Accident breathing rates were used (ref. 3).

The resulting inhalation dose was calculated using the 1-hour meteorological dispersion parameter (X/Q) of 6.1×10^{-4} sec/m^3 for a ground level release. This is discussed in Appendix 2D of the Three Mile Island Unit 2 Final Safety Analysis Report (FSAR). The resulting doses are tabulated in Table 3-4.

The maximum expected offsite dose in the event of a fire in the WHPF will be to a teenager's bone. This dose is 9.07 mrem (including 1.84 mrem from transuranics), which is a small fraction of the dose limits set by 10CFR100 for a comparable limiting organ or whole body.

For the purpose of this TER, the acceptance criterion for the offsite dose due to a fire in the WHPF is 15 millirem to any organ. The quantities of radioactive materials specified in this section are maximum expected activities based on conservative estimates of waste materials anticipated to be present in the WHPF at any time. However, any mix of radionuclide activities is considered acceptable to be present in the WHPF, provided that the maximum calculated offsite dose due to a fire does not exceed 15 millirem to any organ, based on assumptions b., c. and d. provided above.

3.2.2.3 Liquid Spill from Processing Equipment

For the purposes of evaluating the consequences of an airborne release from a potential spill, or leakage, from the processing equipment in the WHPF the following assumptions were made:

a. It is assumed that the total content of all tanks in the process area is spilled. This results in a total of 0.34 Ci available for release based on each tank and filter having a contact dose rate of 50 mrem/hr and a 100 mrem/hr contact dose rate for the ion exchangers. The isotopic distribution is assumed to be 90.6% Cs-137, 4.6% Cs-134 and 4.8% Sr-90. Transuranic isotopes are not considered to be routinely present in the decontamination equipment liquids.

b. The HEPA filter in the ventilation exhaust was not considered in estimating the doses from the airborne release from a liquid spill.

c. A release fraction of 10^{-4} was used, based on the airborne release in a liquid spill (Table 7, ref. 4).

d. Accident breathing rates were used (ref. 3)

The resulting inhalation dose was calculated using the 1-hour meteorological dispersion parameter (X/Q) of 6.1×10^{-4} sec/m^3 for a ground level release. This is discussed in Appendix 2D of the Three Mile Island Unit 2 Final Safety Analysis Report (FSAR). The resulting doses are tabulated in Table 3-5.

The maximum expected offsite dose from an airborne release resulting from a liquid spill in the WHPF is 5.28×10^{-3} mrem to a teenager's bone. The HEPA filter in the WHPF exhaust ventilation was not taken into consideration in determining the doses from a liquid spill. If credit is taken for the filter the dose will be reduced by a factor of 1000. Although transuranics are not normally expected to be in the decontamination liquids, the offsite doses due to transuranics in the liquids are bounded by the fire analysis.

An evaluation was also made of the effects of liquid effluent from a potential spill or leakage. In this evaluation the following assumptions were made.

a. Liquid in the decontamination equipment has a total activity of 0.34 Ci, as explained for the airborne release from a liquid spill. It is all released in the liquid effluent. The volume of the liquid is estimated as approximately 2000 gallons.

b. The isotopic distribution is assumed to be 90.6% Cs-137, 4.6% Cs-134, and 4.8% Sr-90. Transuranic isotopes are not considered to be routinely present in decontamination equipment liquids.

c. The entire liquid volume is released to the east channel, and no dilution of the effluent occurs in the east channel. The river flow is 10,000 cfs at the dam elevation (ref. 5 Figure 2.4-6). A dilution factor is applied for mixing with the river beyond this point. This factor is 3.1×10^{-7} and is the ratio of the flow rate of contaminated liquid over the dam in the east channel and the flow rate of the river.

This effluent will be diluted by mixing with the Susquehanna River water. The resulting concentrations are listed in Table 3-5. Criteria are given in 10CFR20, Appendix B, based on the concentration of an isotope (C_i) and its maximum permissible concentration (MPC_i), for which an isotope may be considered not present in a mixture. These criteria are:

$$\frac{C_A}{MPC_A} \leq 0.1$$

$$\text{and } \frac{C_A}{MPC_A} + \frac{C_B}{MPC_B} + \ldots \leq 0.25$$

The greatest C_A/MPC_A is 2.4×10^{-3}, for Sr-90. Application of the second criteria results in a sum of 3.0×10^{-3}. As both of the criteria are met for a spill from the decontamination equipment in the WHPF, this release does not need to be considered in calculations of doses from liquid effluent releases. Although transuranics are not normally expected to be in the decontamination liquids, the above criteria are still met even assuming all transuranic activity evaluated in the fire analysis is present in the liquids.

3.3 Occupational Exposure

Minimization of personnel radiation exposures is a primary consideration in the design of the WHPF. The design and operational philosophies for the facility follow the guidelines set forth in NRC Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable," Revision 3, June 1978. This section describes the design features that are provided to ensure that exposures are ALARA.

