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Washington, DC 20555
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Three Mile Island Nuclear Station, Unit 2
Operating License No. DPR-73
Docket No. 50-320
Waste Handling and Packaging Facility
Technical Evaluation Report, Revision 8

Dear Sir:

Enclosed for your information is Revision 8 to the Waste Handling and Packaging Facility (WHPF) Technical Evaluation Report (TER). This revision incorporates changes to the off-site dose assessment section and clarifies methods of operation.

Sincerely,

R. L. Long
Director, Corporate Services/TMI-2

EDS/dlb
Enclosure

cc: T. T. Martin - Regional Administrator, Region I
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GPU Nuclear

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DIVISION

TECHNICAL EVALUATION REPORT

FOR

Waste Handling and Packaging Facility

COG ENG _____ DATE 7/6/92

RTR _____ DATE 7/14/92

COG ENG MGR. _____ DATE 7/16/92

Rev.	SUMMARY OF CHANGE	Approval	Date
0	Issue for use.		
1	Revised and issued for use.		
2	Revised and issued for use.		
3	Revised specific levels for beta/gamma and alpha smearable surface contamination to levels for unrestricted release. Revised description of fire detectors and sprinkler heads, and added HVAC detectors. Deleted reference to fire hoses. Revised description of equipment exhaust.		
4	Revised radioactivity source terms, off-site doses, and environmental assessment. Revised ventilation and negative pressure criteria.		
5	Minor changes throughout document.		
6	Revised to include minimum negative pressure of -0.125" water gauge with respect to atmosphere in the Disassembly and Sectioning Area and Decontamination Area of the MHPF.		2/88
7	General update to reflect current site use of the facility. Replaced unreadable Figures 1 and 2; replaced minutiae in dose calculations with results of bounding analysis; and made minor changes to Sections 1.0, 2.1, and 2.2.4 per PCR 88-0562 and ECA-87-0470.		4/89
8	Incorporated changes to the off-site dose assessment section. Clarified and expanded on methods of operation, update usage of various areas; revised drawings.		7/92

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1.0 INTRODUCTION

1.1 General

The Waste Handling and Packaging Facility (WHPF) is designed for processing and packaging solid radioactive waste generated during operations of GPU Nuclear units and TMI-2 cleanup activities. The waste consists of dry active waste (DAW) such as contaminated clothing, and contaminated tools and equipment. Processing, as used in this document, consists 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 are re-used, discarded as radioactive waste, or discarded as clean trash. The WHPF is not a storage facility and no radioactive waste is 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 10 CFR 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:

- The WHPF fulfills the need for a facility capable of accommodating the waste streams associated with operations at GPU Nuclear facilities and TMI-2 cleanup activities.

- The construction and operation of the facility is not an unreviewed safety question as defined in 10 CFR 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 GPU Nuclear units. The following functions are performed in the WHPF:

a. Sectioning and disassembly of large pieces of equipment to a size that will fit into packages such as a 55 gallon drum or a 4 ft x 4 ft x 6 ft strong tight container, also known as a low specific activity (LSA) box. This size reduction may be accomplished by use of plasma arc or oxy-acetylene torches, wood planers, saws, hand held tools or other methods as appropriate.

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, drums, or approved containers.

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 GPU Nuclear units 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 is 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, are shield walls of reinforced concrete, at least 12" thick, to a minimum height of 10 feet. Concrete masonry blocks are used above the shield wall.

2.2.3 Design Basis

The design of the facility conforms 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 was 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 was designed as a non-seismic Category I structure. It was designed for seismic loads determined in accordance with the BOCA Basic Building Code. Environmental and operational live loads were determined in accordance with the General Project Design Criteria (GPDC) and applicable ANSI standards.

The WHPF was designed to conform with 10 CFR 20.1(c). This ensures that personnel exposures associated with the WHPF are ALARA. In addition, access to the building is controlled in accordance with the Radiological Control Procedures in effect at TMI Unit 1.

2.2.4 General Arrangement

The WHPF is comprised of the following areas:

- o Inspection area
- o Compactible trash packaging area
- o Contamination control area
- o Disassembly and sectioning area

- o Decontamination area
- o Personnel access area
- o Administrative areas
- o Receiving and shipping area
- o Equipment room
- o Separation, segregation and survey area
- o Non-compactible staging and packaging area
- o Swipe test area
- o Fork lift battery charging area
- o High radiation staging area

Figure 2 shows the layout of these areas.

2.2.4.1 Inspection Area

Equipment and tools awaiting sectioning or decontamination are staged in this area. Packages may be opened for further evaluation, sorting or repackaging. An inspection hood is provided to minimize the generation of airborne radioactivity if required during the inspection process. Containers leaving this area do not have smearable surface activity exceeding the limits for unrestricted release, as defined in the GPU Nuclear Radiation Protection Plan.

2.2.4.2 Compactible Trash Packaging/Wood Planer Area

This room serves a dual purpose depending on waste form. Compactible DAW is compacted in 55 gallon drums. Drums leaving this area are wiped down to ensure their smearable surface activity does not exceed the limits for unrestricted release. For contaminated lumber, a wood planer is utilized to remove surface material with the non-contaminated wood being "Free Released."

2.2.4.3 Contamination Control Area

This is an area where personnel leaving the compactible trash packaging/wood planer 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 is used to reduce the size of contaminated equipment and tools by cutting and disassembly. Equipment used for reduction include plasma arc and oxy-acetylene cutting tools as well as mechanical and hand-held tools. Size reduction is required for:

- o tools and equipment that are too large to be packaged into drums, LSA boxes, or approved containers;
- o 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 contains the following decontamination systems:

- o Electro-polisher
- o Paint digester
- o Abrasive blaster

These systems are used to decontaminate tools and equipment from the GPU Nuclear units. A rinse tank is provided to rinse the tools and equipment after decontamination in the electro-polisher or paint digester. A self-contained emergency shower and eyewash are provided in this area. Each piece of decontamination system equipment, including filters, has a contact dose rate limit of 50 mrem/hr. Ion exchangers have a maximum contact dose rate limit 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 is also used for changing back into street clothes upon leaving the contaminated area. Personnel monitoring and frisking are 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 is 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 RadCon count/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 is not 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 is 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 is 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 GPU Nuclear units and for shipping the packaged materials, in LSA boxes or 55 gallon drums, to an onsite staging facility. Containers ready for shipping do not have smearable surface activity which exceeds the limits for unrestricted release.

2.2.4.9 Equipment/Storage 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 is located in this area. The equipment area is designed to ensure a dose rate of 2.5 mrem/hr is not exceeded. Temporary shielding in the adjacent work area is used as necessary, in addition to the reinforced concrete wall separating these areas, to ensure this dose rate is not exceeded. Miscellaneous non-contaminated supplies and tools are also stored in this area.

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, determination of the appropriate processing method and repacking drums, boxes, etc. when necessary for effective volume usage and external dose minimization concerns. All waste and contaminated tools and equipment entering this uncontaminated area are pre-packaged to ensure a smearable surface activity that does not exceed the limits for unrestricted release. Packages are labelled in accordance with existing Radiological Controls and Waste Management procedures. Temporary shielding is 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 is packaged into LSA boxes or approved containers in this area. This area is 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 are pre-packaged to ensure smearable surface activity does not exceed the limits for unrestricted release.

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 is also used by personnel who 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 Basis

The WHPF HVAC System:

a. Maintains a negative pressure 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. The HVAC system design assumes that the greatest airborne radioactivity within the WHPF is in the Disassembly and Sectioning Area and in the Decontamination Area. Therefore, the HVAC system design provides a minimum differential pressure in these areas of -0.125" water gauge with respect to atmosphere.

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

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

Summer	$94°F_{DB}$	$75°F_{WB}$
Winter	$7°F_{DB}$	

(DB - Dry Bulb; WB - Wet Bulb)

except in the receiving and shipping area and in the equipment room. These areas 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. Provides exhaust hoods or other devices for process equipment in order to limit exposure of personnel to airborne contamination.

e. Maintains the concentrations within the process areas of the WHPF below maximum permissible limits as defined in 10 CFR 20, Appendix B, Table I, Column 1.

f. Limits releases of airborne radioactivity to the environment below the concentrations established by 10 CFR 20, Appendix B, Table II, Column 1 and the TMI-2 Environmental Technical Specifications.

g. Supplies filtered ventilation to provide approximately 5 air changes per hour.