3.3.1 Layout

The WHPF general arrangement provides for separation of higher radiation areas from lower radiation areas. This separation is achieved through distance and through the use of physical barriers for shielding and minimizing the spread of contamination. For example, the compacting area is separated from the non-compactible staging and packaging area by a 12 inch grout filled CMU wall.

Decontamination equipment is consolidated in the area reserved for decontamination equipment, and can be surrounded by temporary shielding, as necessary. This shielding will protect personnel in the contaminated work area from this potential source of direct radiation.

Personnel access to and from the WHPF is provided through the office, in the administrative area, and through the receiving and shipping area. Access to the separation, segregation and survey area is from the administrative area and the receiving and shipping area. Personnel access to the equipment room is through the administrative area. These areas of the WHPF will have the lowest general area radiation levels.

3.3.2 Shielding

Shield walls inside the WHPF include the grout filled CMU walls around the compacting and decontamination areas. This shielding, coupled with appropriate health physics control of each area, provides assurance that occupational exposures will be minimized in these areas.

The 15 inch thick concrete shield wall separating the administrative area and equipment room from the remainder of the facility will be a minimum of 10 feet high. This will ensure that dose rates of 0.5 mrem/hr in the general administrative areas, 0.25 mrem/hr in the office and a dose rate of 2.5 mrem/hr in the equipment room are not exceeded.

The grout filled CMU block shield wall around the personnel access control area will be a minimum of 15 inches thick and 10 feet high. This will ensure a dose rate of 1.0 mrem/hr is not exceeded in this area.

Separate, shielded areas are provided for staging containers of waste that have a contact dose rate in excess of 100 mrem/hr, and for taking smears from and surveying containers.

Exterior concrete walls will be 10 feet high to satisfy radiation shielding requirements for uncontrolled areas outside the WHPF. The requirement to design the facility so that the radiation field on the outside of the facility is maintained at no greater than 2.5 mrem/hr will ensure that the radiation field will not exceed the 0.6 mrem/hr limit established for the site boundary fence.

Since it is not known precisely what radiation sources will be introduced into the WHPF during the recovery, temporary shielding or restricted access both inside and outside the WHPF will be used as necessary to ensure compliance with the dose rate criteria.

Figure 2, Layout of WHPF and Location of Equipment, provides additional details on the location of shield walls.

3.3.3 Airborne Contamination Control

The WHPF ventilation system is designed to draw air from areas of low potential for contamination to areas of higher potential for contamination. Air from contaminated, or potentially contaminated areas will be filtered by HEPA filters prior to recirculation or discharge to the atmosphere. Radioactive waste and equipment entering the WHPF will be packaged or wiped down to ensure its

surface activity does not exceed 500 dpm/100 cm^2 β/γ activity or 100 dpm/100 cm^2 α activity. All material staged in the staging areas will have a surface activity that does not exceed 500 dpm/100cm^2 β/γ activity or 100 dpm/100 cm^2 α activity. Separate hoods will be used as required for inspection, compaction, sectioning and decontamination. Individual HEPA filters are incorporated into the design of the compactor and in the hood over the inspection table.

3.3.4 Radiation Monitoring

The radiation monitoring system, described in Section 2.3.2.8 will alert personnel to abnormally high airborne radiation levels. Steps can then be taken to minimize personnel occupancy in the affected areas or to reduce the airborne levels as appropriate. Additional radiation monitoring equipment will be provided in accordance with existing radiological controls procedures.

3.4 Design Conditions

The design conditions which must be satisfied are specified in the TMI-2 GPDC. These fall into three categories: normal operation, incidents of moderate frequency, and infrequent incidents. Each of these categories is addressed below.

3.4.1 Normal Operations

Normal operation conditions are discussed in the previous sections. These operations will be carried out without unplanned or uncontrolled releases of radioactive materials to the environment.

3.4.2 Incidents of Moderate Frequency

The WHPF and the equipment provided with the WHPF serve no nuclear safety related functions and since there is no interface with any safety system, it will not interfere with the performance of any safety related feature, such as safe shutdown systems. The effects of loss of electrical power in the WHPF, inadvertent actuation of a component provided with the WHPF, single operator error associated with the operation of the WHPF, or a single failure of an active component in the WHPF, such as the HVAC, are enveloped by the analyses of infrequent incidents. They will not, therefore, endanger the health and safety of the public.

Normal operations in the WHPF will involve the handling of contaminated radioactive material. During the course of handling the packages there is the possibility that a package could be broken open. This would not result in an uncontrolled release of radioactivity to the environment because of the design of the HVAC system, discussed in Section 2.3.1. Releases of radioactivity to the environment would be minimized by the filters in the filtered exhaust system provided with the WHPF. The result of a package breaking open is enveloped by the normal release calculation.