2.3.1.2 System Description

2.3.1.2.1 General Description

The WHPF HVAC system is 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 the 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, the temperature of this area is maintained at or above 60°F. During the summer, forced or natural ventilation prevents 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 causes 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 prevents the temperature of this area from rising above 104°F.

Administrative Area

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

Potentially Contaminated Work Areas

One or more HVAC units is provided for these areas. Air is supplied at a constant flow rate and temperature all year

round. Duct mounted temperature controls are 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 is 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 is HEPA-filtered. Air from the sectioning area, electro-polisher, rinse tank and paint digester is not 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 the main exhaust fan draws air from the compartment above the barrel through a HEPA filter and discharges it to the main exhaust system. When the compactor is not in operation, a control damper 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 exhausts directly to the main exhaust system through the main HEPA filters.

Exhaust and supplied air quantities are regulated to ensure a negative pressure is maintained in the potentially contaminated work areas relative to ambient condition. Preferably, some of the exhaust hoods are in continuous operation when the system is operated. As additional hoods are placed in use, the quantities exhausted and supplied are 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 is required during certain sectioning processes; the breathing air system is provided with CO monitor and alarm. Condensate drained from the compressed air system is 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 is not done in this facility.

2.3.2.3 Fire Protection

A sprinkler system covers the entire facility. The system conforms to the applicable portions of National Fire Protection Association (NFPA) Chapter 13. The system consists of 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 is actuated by a signal from a heat or ionization detector, or manually. The sprinkler system is

for ordinary hazard (group 1).

The building is zoned as required. Heat detectors set for 135°F are placed appropriately throughout the facility. Smoke detectors are located inside the inlet ducting to the HVAC. Audible fire alarms, which are activated by the detectors, annunciate simultaneously at the local panel, and in the plant main control room. Signals for trouble, alarm, and system discharge are annunciated. All wiring was supervised. A signal from any detector initiates the alarms and the time-delay action to open the deluge valve. Auxiliary contacts are provided in the panel to shutdown the HVAC system.

Fire hose standpipes are provided in conformance with the applicable portions of NFPA Codes and Standards. 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 is 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 are 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 are provided to the toilet area. Demineralized water is 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. Exhaust to the atmosphere is isokinetically sampled for particulate activity. An exhaust monitor is provided with local alarm, readout and recorder, and remote alarm in the main control room. Portable monitors are used as required. Area radiation monitors are provided as required by radiological control procedures.