3.4.3 Infrequent Incidents

3.4.3.1 Tank Rupture or Pipe Break

Tanks containing liquid are located in the decontamination room (decontamination equipment and rinse tank). Demineralized water will be connected by pipes from the domestic water inlet, through the ion exchanger and to equipment, as required. The decontamination area is surrounded by a concrete curb which prevents any spill in this area from flowing into other areas of the facility. Any spill from a pipe leakage in areas other than these will be manually cleaned. Potential offsite doses from a spill of contaminated liquid have been previously evaluated (see Section 3.2.2.3).

3.4.3.2 Fire

An automatic water suppression system and portable fire extinguishers are provided to extinguish any fire within the WHPF. The radiological effects offsite from a fire in the WHPF are discussed in sections 3.2.2.2.

3.4.3.3 Operating Basis Earthquake (O.B.E.)

In the event of an O.B.E. it is postulated that containers of waste and the decontamination equipment will rupture. The effects of this are enveloped by the liquid spill and fire analyses.

Table 3-1

Isotopic Distributions in the WHPF

Transuranic Activities

Isotope	Percentage
Pu-238	0.55
Pu-239	6.2
Pu-240	1.6
Pu-241	91.
Am-241	0.65

Non-transuranic Activities

Cs-134	4.6
Cs-137	90.6
Sr-90	4.8

TABLE 3-2

CALCULATED ANNUAL AIRBORNE RELEASES FROM THE WHPF

Radionuclide	Annual Release (curies)
Cs-137	1.75×10^{-4}
Cs-134	8.88×10^{-6}
Sr-90	9.27×10^{-6}
Pu-238	5.70×10^{-10}
Pu-239	6.42×10^{-9}
Pu-240	1.70×10^{-9}
Pu-241	9.44×10^{-8}
Am-241	6.79×10^{-10}

TABLE 3-3

ESTIMATED ANNUAL DOSE TO THE MAXIMALLY
EXPOSED INDIVIDUAL FROM RELEASES FROM THE WHPF

I. Annual Dose from Inhalation, Vegetable Intake, Cow Milk, and Ground Plane

	Dose to Organ (mrem/yr)				
Age Group	Bone	Total Body	Lung	Skin	Liver
Adult	1.09E-2	4.70E-3	1.98E-3	1.76E-3	4.20E-3
Teen	1.04E-2	3.84E-3	2.25E-3	1.76E-3	4.86E-3
Child	1.44E-2	3.82E-3	2.41E-3	1.76E-3	6.46E-3
Infant	7.55E-3	2.09E-3	2.32E-3	1.76E-3	7.09E-3

II. Annual Dose from Inhalation, Vegetable Intake, Goat Milk, and Ground Plane

	Dose to Organ (mrem/yr)				
Age Group	Bone	Total Body	Lung	Skin	Liver
Adult	1.20E-2	5.64E-3	2.13E-3	1.76E-3	5.57E-3
Teen	1.24E-2	4.75E-3	2.57E-3	1.76E-3	7.26E-3
Child	1.90E-2	4.54E-3	2.90E-3	1.76E-3	1.06E-2
Infant	1.48E-2	2.78E-3	3.19E-3	1.76E-3	1.51E-2

TABLE 3-4

INHALATION DOSE ESTIMATE AT THE EXCLUSION AREA
BOUNDARY FROM A FIRE IN THE WHPF

Organ	Controlling Age Group	Dose (mrem)
Bone	Teenager	9.07
Total Body	Adult	0.93
Lung	Teenager	1.27
Liver	Teenager	1.25

TABLE 3-5

ESTIMATED DOSE TO MAXIMALLY EXPOSED INDIVIDUAL FROM A
SPILL OF CONTAMINATED PROCESS LIQUIDS IN THE WHPF

Organ	Controlling Age Group	Dose (mrem)
Bone	Teenager	5.28E-3
Total Body	Adult	6.50E-4
Lung	Teenager	8.25E-4
Liver	Teenager	7.44E-4

TABLE 3-6

CONCENTRATIONS OF LIQUID EFFLUENTS FROM A SPILL OF CONTAMINATED PROCESS LIQUIDS IN THE WHPF

ISOTOPE	CONCENTRATION (μCi/cc)	MAXIMUM* PERMISSIBLE CONC. (μCi/cc)
Cs-137	1.34E-8	2.0E-5
Cs-134	6.81E-10	9.0E-6
Sr-90	7.11E-10	3.0E-7

*from 10CFR20, App. B, Table II, Column 2

4.0 Safety Evaluation

10CFR50, paragraph 50.59, "Changes, Tests and Experiment", permits the holder of an operating license to make changes to the facility provided the change does not involve a modification of the TMI-2 Technical Specifications and the change is determined not to be an unreviewed safety question. As summarized below, the operation of the WHPF does not require a modification to the TMI-2 Technical Specifications and is deemed not to be an unreviewed safety question as defined in 10CFR50.

4.1 Technical Specifications/Recovery Operations Plan

Operation of the WHPF with respect to staging and decontaminating contaminated material will not require a change to the Technical Specifications. The Recovery Operations Plan will be revised to include the radiation monitor for each exhaust to the environment from potentially contaminated areas or from decontamination equipment.

4.2 Unreviewed Safety Questions

The WHPF does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report. As demonstrated in Section 3, the consequences of various accidents are well within acceptable limits.

The only interface between systems provided in the WHPF and any Important to Safety (ITS) systems is for fire protection. Tie-ins between the WHPF and ITS systems will be done in accordance with procedures approved for TMI-2. Therefore, the WHPF will not impact existing ITS structures or systems and there will be no increase in the probability of an accident or malfunction of equipment important to safety.

The possibility of an accident or malfunction of a different type than any previously evaluated in the Final Safety Analysis Report is not created by the existence of the WHPF.

Also, the operation of the WHPF does not result in a reduction in the margin of safety as defined in the TMI-2 Technical Specifications since the WHPF does not impact any systems covered in the technical specifications and any release of radioactivity from the WHPF will be monitored for compliance with TMI-2 Environmental Technical Specifications.

Based on the above, the WHPF is deemed not to be an unreviewed safety question as defined in 10CFR50.

5.0 Environmental Assessment

The activities associated with the operation of the WHPF have been evaluated to ensure that these activities do not pose unacceptable risk to the health and safety of the public and to TMI workers. In addition, these activities have been evaluated to ensure that the environmental impact from the operation of the WHPF is acceptably low and does not significantly differ from the impact postulated for similar activities in the TMI-2 PEIS (ref. 7).

Proposed activities in the WHPF are similar in nature to those activities associated with solid waste packaging and handling as described in Reference 7. Postulated releases of radioactive materials to the environment from the normal operation of the WHPF are presented and discussed in Section 3.2.2.1 of this TER. These releases are similar to those estimates in Reference 7, that is, normal activities should result in a maximum organ and whole body dose of less than 1 millirem to the maximally exposed offsite individual. It is worthwhile to reiterate that the doses reported in this TER do not take credit for the ventilation and HEPA filtration systems which will be operated in the WHPF. HEPA filters normally provide greater than 99.9% efficiency for the removal of airborne particulates.

Accident scenarios evaluated in this TER are presented and discussed in Sections 3.2 and 3.4. Offsite radioactive releases were quantified for a fire involving all contaminated materials in the WHPF and a spill of all contaminated process liquids. The maximum calculated offsite doses were for a fire and were 9.07 millirem to the bone and less than 1 millirem to the whole body. This is well within the limits for offsite exposures from accidents presented in 10CFR100, which are 25 rem to the whole body and 300 rem to an organ (thyroid). Reference 7 includes an estimate of offsite doses due to a fire in contaminated dry waste storage areas. The maximum offsite doses were greater than those calculated for the WHPF, that is, a maximum whole body dose of 6.5 millirem and a maximum organ dose of 30 millirem were reported in Reference 7 (p. 8-70).

Specific collective occupational exposures for the operation of the WHPF have not been calculated. The exposures will be maintained as low as reasonably achievable as discussed in Section 3.3 of the TER. The availability of adequate facilities for waste handling, such as provided in the WHPF, is important in maintaining low occupational exposures for these activities. Reference 7 estimates a range of exposures from 39 to 99 person-rem for all handling and packaging of solid wastes. Reference 8 estimates 97 to 485 person-rem for radioactive waste management and transportation. Handling and packaging of radioactive waste in the WHPF should not adversely impact the total collective exposures for these activities.

In conclusion, the activities associated with the operation of the WHPF will have negligible environmental impact and will have no unacceptable consequences to the health and safety of the public or to TMI workers.

6.0 References

1. "Technical Plan, Solid Waste Handling and Packaging Facility", Rev. 0, Jan. 1985.

2. "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants", Wash-1238, December 1972.

3. Reg. Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactor," Rev. 2, June 1974.

4. NUREG/CR-2139, "Aerosols Generated by Free Fall Spills of Powders and Solutions in Static Air", December, 1971.

5. TMI-2 FSAR

6. Technical Evaluation Report for the Interim Solid Waste Staging Facility, 15737-2-G03-105, Rev. 6.

7. NUREG-0683 Final Programmatic Environmental Impact Statement Related to the Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979, Accident Three Mile Island Nuclear Station, Unit 2, March 1981.

8. NUREG-0683, Supplement No. 1 to the Final Programmatic Environmental Impact Statement, Final Supplement Dealing with Occupational Dose, October, 1984.