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

FIGURE 1

Location of WHPF

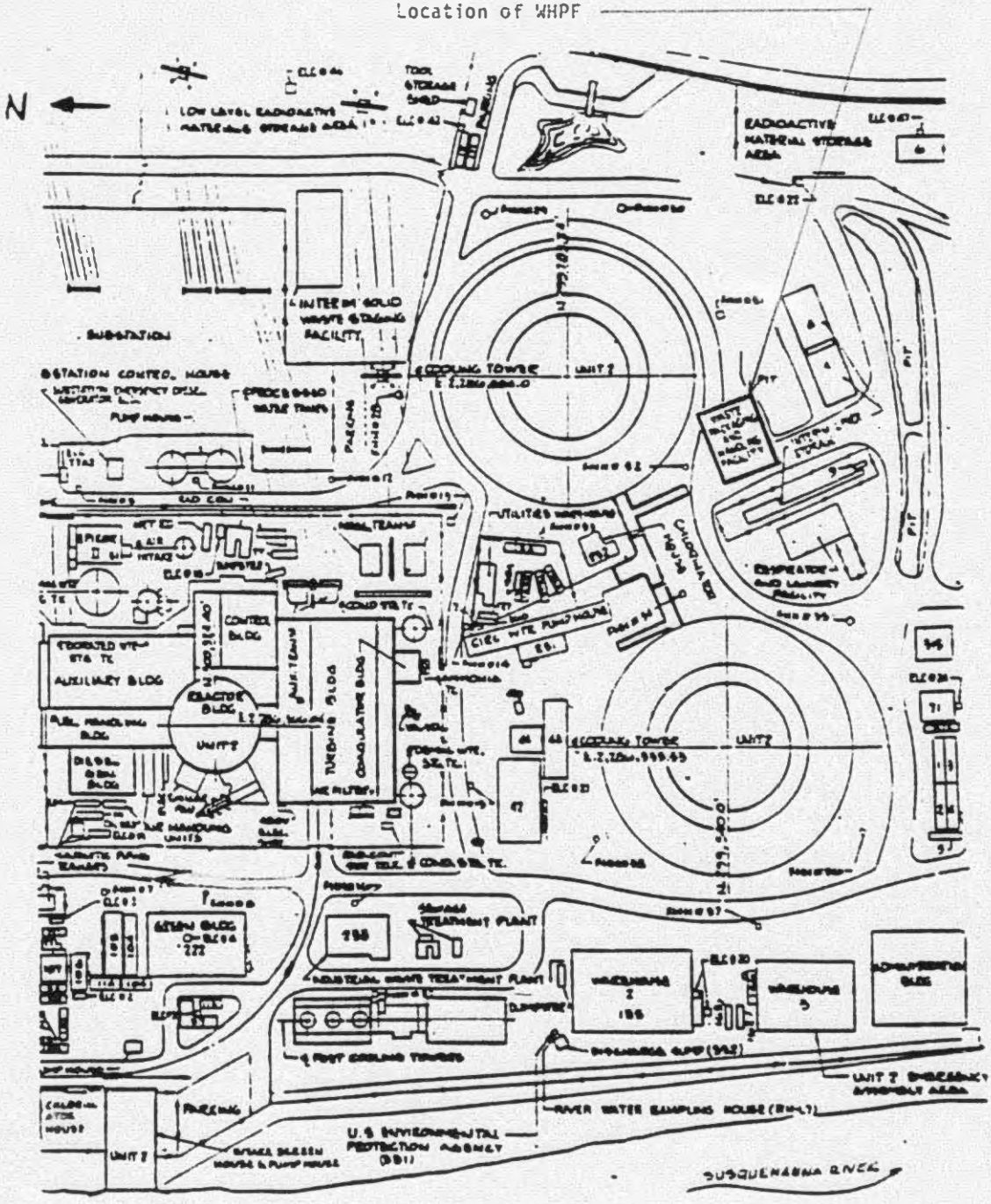
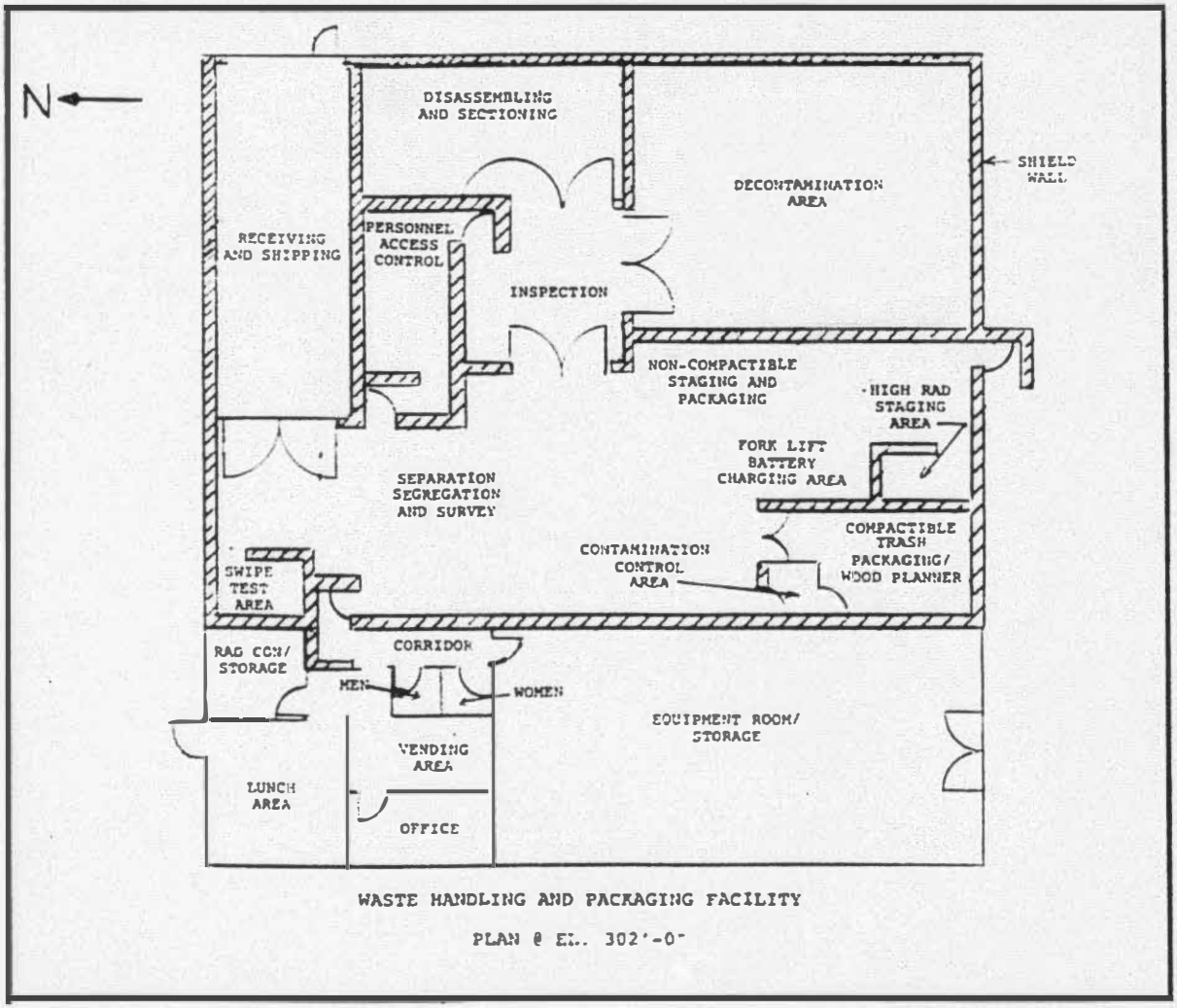


FIGURE 2

General Arrangement - Waste Handling and Packaging Facility



WASTE HANDLING AND PACKAGING FACILITY

PLAN @ EL. 302'-0"

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:

- o Demonstrating compliance with 10 CFR 20 with respect to on-site dose limits.
- o Demonstrating compliance with 10 CFR 50, Appendix I, with respect to offsite radiation doses due to releases of radioactivity to the environment from normal operations within the WHPF.
- o Assessing the consequences of potential accidents in the WHPF that could lead to radioactive releases to the environment.
- o 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 are reinforced concrete or grout filled concrete masonry unit (CMU) blocks and are 10 feet high. These walls are thick enough to ensure that the direct dose rates from material in the building do not exceed the following dose rates:

	Dose Limit	Minimum Wall Thickness
-outside building	2.5 mrem/hr	12 inches
-site boundary fence	0.3 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 is filled CMU block. The other walls are formed of poured concrete.

Since radiation field strengths are not precisely known for all 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 are 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 could be as a result of activities related to processing contaminated material from the GPU Nuclear units. 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 does not have smearable surface activity that exceeds the limits for unrestricted release.

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) and 12,000 ft^3 contaminated tools and equipment (Reference 1), i.e., 500 Curies total.

c. Of this activity 1E-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 (Reference 2) for all material handling except sectioning. The 1E-6 release fraction from sectioning is based on the assumptions that a high fraction of activity along the cut line may become airborne but that only a small fraction of the equipment and tools will be sectioned, and only a small fraction of the surface area is in the cut zone. No credit is taken for the WHPF building or ventilation system filters in reducing the release of radioactive materials.

d. The assumed isotopic distributions of radioactive materials processed through the WHPF are listed in Table 3-1 for the two waste streams expected to predominate during the cleanup period. Defueling waste may include transuranic and other fuel-related isotopes, and normal waste is composed primarily of cesium-134, cesium-137 and strontium-90. The isotopic distributions were derived from radwaste conversion factors for these waste streams, which are developed according to TMI-2 procedures.

e. To assess offsite doses from normal operations it was assumed that half the activity released is from defueling waste and half is from normal waste.

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

The dose to the public was calculated for these releases according to the guidelines of Regulatory Guide 1.109. 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. (This maximum calculated dose is 0.1 mrem/yr.) This dose is a small fraction of the 10 CFR 50 Appendix I limits for the site. The maximum total body dose is 2.2 E-2 mrem/year. If credit is taken for the HEPA filters in the WHPF ventilation exhaust these annual doses would be further reduced by a factor of 1000.

The average particulate release from the WHPF is 1.6 E-5 Ci/sec, which is based on 500 curies throughput with a release fraction of 1E-6, averaged over the period of one year. This is a very small percentage of the Technical Specifications limit of 2.4 E-2 Ci/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 40 CFR 190. A conservative 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 limiting analysis.

The skyshine dose calculation was performed utilizing a previous skyshine calculation done for the Interim Solid Waste Staging Facility (Reference 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 0.87 mrem from skyshine and direct radiation from the WHPF. Therefore the dose contribution to the nearest residence from 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 Reference 1), both awaiting processing and awaiting shipment, plus the expected activity from waste and equipment being processed. Using conservative assumptions regarding the volume of waste in the WHPF, the total activity assumed to be present at any one time in the WHPF is either:

   - o 10 curies defueling waste, or
   - o 15 curies defueling and normal waste (50% each, by activity).

b. Although much of the waste at any time is in sealed metal containers, the release fraction was chosen as 1E-2, which is derived for waste burning in an open fire (Reference 2).

c. No credit was taken for HEPA filtration or the WHPF building in reducing the releases of airborne radioactivity from the WHPF.

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

e. No credit was taken for the fire protection system, that is, all waste present in the building was assumed to be involved in the fire.

The resulting inhalation doses are tabulated in Table 3-4.

The maximum calculated offsite dose in the event of a fire in the WHPF was for the case of 10 curies of defueling waste in the building. The maximum organ dose and the whole body dose are a small fraction of the dose limits set by 10 CFR 100 for a comparable limiting organ or whole body. The consequences of this accident are also compared to 10 CFR 20, which defines a limiting whole body dose of 500 millirem/year to unrestricted areas due to normal operations. Since specific organ dose limits are not given in 10 CFR 20, the separate organ doses were evaluated according to ICRP Publication 26 (Reference 9), which states that, for dose limitation, the risk should be equal whether the whole body is irradiated uniformly or whether there is non-uniform irradiation, as in the current case. The methodology and weighting factors contained in ICRP Publication 26 were used to determine the whole body dose which is equivalent in risk to the doses given in Table 3-4. The resultant maximum equivalent whole body dose is 326 millirem which is well within the 10 CFR 20 limit of 500 millirem for the maximum annual dose to the whole body in an unrestricted area.

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 0.95 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 that of defueling waste.

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 (Reference 4, Table 7).

d. Accident breathing rates were used (Reference 3)

The resulting inhalation doses are tabulated in Table 3-5.

The maximum calculated offsite dose from an airborne release resulting from a liquid spill in the WHPF is 2.4 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.

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 0.95 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 that of defueling waste.

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 (Reference 5, Figure 2.4-6). A dilution factor is applied for mixing with the river beyond this point. This factor is 3.0×10^{-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. Criteria are given in 10 CFR 20, Appendix B, based on the concentration of an isotope (C_i) and its maximum permissible concentration (MPC_i), from Table II of Appendix B of 10 CFR 20, for which an isotope may be considered not present in a mixture. These criteria are:

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

and

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

The greatest C_A/MPC_A is 6.9×10^{-2}, for Sr-90. Application of the second criteria using the isotopes in Table 3-1 results in a sum of 7.0×10^{-2}. 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.

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 protects 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 have the lowest general area radiation level.

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 are minimized in these areas.

The 15 inch thick concrete shield wall separating the administrative area and equipment room from the remainder of the facility is 10 feet high. This ensures 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 is 15 inches thick and 10 feet high. This ensures that 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 are 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 ensures that the radiation field does not exceed the 0.3 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 cleanup, temporary shielding or restricted access both inside and outside the WHPF is 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 is filtered by HEPA filters prior to recirculation or discharge to the atmosphere. Radioactive waste and equipment entering the WHPF are packaged or wiped down to ensure its smearable surface activity does not exceed limits for unrestricted release.

All material staged in the staging areas have a smearable surface activity that does not exceed limits for unrestricted release. Separate hoods are used as required for inspection, compaction, sectioning and decontamination. An individual HEPA filter is incorporated into the design of the compactor.

3.3.4 Radiation Monitoring

The radiation monitoring system, described in Section 2.3.2.8 would 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 is 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 General Project Design Criteria (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 are 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 does 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 do not, therefore, endanger the health and safety of the public.

Normal operations in the WHPF 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 is 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 would 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 Section 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

FRACTIONAL ISOTOPIC DISTRIBUTIONS
FOR NORMAL AND DEFUELING WASTE IN THE WHPF

Isotope	Defueling Waste	Normal Waste
Sr-90	0.509	0.073
Cs-134	0.100	0.024
Cs-137	0.340	0.903
Pu-238	2.96 E-4	
Pu-239	3.44 E-3	
Pu-240	9.07 E-4	
Pu-241	4.12 E-2	
Am-241	5.59 E-3	

TABLE 3-2

CALCULATED ANNUAL QUANTITY OF AIRBORNE EFFLUENTS FROM THE WHPF

Radionuclide	Annual Release (curies)
Sr-90	1.5E-4
Cs-134	3.1E-5
Cs-137	3.1E-4
Pu-238	7.4E-8
Pu-239	8.6E-7
Pu-240	2.3E-7
Pu-241	1.0E-5
Am-241	1.4E-6

TABLE 3-3

CALCULATED ANNUAL DOSE TO THE MAXIMALLY EXPOSED INDIVIDUAL FROM ROUTINE RELEASES FROM THE WHPF

Annual Dose from Inhalation, Vegetable Intake, Meat Consumption, Cow Milk, and Ground Plane

	Dose (mrem/yr)	
Age Group	Bone	Total Body
Adult	6.2 E-2	1.3 E-2
Teen	7.1 E-2	1.5 E-2
Child	9.5 E-2	2.2 E-2
Infant	1.6 E-2	4.4 E-3

TABLE 3-4

CALCULATED DOSE TO THE MAXIMALLY EXPOSED INDIVIDUAL
FROM A FIRE IN THE WHPF

Organ	Controlling Age Group	Organ Dose (mrem)	Weighting Factor (Ref. 9)	Equiv. Whole Body Dose (mrem)
Bone	Adult	1814	0.12*	218
Total Body	Adult	108	1.0	108
			Total	326

*Weighting factor for red bone marrow is used for all bone dose. This overestimates the equivalent whole body dose since some radionuclides tend to remain deposited on the bone surfaces, for which a lower weighting factor may be used.

TABLE 3-5

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

Organ	Controlling Age Group	Dose (mrem)
Bone	Teenager	2.4 E+0
Total Body	Adult	1.4 E-1

4.0 SAFETY EVALUATION

10 CFR 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 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 10 CFR 50.

4.1 Technical Specifications/Recovery Operations Plan

Operation of the WHPF with respect to staging and decontaminating contaminated material did not require a change to the TMI-2 Technical Specifications. The Recovery Operations Plan was 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 TMI-2 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 were done in accordance with procedures approved for TMI-2. Therefore, the WHPF does not impact existing ITS structures or systems and there is 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 TMI-2 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 would

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 10 CFR 50.

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 exceed acceptance criteria established for similar activities in the TMI-2 PEIS (Reference 7).

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 are 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 are listed in Table 3-4. These doses are a small fraction of the limits for offsite exposures from accidents presented in 10 CFR 100, which are 25 rem to the whole body and 300 rem to an organ (thyroid). Section 10.4.1.2 of Reference 7 compares the results of a fire in a low level waste storage area to the requirements of 10 CFR 20. According to 10 CFR 20.105(a) the maximum permissible dose to the whole body in any period of one calendar year in an unrestricted area is 500 mrem. The calculated maximum equivalent whole body dose is 326 mrem due to a fire in the WHPF, which is well within the 10 CFR 20 limit of 500 mrem.

Specific collective occupational exposures for the operation of the WHPF have not been calculated. The exposures are 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 do not adversely impact the total collective exposures for these activities.

In conclusion, the activities associated with the operation of the WHPF have negligible environmental impact and 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, January 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. 7.

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.

9. ICRP Publication 26, "Recommendations of the International Commission on Radiological Protection," adopted January 17, 1977.